Sustainable Business Development
Managing Change in an International Context

Arie Hans Verkuil
Uta Milow
Andreas Hinz
Mahmoud Al-Kilani *Editors*

Innovating Business and Education for Sustainable Development

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Series Editors

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This open access book series focuses on the key success factors for sustainable business transformation, including the efficient use of resources, the systematic consideration of relevant aspects and technologies of digitalization, and the involvement of all relevant stakeholders. Furthermore, it identifies risks and opportunities for businesses arising from the climate crisis and digitalization and explores solutions to prevent or minimize negative effects. The series takes a multi-faceted, multi-disciplinary approach by integrating economic, sustainable, and technological perspectives. It welcomes monographs and contributed volumes from senior and promising young scholars.

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Part V Education for Economic and Sustainable Development

Chapter 1
Introduction: Redefining Value, Integrating Profitability, Environmental Stewardship and Social Equity

Mahmoud Al-Kilani and Arie Hans Verkuil

Abstract Faced with the simultaneous imperatives of profitable growth, alignment with United Nations Sustainable Development Goals and mounting geopolitical uncertainty, firms, educators and policy-makers need evidence about what actually works. This volume, spanning 23 peer-reviewed chapters from Europe, Africa and Asia, meets that need by weaving together theory, data and practice across five themes:

Part 1 shows how circular-economy design, smart regulation and industrial symbiosis can reduce the use of raw materials in some cases by up to an astonishing 80% whilst at the same time protecting fiscal margins.

Part 2 demonstrates that living wages, community-owned renewables and gender-responsive climate finance can lift incomes and resilience without eroding competitiveness.

Part 3 bridges business and academia, revealing how eco-labelling, behavioural "nudges" and SDG-infused curricula can shift consumer choices and graduate career paths towards sustainability.

Part 4 highlights that innovation mechanisms such as circularity-screened corporate venture funds, stackable micro-credentials and hybrid university incubators can accelerate the diffusion of low-carbon solutions.

Part 5 widens the lens to lifelong learning and workforce policy, mapping green-skills frameworks, blended finance models and indigenous knowledge integration.

Collectively, the book translates sustainability pressures into actionable frameworks, measurable environmental gains and inclusive economic value, offering

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scholars and practitioners a roadmap for embedding environmental stewardship and social equity at the heart of competitive strategy.

Keywords Circular economy · UN sustainability goals · Resource sharing · Fair wages · Women-focused climate finance · Eco labels · Sustainable business education · Green venture funds · Micro-credentials · Green job skills · Inclusive growth · Climate resilience

Companies operating in today's global markets are confronted with a threefold challenge. They must redefine "value" so that profitability, environmental stewardship and social equity reinforce one another; they must satisfy intensifying stakeholder and regulatory demands for alignment with the United Nations Sustainable Development Goals (SDGs); and they must do all this while geopolitical fragmentation reshapes trade, finance and talent flows. This edition of the Sustainable Business Development series addresses that agenda head-on. Drawing on interdisciplinary, research-driven contributions from Europe, Africa and Asia, it blends theory with practical tools to show how businesses, universities and social innovators are translating sustainability pressures into competitive advantages, climate resilience and inclusive growth. By offering case studies, empirical evidence and actionable frameworks, the volume deepens the scientific discourse on how organisations can align core strategy, operations and financial logic with responsible business practice, and it provides scholars and practitioners alike with a platform for sharing emerging trends, strategies and real-world solutions.

Sustainability in Businesses and Operations

Over the past 10 years, management literature has steadily established the competitive relevance of sustainability to financial returns. Evidence from studies such as those by Friede et al. (2015) and Whelan et al. (2021), which show positive or neutral correlations between ESG performance and fiscal returns, increasingly reinforces the sustainability drive of many companies and forms part of the founding principles of many start-ups and small and medium enterprises (SMEs). The research presented in this volume focuses on the implementation of sustainable strategies through three key pathways:

1. Circular value creation, where lifecycle strategies are shown to improve material usage and significantly reduce wastage (Ellen MacArthur Foundation, 2021);
2. Strategic social upgrading, where pilot projects promoting inclusivity and realistic living wages for all employees in the apparel and cocoa industries are shown to enhance companies' competitiveness (Anner, 2020; Locke et al., 2023);
3. Data-enabled stewardship, using digital twins and artificial intelligence (AI) analytics (Guandalini, 2022).

Despite the emerging evidence of the benefits of sustainable approaches, diffusion is uneven, and policy and design interventions are desirable to increase uptake (Kirchherr et al., 2017), as is regulation, for example, in the form of the Corporate Sustainability Reporting Directive (CSRD) introduced in Europe in January 2023 (European Commission website, accessed 2nd July 2025).

Sustainability in Higher Education

Universities and business schools are key incubators of the knowledge and skills needed for a low-carbon, inclusive economy, yet they, too, must reform their own curricula and campus operations. Responsible-management education frameworks (Lozano et al., 2013) call for embedding systems thinking, stakeholder engagement and familiarity with the Sustainable Development Goals (SDG) into every discipline. Recent studies—several captured in this book–show that SDG-infused MBA modules (Perkins et al., 2023) and serious game simulations (Coelho et al., 2023) measurably enhance graduates' propensity to take ESG-related roles. At an institutional level, initiatives such as carbon-neutral campuses and living labs demonstrate how universities can act as microcosms for sustainable practice while supplying evidence-based solutions to industry and policymakers (Wiek et al., 2011; de Villiers et al., 2025).

Sustainability in Ecologic and Social Innovation

Finally, the frontier of sustainable development lies where technological, ecological and social innovations intersect. Research on circular-economy networks shows that design-for-disassembly and modularity can cut raw material demand by up to 80% (Garusinghe et al., 2023), while inclusive-growth experiments reveal that community-owned renewable-energy cooperatives can deliver double-digit financial returns and retain up to 70% of value locally (Dudka & Magnani, 2024). **Social innovators are also adopting living-wage supply chains and gender-responsive budgeting strategies to ensure business growth aligns with equitable outcomes.** Taken together, these findings support the broader literature that positions eco-social innovation as a catalyst for systemic change to unlock new markets, democratize value creation and accelerate progress towards the SDGs (Geissdoerfer et al., 2017; Di Domenico et al., 2010).

The five parts of this volume translate those three sustainability arenas into a coherent learning journey.

Part 1, "Circular Economy", explores practical strategies to advance the circular economy, from regenerative business models to digital-enabled solutions. Case studies like circular breweries demonstrate real-world applications, while research identifies knowledge gaps as key barriers to scaling recycling systems.

Part 2, “Social Impact”, explores workplace stress and well-being in Vietnam’s service industry, analysing how job embeddedness affects employee happiness. This is followed by a study into early-stage social enterprises that aim to balance social missions with financial viability. The section concludes with an investigation into homestay businesses run by older women entrepreneurs in India, showing how they promote empowerment and sustainable tourism.

Part 3, “Sustainable Marketing and Sales in International Markets”, examines critical business challenges in sustainability, digitalization and global strategy. Topics include a framework for sustainable marketing, Chinese platforms’ expansion in Switzerland, the impact of data privacy on trust in African e-taxi hailing services, near-shoring trends in Eastern Europe and how digital transformation boosts Vietnamese SMEs’ exports.

Part 4, “Business Ecosystems and Governance”, considers how corporate boards navigate geopolitical risks, evolving non-financial reporting requirements and the impact of these on internal controls and credibility challenges in pension funds’ sustainability disclosures. Another piece explores whether trustworthy AI can enhance sustainable decision-making.

Finally, Part 5, “Education for Economic and Sustainable Development”, explores innovative approaches to **sustainability-focused education** across academic and corporate settings by examining interdisciplinary, project-based learning in Swiss business education; university-SME collaborations for sustainable business models; and IT service-learning initiatives in rural South Africa. Several contributors focus on **emerging technologies,** including VR for workforce preparation and AI-driven curriculum development. Additional contributions analyse design thinking (DT) in management education and corporate learning architectures for intrapreneurship.

Part 1: Circular Economy

Opening the volume, Sabrina Tabares explores the concept of regenerative ecosystems by integrating insights from regenerative business model literature and ecosystems theory. Using an integrative review methodology, she examines articles, books and book chapters published between October 2024 and February 2025. The study identifies core principles of regenerative ecosystems, such as interconnectedness, process orientation, collaboration and adaptive capacity. Tabares concludes that regenerative ecosystems can foster systemic regeneration beyond circularity, offering a novel theoretical perspective for businesses to create net positive value and enhance social-ecological systems.

Manuel Lämmle presents a framework for sustainable business development, focusing on the technological dimensions of energy, materials, circularity and digitalization. The chapter outlines the competencies required for sustainability leaders to master these dimensions. Using a theoretical approach, Lämmle emphasizes the importance of integrating these technological dimensions with strategic and sustainability principles. The author concludes that businesses can systematically advance resource efficiency and drive innovation by incorporating these dimensions into their sustainable transformation pathways.

Valéry Bourquard, Isabelle Hirs, Ada Janka, Max-Alexandre Rodriguez and Dominik Wörner examine the integration of circular economy principles in the brewing industry. Through a literature review and an interview with a large Swiss brewery, they analyse how circular practices are implemented. The study highlights the potential of revalorizing brewery byproducts and innovative approaches such as wastewater recycling and biogas production. Despite advances, financial constraints and regulatory barriers hinder widespread adoption. The authors conclude that achieving a fully circular brewing industry requires long-term investment, stakeholder collaboration and consumer engagement.

Closing the chapter, Josua Käser and Barbara Eisenbart explore the barriers posed by information gaps in the recycling and circularity of plastic roof membranes within the construction industry. Using the Design Science Research methodology, they conducted seven interviews and a workshop with stakeholders from a Swiss multinational roof system company. The study identifies information gaps in material composition, process flows and stakeholder engagement as significant barriers to effective recycling. The authors conclude that addressing these gaps can enhance collaboration and align sustainability goals with practical challenges, ultimately driving the transition to a Circular Economy.

Part 2: Social Impact

Nguyen-Hau Le and Khanh-Ngoc Nguyen explore the impact of job-related stress on employees' hedonic workplace well-being in Vietnam's IT consulting services sector. Using a structural model tested on 193 professionals, the study examines how job-related stress affects well-being directly and indirectly through perceived job fit and organizational links. The findings indicate that job-related stress negatively impacts well-being directly and through job fit, but not through organizational links. The authors conclude that addressing job-related stress and enhancing job fit can improve employee well-being, and they suggest managerial strategies to mitigate stress and foster a supportive work environment.

Irina Popova and Mahmoud Al-Kilani examine the emergence of dual missions in early-stage social ventures (SVs) using Siebold et al.'s model of dual mission management. Through longitudinal ethnographic data from a social venture incubator in the United Kingdom, the study presents two vignettes illustrating the challenges and processes involved in achieving social and economic sustainability. The findings emphasize the importance of external support networks and learning in enabling nascent social entrepreneurs to align their economic and social missions. The authors propose that the emergence of an economic mission is crucial for sustainable outcomes.

Minu Mehta and Boishampayan Chatterjee explore the potential of homestay businesses as a sustainable entrepreneurial venture for senior women in India. Using a conceptual framework and in-depth interviews with 25 senior women homeowners, the study identifies key factors influencing their intention to start a homestay business. The findings highlight the importance of Ability Endowment and User Behaviour as enablers and Financial Need and Social Engagement as inducers. The authors conclude that homestay businesses can empower senior women by utilizing their existing skills and resources, and they recommend policy interventions to support this demographic.

Part 3: Sustainable Marketing and Sales in International Markets

Nikolina Fuduric introduces the Sustainability Marketing Canvas (SMC), a decision-making framework that integrates the traditional 7Ps of marketing with the dimensions of Planet and People from the Triple Bottom Line. The methodology involves a literature review and pilot studies at VAUDE GmbH and Hilti AG. The SMC provides a structured approach to defining, conceptualizing and operationalizing sustainability marketing. The findings highlight the SMC's value in providing a coherent structure for comparative sustainability assessments, enabling firms to refine their sustainability strategies and align them with corporate objectives and industry standards.

Dominik Reust examines the marketing strategies of Chinese online platforms, particularly Temu, in Switzerland. Using a comprehensive analysis of market reports and current examples, the study highlights Temu's focus on ultra-low pricing, dynamic supply chain management and digital engagement tactics. The findings reveal Temu's success in capturing the Swiss market despite regulatory challenges and sustainability concerns. The author concludes that Temu's adaptability and innovative strategies position it as a formidable competitor, prompting local retailers to reassess their marketing and pricing strategies.

Marié Hattingh and Koketso Motiang investigate the impact of data privacy and security concerns on consumer trust in sharing economy platforms, focusing on Uber and Bolt in South Africa. Using semi-structured interviews with 14 users, the study identifies significant concerns about unauthorized use of personal information and cybersecurity incidents. The findings indicate that these concerns affect consumer trust and platform usage. The authors suggest that platform providers address these issues by enhancing security measures and transparency to improve consumer trust and service offerings.

Marcel Hirsiger explores the evolution of nearshoring in Central Eastern Europe, focusing on Poland's success in attracting shared service centres (SSCs) and global business services (GBS). Using a review of recent developments and industry reports, the study highlights the advantages of nearshoring, such as reduced CO_2

emissions and enhanced operational flexibility. The findings emphasize the importance of sustainability and cultural proximity in nearshoring strategies. The author concludes that Central Eastern Europe remains an attractive destination for nearshoring, offering significant benefits for Western European companies.

Minh Chuong Truong, Nguyen Gia Ky Tran and Quoc Trung Pham examine the impact of digital transformation on the export performance and sustainability of SMEs in Vietnam. Using a quantitative approach and structured questionnaires, the study investigates how digital tools enhance international competitiveness and supply chain efficiency. The findings suggest that investing in digital literacy and IT capabilities strengthens export performance and fosters economic sustainability. The authors recommend that SME managers leverage digital transformation to achieve sustainable growth and international market insights.

Part 4: Business Ecosystems and Governance

Beat Habegger examines the integration of geopolitical expertise into the qualification profiles of board members in Germany's DAX 40 companies. Using an empirical analysis of qualification matrices mandated by the German Corporate Governance Code, the study assesses whether boards include members with geopolitical skills. The findings indicate a pronounced lack of geopolitical expertise, as most firms fail to adopt systematic approaches for integrating such competencies into board composition. The author concludes with recommendations for strengthening board-level geopolitical expertise through targeted recruitment and training, emphasizing the strategic relevance of geopolitics in guiding companies.

Basil Sommerhalder and Emilio Sutter explore the impact of recent developments in non-financial reporting on the Internal Control System (ICS) in Swiss companies. The study reviews changes in the Swiss Code of Obligations and international pressures, such as the EU's Corporate Sustainability Reporting Directive. The authors highlight the need for integrating non-financial matters into management processes and the ICS. They provide practical recommendations for Swiss companies to enhance their ICS to support non-financial goals, emphasizing the importance of transparency and risk management in sustainability reporting.

Christina Meier and Matthias Härri analyse the challenges and opportunities faced by Swiss pension funds in implementing the ASIP ESG reporting standard. Through interviews with representatives of Swiss pension funds, the study identifies key challenges such as the complexity of ESG reporting and the need for credible communication to avoid greenwashing. The authors propose transparent and honest reporting as the best way forward, emphasizing the importance of addressing problems and challenges where targets have not yet been met to maintain credibility in sustainability reporting.

Marta Ottogalli and Ben Sebian investigate the factors influencing algorithm aversion among decision-makers in sustainability contexts. Using mixed research methods, including scenario-based surveys and semi-structured interviews, the study explores decision-makers' reluctance to adopt AI in decision-making processes. The findings reveal that decision-makers prefer AI technologies they have helped co-design and are interested in automating secondary tasks. The authors conclude that enhancing AI trustworthiness and involving stakeholders in AI design can facilitate progress towards sustainability by improving decision-making efficiency and effectiveness.

Part 5: Education for Economic and Sustainable Development

Stefanie Flotho, Craig Thorrold and Andrea Ochsner discuss the integration of sustainability into business education at the University of Applied Sciences and Arts Northwestern Switzerland (FHNW). Using a case study approach, they describe two courses in the International Business Management program that emphasize project-based and experiential learning. The courses aim to inspire entrepreneurial thinking and provide students with tools for leading sustainable economic transformations. The authors conclude that active learning and interdisciplinary approaches are essential for equipping students with the competencies needed to address sustainability challenges.

Michael von Kutzschenbach, Ananda Wyss, Maya Hoveskog, Joakim Tell and Fatima Khitous explore the collaboration between universities and SMEs in business model innovation for sustainability (BMIfS). Through two case studies involving universities and SMEs, the authors identify opportunities and risks in value co-creation initiatives. They propose seven principles for successful inter-organizational collaboration, emphasizing the importance of systemic thinking and stakeholder engagement. The authors conclude that such collaborations can drive sustainable innovation and benefit the entire ecosystem.

Rouxan Colin Fouché and Liezel Nel investigate the impact of an Information Technology Service-Learning (ITSL) project in Botshabelo, South Africa. Using a qualitative phenomenological approach, they assess the project's long-term effects on participants' digital literacy, employment opportunities and community engagement. The findings reveal significant improvements in digital literacy and self-confidence, with many participants transitioning to employment or becoming digital literacy advocates. The authors conclude that ITSL programs can promote sustainable development and economic growth in rural settings.

Sunet Eybers, Bester Chimbo, Charlotte Lungile Hlengwa, Lario Malungana and Tebatso Gina Moape explore the use of virtual reality (VR) in higher education institutions. Through a systematic literature review, they identify 19 subject areas where VR is applied, with general education, engineering and medicine being the most prevalent. The study highlights the potential of VR to enhance learning experiences and prepare students for the workforce. The authors conclude that VR can transform traditional educational environments and recommend further research in underexplored areas.

Havisha Vaghjee examines the integration of AI in curriculum development for sustainable education. Using a systematic literature review, the study explores AI's role in personalizing learning experiences and enhancing student engagement. The findings highlight the potential of AI to address educational gaps and promote inclusivity. The author concludes that while AI offers significant benefits, ethical considerations must be addressed to ensure equity and transparency in its application.

Sean Kruger and Dawie Bornman investigate the use of DT in business management education to cultivate innovation and entrepreneurial skills. Through a comparative case study of two student cohorts, the study assesses the impact of DT on innovation, prototyping and entrepreneurship. The findings suggest that structured DT training enhances students' competencies in these areas. The authors conclude that integrating DT into business curricula can better prepare students for the future of work.

Concluding the book, Rolf-Dieter Reineke and Oliver Gottschall explore the evolving role of corporate universities as platforms for sustainable learning and intrapreneurship. Using case studies from Europe and Asia, the study identifies trends shaping corporate universities, such as digital learning and AI-driven education. The authors highlight challenges in implementation, including cultural adaptability and internal resistance. They conclude that successful corporate universities require strong executive commitment and flexible structures to drive strategic transformation and knowledge sharing.

Across these 23 empirically rich chapters, readers will find concrete demonstrations of how the strategic, educational and innovation themes outlined earlier translate into measurable environmental gains, social equity and resilient profitability.

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Part I
Circular Economy

Chapter 2
Toward Net Positive: Integrating "Regeneration" into Ecosystem Thinking

Sabrina Tabares

Abstract As businesses progress along the archetypal hierarchy of sustainability—shifting from sustainable and circular economy models to regenerative and net-positive approaches—new challenges and demands emerge. While the ecosystems literature has explored and conceptualized circular ecosystems, our understanding of *regenerative ecosystems* remains limited. To address this gap, this study adopts a systemic perspective on regenerative business, drawing from regenerative business model literature and ecosystems theory to illuminate the principles and structural formation of regenerative ecosystems. A systemic view of regenerative business is articulated through core principles of regeneration, including interconnectedness, process orientation, collaboration and interdependence, transformation, and adaptive capacity. The study identifies key dimensions of regenerative ecosystems, such as purpose, actors, value, activities, governance systems, relationships, and learning and reflexivity. Seeking to expand traditional perspectives on sustainability and circularity, this chapter offers a novel theoretical perspective on how businesses can foster systemic regeneration beyond circularity.

Keywords Regenerative ecosystems · Circular ecosystems · Regenerative business models · Net positive · Regeneration

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Introduction

As businesses scale the archetypal hierarchy of sustainability (Bocken & Short, 2021), moving from lower to higher degrees of sustainability (e.g., from efficiency, net-zero approaches, or circular economy) toward *regenerative* and *net positive* approaches (Fig. 2.1), higher demands are required for businesses (Das & Bocken, 2024; Konietzko et al., 2023). To illustrate, while circular business models (CBMs) focus on narrowing, closing, and slowing resource loops (Bocken et al., 2016), regenerative business models (RBMs) elevate business commitments toward sustainability by integrating activities such as conservation, restoration, and the restoration of socio-ecological systems (Bedarkar et al., 2024; Konietzko et al., 2023; Panwar et al., 2023; Torelli & Balluchi, 2023; Wagner, 2023).

One of the key complexities in understanding RBMs lies in recognizing that these configurations require a systemic perspective on sustainability (Hahn & Tampe, 2021). While the literature has established three well-known typologies of ecosystems—business ecosystems, innovation ecosystems, and platform ecosystems (Adner, 2016; Jacobides et al., 2018)—there has been limited exploration of ecosystems that support sustainable business models (SBMs). Interestingly, the concept of circular ecosystems has recently emerged as the closest framework for examining ecosystem configurations within sustainability research (Konietzko et al., 2020; Thakur & Wilson, 2024). This development stems from the fact that while SBMs engage a broad range of stakeholders, CBMs inherently require a systemic approach to function effectively (Geissdoerfer et al., 2018b, 2020). Particularly, circular ecosystems are considered subtypes of business ecosystems (Trevisan et al., 2022) and represent a shift from a firm-centric perspective to a multi-actor business model approach (Kanda et al., 2021; Ritala et al., 2023). Thus, circular ecosystems serve as essential enablers of CBMs (Zucchella & Previtali, 2019), facilitating

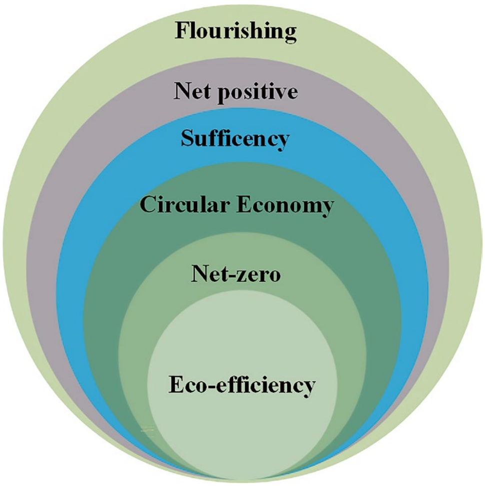

Fig. 2.1 Archetypes of sustainability. Source. Adapted from Bocken et al. (2022) and Bocken and Short (2021)

circular economy activities such as narrowing, slowing, closing, and regenerating material and energy flows (Konietzko et al., 2020).

The circular economy is recognized as a system in which nature is regenerated, and materials are continuously cycled rather than wasted (Ellen MacArthur Foundation, 2013); therefore, regeneration constitutes an integral aspect of circularity (Konietzko et al., 2020, 2023). While research on circular ecosystems has expanded, there is still a limited understanding of regenerative ecosystems, particularly in terms of their conceptualization, configuration, and structure (Le et al., 2023; Sanhokwe, 2024). Even though a recent publication from Gualandris et al. (2024) describes a supply chain with the potential of regenerating social–ecological systems, one of the most significant gaps highlighted in the literature on regenerative business is that its structure and formation are essentially systemic (Hahn & Tampe, 2021). However, to date, there has been no concrete idea of how regenerative ecosystems could be conceptualized or structured. Given the gaps in our knowledge about regeneration from an ecosystem perspective, this chapter seeks to answer the question: *What are the core principles that define regenerative ecosystems, and how do they shape their structures?*

To this end, this chapter conducts an integrative review to develop a framework for better understanding regenerative ecosystems (Torraco, 2005). The framework aims to guide future discussions on regenerative business and regenerative ecosystems literature. This study could inspire scholars and practitioners to gain awareness of the relevance of creating ecosystems that support endeavors beyond traditional sustainability issues but dive into topics related to planetary health, societal well-being, and deeper social interconnectedness.

The following three sections describe the method followed, the theoretical construction upon which the study is built, and the theoretical discussion. The last section presents the conclusions and discusses future research lines.

Methodology

To advance in this inquiry, this chapter was built on an integrative review approach, a method that allows addressing research questions through a creative collection of data (Snyder, 2019). Integrative reviews are useful for criticizing or synthesizing data and are suitable for developing taxonomies, classifications, theoretical models, or frameworks (Torraco, 2005). Because regenerative business (and RBMs) is a recent research field, regenerative ecosystems, as a derived concept from circular ecosystems, has not been relatively explored. In this regard, an integrative review is an adequate research method "*to generate new ideas and directions to the field*" (Torraco, 2005, p. 364), particularly, because this method stimulates further inquiry. To carry out the integrative review, the author performed the process as follows. After defining the research problem and scope concerning the gaps introduced in the literature, a comprehensive literature review was conducted using SCOPUS and Google Scholar, focusing on articles, books, and book chapters that explore regeneration in business and ecosystem theory for circularity. The selection process prioritized works published between October 2024 and February 2025. Keywords such as “regeneration” and “net positive” were paired with business-related terms such as “business,” “enterprise,” and “business models,” in various combinations. In parallel, keywords for ecosystem topics were used, such as “ecosystem theory” and “circular ecosystem.” Reports, websites, and other gray literature were excluded, as well as other documents not written in English. Snowballing was used to identify further relevant articles. The author analyzed and critically evaluated the identified literature to uncover thematic patterns and key contributions. This analysis is synthesized and presented in the following section, which is divided into two parts. The first part delves into the concept of the “regenerative business model,” while the second part offers an in-depth exploration of ecosystem theory, with a particular focus on circular ecosystems. A preliminary framework is introduced in the section “Discussion: Toward a Concept of Regenerative Ecosystems,” aimed at developing a conceptual understanding of regenerative ecosystems.

Theoretical Construction

Regenerative Business Models

Regenerative and “‘net Positive” Businesses

Regeneration in organizational contexts is a topic of emerging academic discussion. While regeneration is borrowed from the biological process that refers to “*the capacity to bring into existence again*” (Muñoz & Branzei, 2021, p. 509), early references to regenerative businesses were introduced by Randall J. Alford in his work *The Regenerative Organization*, published in the *National Productivity Review*. In his publication, Alford (2000) argues that regenerative organizations are characterized by four key criteria: a conscious redefinition of success, the integration of a community of individuals to create and sustain a meaningful life experience, the organization as an integrated system based on the well-being of all individuals, and an entity that becomes an extension of its members. A few years later, Bill Reed, in his publication *Shifting from “Sustainability” to Regeneration*, revisited the concept of regeneration as an extension of sustainability beyond merely “doing less damage to the environment.” He emphasized the need for a new model that enables us to actively engage with the environment by using the health of ecological systems as the central foundation of this approach (Reed, 2007). These publications, along with those by Mang and Reed (2012) and Du Plessis (2012), laid the foundation for a clearer paradigm of regenerative business. They sparked deeper discussions on sustainability, highlighting the essential role of humans, the emergence of new mindsets, and regeneration as an ongoing process. Notably, these authors challenged the way humans have exceeded the limits of growth.

The term *regenerative business* started to gain traction through a series of publications by Nel Hofstra on nature-inspired entrepreneurship (Hofstra, 2015) and eco-spirituality (Hofstra, 2016) in business ethics and ethical leadership. It gained further recognition and broader acceptance in the academic community with Carol Sanford’s (2017) book *The Regenerative Business: Redesign Work, Cultivate Human Potential, Achieve Extraordinary Outcomes*. According to Sanford (2017), regenerative businesses prioritize creating the best and healthiest workplace, focusing on attracting and retaining talent, fostering innovation, building resilience, and effectively navigating complexity. Regenerative businesses are those that function within collaborative networks, actively transforming the ecosystems they engage with, and are rooted in the belief that humans are an integral part of a larger social-ecological system (Hahn & Tampe, 2021; Konietzko et al., 2023). Also noticed in these first approaches to regeneration and regenerative business is that organizations advocate “for stronger human–nature connections” (Gervais et al., 2024).

Regenerative businesses engage in a “*co-creative partnership with nature*” (Du Plessis, 2012) to enhance the self-renewing capacities of damaged or overexploited natural systems (Morseletto, 2020). An enriching view of regenerative businesses is developed by Mang and Reed (2012) through a three-phased framework: *(i)* businesses are expected to recognize and acknowledge the territory in which their influence is embedded, which implies considering geographical places as dynamic and evolving entities with unique histories and futures; *(ii)* organizations are expected to design harmony patterns by optimizing the presence of humans in geographic areas, embedding the organizational activity with local communities and land, and *(iii)* phase 3 relates to co-evolutionary processes not as a final draw or a constructed project, but as the capacity to generate capacities sustained through time.

The term regenerative business is often used interchangeably with *net positive* (Bocken & Short, 2021; Das & Bocken, 2024), representing how regenerative businesses aim to become a force for positive change that contributes unique value to the environment in which they operate (Robinson & Cole, 2015). Net positive as an integrative concept of sustainability regeneration is defined from an organizational standpoint as: “*one that ‘improves well-being for everyone it impacts and at all scales—every product, every operation, every region, and country, and for every stakeholder, including employees, suppliers, communities, customers, and even future generations and the planet itself*’” (Polman & Winston, 2021). Similarly, net positive has been associated with “positive sustainability” (positainability) (Lichtenthaler, 2023), which encompasses not only “avoiding damage or minimizing harm”—with a focus on preventing environmental damage as a core aspect of business operations—but also “*doing more good*” (Caldera et al., 2022) by leveraging “*business innovation as a force for positive change*” (Laszlo et al., 2024).

Regenerative businesses, as a net positive business, strive to address both environmental degradation and social challenges by fostering flourishing communities, where flourishing is understood as the collective creation of prosperous, healthy, and sustainable growth within society (Slawinski et al., 2021; Torelli & Balluchi, 2023; van Hille et al., 2021). Well-established regenerative business strategies include nature regeneration, social regeneration, regenerative leadership, responsible source, products and services for human health and well-being, and employee-level focus (Das & Bocken, 2024; Konietzko et al., 2023). In this line, the principles of regenerative businesses are the generation of value for all stakeholders, and the capture of value from natural, social, and cultural capital, while engaging in a process of true pricing which takes a holistic view of human and nature rights (Konietzko et al., 2023). Regeneration is also linked to key principles for supply chains, including *proportionality* (producing and consuming within the boundaries of socio-ecological systems), *reciprocity* (interactions that benefit human and non-human actors), and *poly-rhythmicity* (aligning with the biorhythms of the natural spaces) (Gualandris et al., 2024).

In the business realm, regenerative businesses are those that implement RBMs serving both people and the planet by enhancing systemic health (Caldera et al., 2022). Business model insights from regeneration are explored in the following section.

From Sustainable to RBMs

The business model concept emerged at the end of the twentieth century to describe new forms of businesses (Schaltegger et al., 2016), calling attention to the creation of business models to better frame a company's strategic intent and innovation (Chesbrough & Rosenbloom, 2002; Richardson, 2008). Business models are types of systems that base their actions on framing determined activities ("*what*"), system structures ("*how*"), and people in charge of those activities ("*who*") (Zott & Amit, 2010). An overarching definition of business model was provided by David Teece (2010), suggesting that "*a business model describes the design or architecture of the value creation, delivery and capture mechanisms employed*" (p. 179). These core elements of business models are built upon Osterwalder and Pigneur's (2010) building blocks and ultimately summarized by Richardson (2008) on three key aspects, notably value proposition, value creation and delivery system, and value capture.

RBMs are a subtype of the umbrella concept, SBMs (Bocken et al., 2014; Stubbs & Cocklin, 2008), specifically RBMs are classified as a subcategory of CBMs (Geissdoerfer et al., 2017; Konietzko et al., 2023). On one hand, SBMs are business models whose purpose is to create sustainable value by implementing the triple-bottom-line approach by considering a wide range of stakeholder interests from a long-term perspective (Geissdoerfer et al., 2018a). CMBs, on the other hand, are designed to promote restorative and *regenerative* outcomes through the implementation of circular economy principles (Ellen MacArthur Foundation, 2013). Widely discussed in the literature, circular economy principles focus on slowing, closing, narrowing, and regenerating resource loops to minimize waste and optimize energy and material use (Bocken et al., 2016; Geissdoerfer et al., 2017; Konietzko et al., 2020).

Just as the concept of regenerative business is a novel addition to the literature, RBMs have only recently begun to receive scholarly attention (Konietzko et al., 2023). The most recent definition describes RBMs as those that "*focus on planetary* *health and societal wellbeing. They create and deliver value at multiple stakeholder levels—including nature, societies, customers, suppliers and partners, shareholders and investors, and employees—through activities promoting regenerative leadership, co-creative partnerships with nature, and justice and fairness. Capturing value through multi-capital accounting, they aim for a net positive impact across all stakeholder levels*" (Konietzko et al., 2023, p. 375). RBMs are characterized by a value proposition focusing on planetary health, human health and well-being, healthy products and services, organizational purpose, meaning, and values (Konietzko et al., 2023).

To clarify the boundaries between sustainability, circularity, and regeneration within the context of business model literature, Hahn and Tampe (2021), in their publication *Strategies for Regenerative Business*, emphasize that regenerative businesses focus on three key strategies: restoration, preservation, and enhancement. Meanwhile, Geissdoerfer et al. (2017, 2020) have further explored the distinctions between SBMs and CBMs. Figure 2.2 builds on this discussion by integrating key concepts that differentiate the implementation of sustainable, circular, and RBMs (Bocken & Short, 2016; Geissdoerfer et al., 2018b; Hahn et al., 2015).

Ecosystems Theory

The term "ecosystem" was integrated into management literature and is derived as a metaphor from biology, referring "*to a group of interacting firms that depend on each other's activities*" (Jacobides et al., 2018, p. 2256). This theoretical framework highlights that businesses extend beyond the narrow view of a stand-alone company and its business model; instead, they become integral parts of a broader network, interacting and co-evolving with other actors rather than operating in isolation (Kanda, 2024). Ecosystems are configured as networks of actors interconnected either through *affiliation*—defined by roles and mutual agreements among members—or through *structure*, shaped by the creation of a shared value

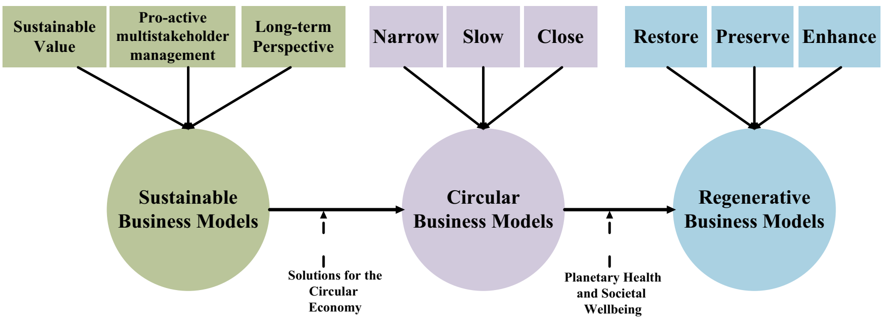

Fig. 2.2 From sustainable to RBMs. Source: Adapted from Bocken and Short (2016), Geissdoerfer et al. (2018b), Hahn et al. (2015), and Konietzko et al. (2023)

proposition (Jacobides et al., 2018). When conceived as structures, ecosystems comprise four elements, namely, *activities, actors, positions,* and *links* (Adner, 2016). In line with Adner (2016), *activities* are discrete actions undertaken to materialize the value proposition; *actors* are the entities responsible for carrying out activities; *positions* indicate the flow of activities within the system, specifying how tasks transition between entities, while *links* represent the interactions and exchanges between actors.

Although ecosystem theory distinguishes between business ecosystems, innovation ecosystems, and platform ecosystems (Jacobides et al., 2018), *circular ecosystems* are considered a subset of business ecosystems that apply circular economy principles to operate and do business (Ferrari et al., 2023). Business ecosystems are conceived as "*an economic community of interacting actors*" (Jacobides et al., 2018, p. 2257), while circular ecosystems can be defined as "*a system of interdependent and heterogeneous actors that go beyond industrial boundaries and direct the collective efforts towards a circular value proposition, providing opportunities for economic and environmental sustainability*" (Trevisan et al., 2022, p. 292). The study of circular ecosystems has gained strength (Zucchella & Previtali, 2019) because the adoption of circular economy principles requires enterprises to shift from a firm-centric perspective toward an ecosystemic and collaborative one (Pieroni et al., 2019).

What is unique about circular ecosystems is that these meta-entities are co-evolving, self-organized, and dynamic structures where actors interact by shaping the value creation process through circular value flow co-creation (Aminoff et al., 2017). Circular ecosystems rely on a diverse set of actors who contribute essential resources and services, complementing one another to enable the ecosystem's functioning (Ritala et al., 2023). A core aspect of circular ecosystems is the collective creation of a circular value proposition (Gomes et al., 2024; Kanda et al., 2021; Marreiros Barbosa et al., 2024; Trevisan et al., 2022); therefore, his value proposition can only be realized through collective action (Marreiros Barbosa et al., 2024; Thomas & Autio, 2020), requiring alignment of activities among partners (Linde et al., 2021; Lit et al., 2024). As a result, circular ecosystems are marked by shared decision-making, trust, communication, the establishment of common goals, and a balanced distribution of power among ecosystem members (Brown et al., 2018). Thus, circular ecosystems are multilayered, symbiotic, function under governance models, and are enacted through the inclusion of multiple stakeholders through the introduction of innovations (Asgari & Asgari, 2021).

To enhance our understanding of circular ecosystems, Aarikka-Stenroos et al. (2020) identified three typologies. The first is *material flow ecosystems*, which include industrial and urban ecosystems. The second is *knowledge flow ecosystems*, integrated by knowledge and entrepreneurial ecosystems. Finally, *value flow ecosystems* are integrated by innovation, platform, and business ecosystems. This classification enables the identification of both the unique attributes of circular ecosystems and the distinct characteristics that emerge from them. In this context, the literature concurs that establishing a circular ecosystem requires a transformative process (Gomes et al., 2024). Circular ecosystem transformation is thus the result of *alignment enablers* (attraction of new ecosystem members), *interdependence enablers* (nurturing relationships), *affiliation enablers* (integrated ecosystem value proposition), and *ecosystem engineering enablers* (innovations in the ecosystem structure).

Because of the interaction of multiple actors, circular ecosystems need management configurations related to the construction of a circular governance system, the nurturing of circular interdependencies, the promotion of circular integration, and the generation of circular complementarities (Gomes et al., 2023). Zucchella and Previtali (2019) add to this discussion by highlighting that prerequisites for circular ecosystems are resource investment, collaboration, and governance. Building upon Adner's (2016) ecosystem elements, Trevisan et al. (2022) integrate five key elements of circular ecosystems, namely: *value* (circular value proposition, value co-creation, collective capture of value), *actors* (heterogeneous, interdependent, with aligned interests and defined roles, reliable, balanced, and consciously orchestrated), *data, materials, and flows* (rethink how resources are used, resource sharing, and information management), *circular activities and strategies* (collective purpose, environmental and financial return, and multiple circular economy activities), and *governance* (non-hierarchical and collaborative).

Since the regenerative business literature has yet to conceptualize regenerative ecosystems, this chapter builds on the concept of circular ecosystems as a foundation for advancing a systemic understanding (Kanda, 2024). This systemic perspective is crucial for shaping a comprehensive concept of regenerative ecosystems.

Discussion: Toward a Concept of Regenerative Ecosystems

A Systemic View of Regenerative Business

Regenerative businesses diverge from dominant sustainability approaches, where the business logic primarily shapes an organization's relationship with its various stakeholders (Stubbs & Cocklin, 2008). In contrast, regeneration is inherently *systemic*, requiring the dismantling of linear interdependencies between social, economic, and ecological systems (Holling, 2001). Regenerative businesses consider themselves an integral part of social-ecological systems (Hahn & Tampe, 2021), in which interconnection is nested through feedback processes and collective interdependencies with human and non-human actors in which an organization enacts its business. Social-ecological systems that are configured by human and ecological components, as well as social and ecological processes, are integrated by businesses through management practices of adaptation and resilience, as well as adequate resource use (Virapongse et al., 2016). To deepen the exploration of the principles guiding regenerative business and RBMs from a firm-centric perspective, and to enhance the systemic discussion, Table 2.1 provides a summary of seminal literature on these topics.

Table 2.1 Seminal literature on regenerative businesses and RBMs

Author	Title	Source
Das and Bocken (2024)	Regenerative business strategies: A database and typology to inspire business experimentation towards sustainability	Sustainable Production and Consumption
Inversini et al. (2024)	The rise of regenerative hospitality	Journal of Tourism Futures
Gervais et al. (2024)	Implementation of regenerative business models in transitioning companies—Are middle managers ready for action?	International Journal of Organizational Analysis
Gualandris et al. (2024)	Unchaining supply chains: Transformative leaps toward regenerating social-ecological systems	Journal of Supply Chain Management
Waddock et al. (2024)	The paradigm shift: Business associations shaping the discourse on system change	Business and Society Review
Drupsteen and Wakkee (2024)	Exploring characteristics of regenerative business models through a Delphi-inspired approach	Sustainability (Switzerland)
Yadav and Yadav (2024)	Beyond sustainability, toward resilience, and regeneration: An integrative framework for archetypes of regenerative innovation	Global Journal of Flexible Systems Management
Caruso (2023)	Toward regenerative hospitality business models: The case of "Hortel"	Tourism and hospitality
Konietzko et al. (2023)	Towards regenerative business models: A necessary shift?	Sustainable Production and Consumption
Caldera et al. (2022)	Moving beyond business as usual toward regenerative business practice in small and medium-sized enterprises	Frontiers in Sustainability
Muñoz and Branzei (2021)	Regenerative organizations: Introduction to the special issue	Organization and Environment
Coskun-Setirek and Tanrikulu (2021)	Digital innovations-driven business model regeneration: A process model	Technology in Society
Polman and Winston (2021)	The net positive manifesto: Is the world better off because your company is in it?	Harvard Business Review
Hahn and Tampe (2021)	Strategies for regenerative business	Strategic Organization
Hofstra (2017)	Regenerative firms	Contributions to Conflict Management, Peace Economics and Development
Du Plessis and Brandon (2015)	An ecological worldview as basis for a regenerative sustainability paradigm for the built environment	Journal of Cleaner Production
Mang and Reed (2012)	Designing from place: A regenerative framework and methodology	Building Research and Information
Du Plessis (2012)	Towards a regenerative paradigm for the built environment	Building Research and Information

(continued)

Table 2.1 (continued)

Author	Title	Source
Reed (2007)	Shifting from 'sustainability' to regeneration	Building Research and Information
Alford (2000)	The regenerative organization	National Productivity Review

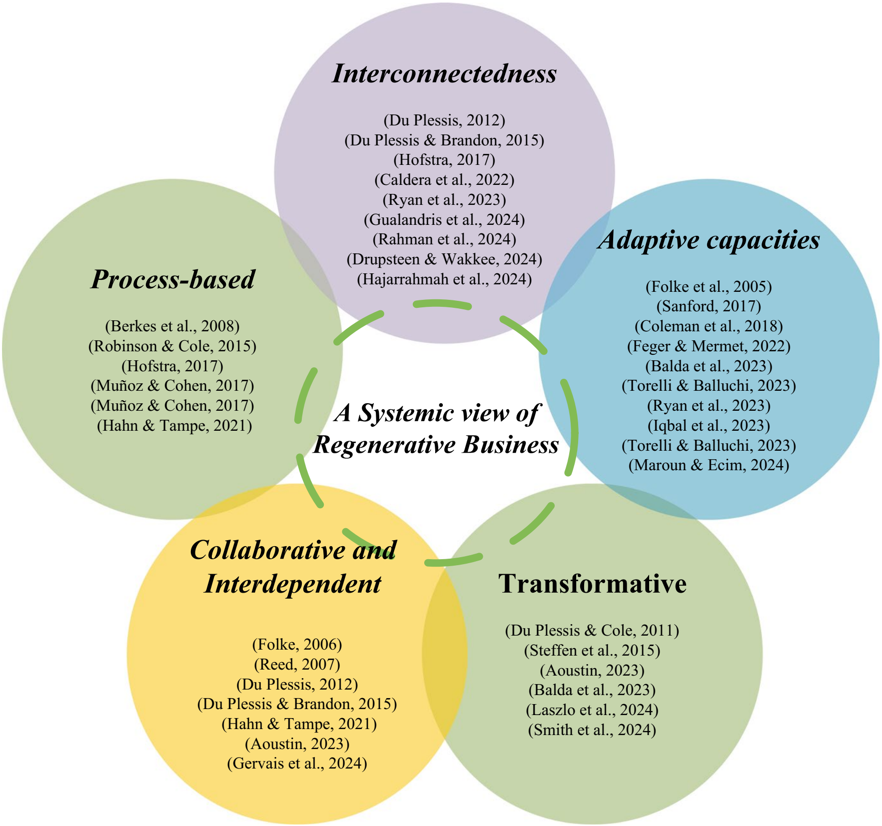

Fig. 2.3 Systemic principles for regenerative businesses

Drawing from the literature, several key premises highlighting the systemic nature of regenerative businesses were identified, namely, interconnectedness, process-based, collaborative and interdependent, transformative, and based on adaptive capacities. The authors and principles associated with these premises are summarized in Fig. 2.3. First, regenerative businesses operate under the principle of life's *interconnectedness* (Balda et al., 2023). This interconnectedness underscores the reciprocal relationship between societies and their surrounding environments, where the well-being and flourishing of one are inseparable from the health and vitality of all others (Muñoz & Branzei, 2021). Businesses recognize the principle of interconnectedness by aligning their organizational models with natural capital and the needs of the ecosystems where they operate, an approach referred to as "*organizational ecosystem embeddedness*" (Winn & Pogutz, 2013). Such embeddedness reveals the principle of interconnectedness by unveiling the ripple effects between the entire ecological, social, and economic system (Waddock et al., 2024). The integration between human systems and natural systems is referred to as "wholeness" (Hofstra, 2017), explaining how both dimensions emerge and co-evolve together (Du Plessis, 2012; Du Plessis & Brandon, 2015). The central focus of this idea lies in the understanding that the organization does not position itself at the center of the system; rather, it acknowledges the "reciprocity" (Gualandris et al., 2024) or "mutuality" (Hofstra, 2017) of all actors within the socio-ecological system. This perspective requires companies to move beyond an anthropocentric notion of "I" toward an ecocentric understanding of "we" (Aoustin, 2023).

Second, regenerative businesses assimilate a *process-based* view of sustainability (Hahn & Tampe, 2021). From this perspective, regeneration is not a final product or a mere outcome; rather, it entails long-term processes, thoughtful consideration, and strategic planning (Berkes et al., 2008). Regenerative businesses, therefore, are grounded in practices that require careful planning and alignment with natural cycles (Muñoz & Cohen, 2017; Robinson & Cole, 2015). From a process-based perspective, regeneration is understood as a dynamic, nature-centered journey of ongoing renewal and transformation, as framed by Hofstra (2017).

Third, regenerative businesses are based on *collaborative and interdependent* relationships ruled by a shared interpretation of desirable futures, aspirations, and values (Reed, 2007). Interdependencies are rooted in the cultivation of relationships (Du Plessis & Brandon, 2015). As such, interdependence is inherently relational and collaborative, driven by exchanges that are fostered through collective learning, open dialogue, and the creation of mechanisms that facilitate reflection and feedback, thereby improving the overall functioning of the system (Du Plessis, 2012; Hahn & Tampe, 2021). Therefore, organizations engage in interdependent relationships with land, ecosystems, and nature through co-evolutionary processes (Folke, 2006; Reed, 2007). The ecocentric vision of regenerative businesses acknowledges that individual and solitary actions of single actors will not ensure the functioning or well-being of all involved in the system. Therefore, regardless of their capacities, resources, or potential for action, each actor is significant to the system's overall functioning. By pursuing a common vision of the future, regenerative businesses are inclined to develop interdependent relationships and set common goals through globally recognized frameworks such as the United Nations' Sustainable Development Goals (SDGs) (Balda et al., 2023).

Fourth, regenerative businesses prioritize addressing pervasive and complex global challenges, making their mission inherently *transformative*. By viewing the world holistically, they aim to tackle the root causes of problems rather than just the symptoms (Aoustin, 2023), representing the multi-dimensionality of the regenerative implications (Smith et al., 2024). This approach reflects a deep awareness of the polycrisis facing the planet and recognizes how unrestricted production and consumption push the planetary boundaries (Steffen et al., 2015). By using innovation as a source for good (Laszlo et al., 2024), transformative change is a force that sustains broader sustainability transitions, helping society to shift toward novel development pathways (Balda et al., 2023).

Finally, to uphold the system, regenerative businesses entail *adaptive capacities* (Balda et al., 2023; Torelli & Balluchi, 2023). This implies the acknowledgment of ecosystems as complex adaptive systems integrated by agents that continuously learn and adapt from interactions with the different agents of the system (Folke et al., 2005). Ryan et al. (2023) argue that regeneration is inherently place-sensitive, meaning that organizations must continuously evolve in response to their interactions with social-ecological systems. The adaptive capacity of regenerative businesses hinges on their responsiveness and ability to adjust to environmental changes, such as unpredictable natural cycles (Feger & Mermet, 2022; Maroun & Ecim, 2024). Consequently, regeneration is intrinsically connected to resilience, serving as a key aspect of adaptive capacity, both of which are essential for driving profound transformations within social-ecological systems (Coleman et al., 2018). This adaptability is often driven by innovative approaches and creative problem-solving (Iqbal et al., 2023; Sanford, 2017; Torelli & Balluchi, 2023).

Regenerative Ecosystems

Based on the principles of regenerative businesses from a systemic perspective, we define regenerative ecosystems as "*a system of interconnected and interdependent heterogeneous actors that, through reciprocal efforts and feedback learning processes, aim to positively transform and enhance the health and well-being of social-ecological systems through net-positive value by implementing place-sensitive solutions with a long-term orientation under a non-hierarchical governance system.*"

This definition of regenerative ecosystems is analyzed concerning the key considerations that define circular ecosystems, yet it is examined through the principles of regenerative businesses. The following categories are employed to interpret the structure of regenerative ecosystems: (*i)* purpose, (*ii)* actors, (*iii)* value, (*iv)* activities, (*v)* governance system, (*vi)* relationships, and (*vii)* reflexivity and learning. The categories are understood in an abductive manner (Dubois & Gadde, 2002), in a process of back-and-forth between the characteristic principles of regenerative businesses, extending beyond sustainability, and as an integral part of the principles of the circular economy. Additionally, the constitutive elements of the structure of circular ecosystems are examined, with regenerative ecosystems understood as a type of circular ecosystem. Figure 2.4 presents our framework for understanding the configuration of regenerative ecosystem structures. Categories are presented as follows:

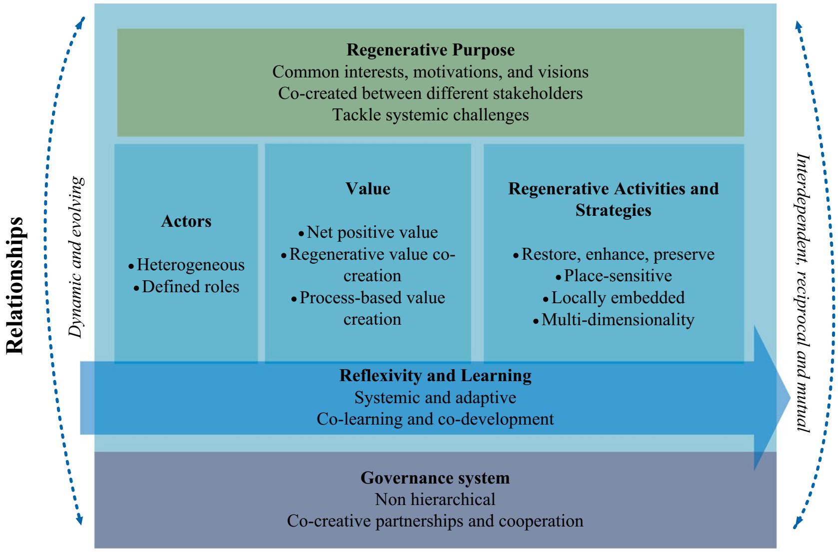

Fig. 2.4 Framework for regenerative ecosystems

Regenerative Purpose

Regenerative businesses are often described as "*purpose-driven*" (Yadav & Yadav, 2024). In this context, regenerative ecosystems emerge when a group of stakeholders, united by shared *interests, motivations, and visions of the future*, come together around a common purpose. Comprising actors who take responsibility for their impacts, these ecosystems are propelled by a deep "sense of purpose" (Polman & Winston, 2021). Actors in regenerative ecosystems enact an organizational purpose that is "*aligned with norms, values, and beliefs that are oriented towards the planet, diversity, inclusion, and health*" (Konietzko et al., 2023, p. 380). In line with Konietzko et al. (2023), the purpose is *co-created between different stakeholders* through keen observation, inner work, generative conversations, and deep listening. Commonly, regenerative purposes aim to generate solutions for wicked problems (Yadav & Yadav, 2024) and to tackle systemic challenges facing humanity (Polman & Winston, 2021).

Actors

The actors that integrate regenerative ecosystems are characterized by "multiple stakeholder levels" with *defined roles*, including society, nature, suppliers, investors, organizations, and their employees, among others (Das & Bocken, 2024). Therefore, like circular ecosystems, regenerative ecosystems integrate a variety of heterogeneous actors from different origins. This includes highly *heterogeneous* ecosystem members, which are integrated by rural (Panwar et al., 2023) and Indigenous communities (Caruso, 2023), species, and other living systems (Bishop et al., 2009), and financial institutions (Sanhokwe, 2024), among other untraditional actors.

Value

Considering the benefits that emerged from the interactions between the multiple stakeholders of a regenerative ecosystem, a focus was identified on regenerative and net positive value and regenerative value co-creation. Regenerative ecosystems are focused on generating *regenerative and net positive value*, which, in terms of the literature, means that ecosystem members aim to promote and enhance the health and well-being of social-ecological systems (Hahn & Tampe, 2021). Regenerative and net positive value is related to developing life-supporting and life-enhancing conditions for the systemic health of people and the planet (Du Plessis & Brandon, 2015; Sanford, 2017). This is achieved by creating “shared prosperity” (Mang & Reed, 2015); this form of value generation is associated with supporting human growth and self-actualization (Caldera et al., 2022). Similarly, regenerative ecosystems are supported through activities based on *regenerative value co-creation* (Drupsteen & Wakkee, 2024), meaning a process of co-creation interplay between humans, the places they inhabit, nature, and their culture (Mang & Reed, 2012). By embracing the wholeness of the world, co-creation among ecosystem members seeks to foster co-evolutionary processes that benefit all stakeholders within a social-ecological system (Caldera et al., 2022; Du Plessis & Brandon, 2015). Finally, creating regenerative and net positive value requires *process-based approaches* toward regeneration (Berkes et al., 2008; Hahn & Tampe, 2021). It means that regenerative ecosystems are working on the process of creating value between ecosystem members, and not in the mere results.

Regenerative Activities and Strategies

Members of regenerative ecosystems adopt strategies and implement activities that allow the creation of regenerative and net positive value. Common regenerative strategies have been highlighted, such as *restoration, preservation, and enhancement* (Caldera et al., 2022; Hahn & Tampe, 2021); however, other studies explore more specific activities in which regenerative value can materialize. Such variety in the description of regenerative activities and strategies is *multi-dimensional*. To illustrate, authors such as Slawinski et al. (2021) highlight that regenerative strategies are focused on building cultural and economic resilience, while Yadav and Yadav (2024) listed regenerative strategies such as building capacities, being responsive and adaptive, or creating multistakeholder value for nature-based socio-ecological systems. Konietzko et al. (2023) describe three activities as the inner part of RBMs value creation, integrating regenerative leadership, co-creative partnerships with nature, and justice and fairness. Finally, Das and

Bocken (2024) developed an exhaustive list of regeneration strategies, which include regenerative leadership, nature and social regeneration, focus on human health and well-being, employee well-being, and responsible sourcing (Alford, 2000). It is important to highlight that every regenerative strategy is *place-sensitive* (Mang & Reed, 2012; Ryan et al., 2023) *to locally embedded action* (Das & Bocken, 2024) which gives relevance to the ties between geography, its history, narratives, and culture (Hahn & Tampe, 2021), and is developed under a long-term orientation (Caldera et al., 2022) or "rhythmicity" (Gualandris et al., 2024), which means that regenerative strategies must be aligned with the cycles of nature (Muñoz & Cohen, 2017).

Relationships

Regenerative ecosystems are characterized by *interdependent* and *reciprocal* relationships between ecosystem members (Du Plessis & Brandon, 2015; Yadav & Yadav, 2024). Relationships are built upon *mutuality* (Reed, 2007; Ryan et al., 2023) and participative outcomes that are beneficial for human and ecological systems (Caldera et al., 2022). Because of the heterogeneity of actors, relationships must be built on acknowledging, recognizing, and working collaboratively with people of different mindsets and worldviews (Waddock et al., 2024). Higher commitment to regeneration requires higher levels of collaboration and stronger relationship ties. To illustrate, enhancement calls for synchronic iterative and participative experimentation between ecosystem members; preservation is linked to the adjustment of business operations through feedback, while restoration requires more unilateral and punctual intervention (Caldera et al., 2022). Finally, regenerative ecosystems and *dynamic and constantly evolving* since each attempt to create regenerative and net positive value requires reinventing stakeholders' relationships with each ecosystem intervention (Feger & Mermet, 2022).

Governance

In alignment with Gualandris et al. (2024), regenerative supply chains, which serve as a foundation for regenerative ecosystems, require effective governance models and operational coordination mechanisms. Governance, defined as the framework enabling ecosystem members to make collective decisions, establish structure, and allocate resources (Aminoff et al., 2017), is particularly crucial in regenerative ecosystems. In this context, governance is characterized by *non-hierarchical structures* that empower members to make decisions independently while maintaining accountability for their actions (Caldera et al., 2022). Governance must focus on cultivating relationships through *co-creative partnerships and cooperation* with nature and social-ecological systems (Du Plessis, 2012; Folke, 2006; Yadav & Yadav, 2024).

Reflexivity and Learning

Data flows and information sharing are constructed under the principles of *systems thinking* and *adaptive management* (Hahn & Tampe, 2021). Regenerative ecosystems require multiple ways of learning and sharing specialized knowledge between business functioning and the social-ecological system's needs (Caldera et al., 2022). Therefore, data flows are built upon *co-learning* and *co-development* processes based on expertise and responsive capabilities to emerging changes across ecosystem interactions (Du Plessis & Cole, 2011). Therefore, governance systems for regenerative ecosystems must be conceived under a structure that provides adaptive capacity to respond to change (Caldera et al., 2022).

Conclusions and Future Research Lines

This chapter aimed to offer a nuanced perspective on regenerative ecosystems by examining their core principles and the structural configurations that shape them. Drawing from an integrative review of regenerative business literature and ecosystem theory, this chapter explores the concept of regenerative ecosystems. Thus, this chapter focuses on three main contributions.

First, we aimed to provide a departing definition of regenerative ecosystems, as: "*a system of interconnected and interdependent heterogeneous actors that, through reciprocal efforts and feedback learning processes, aim to positively transform and enhance the health and well-being of social-ecological systems through net-positive value by implementing place-sensitive solutions with a long-term orientation under a non-hierarchical governance system.*" Our definition integrates the key theoretical elements proposed in business ecosystems theory (Adner, 2016; Jacobides et al., 2018) and circular ecosystems (Kanda et al., 2021; Trevisan et al., 2022). By delving into this definition, it can be noticed that regenerative ecosystems can be interpreted as a subtype of circular ecosystems, classified by Aarikka-Stenroos et al. (2020).

Second, in alignment with the principles of regenerative business that have been advanced in the literature (Hahn & Tampe, 2021; Sanford, 2017), this study lists the systemic principles of regeneration that contribute to a better understanding of regenerative ecosystems. Thus, it was observed that such a systemic approach toward regeneration can be nurtured by regenerative principles, notably, interconnectedness, process-based, collaborative and interdependent, transformative, and based on adaptive capacities (Fig. 2.3). Finally, as a key outcome of this study, this chapter presents a guiding framework and outlines essential categories for understanding the structural configurations of regenerative ecosystems: (i) purpose, (ii) actors, (iii) value, (iv) activities, (v) governance system, (vi) relationships, and (vii) reflexivity and learning (Fig. 2.4).

The theoretical framework for understanding regenerative ecosystems developed in this study offers a foundation for scholarly discussions on regenerative business and serves as a source of inspiration for regenerative businesses and entrepreneurs advancing beyond traditional sustainability and circularity models. Regarding this last point, the significance of this study lies in emphasizing that, to effectively address the global polycrisis related to environmental, social, and economic issues, a deeper understanding of regenerative business and its ecosystems will enable a larger network of companies to create net positive value while committing to "doing more good," leaving the planet and society in a better state than they found them. Since regenerative ecosystems are grounded in a place-sensitive premise, the insights from this study can be valuable to policymakers who face the challenging task of uniting a nation's society while implementing ambitious international environmental goals and targets.

One of the major challenges for future scholars on regenerative business and RBMs will be to test in practice the functioning and corresponding categories of the theoretical framework of regenerative ecosystems proposed in this study. While the literature highlights notable RBM cases such as Guayakí Yerba Mate, Tony's Chocolonely, ClayTec, and Patagonia (Das & Bocken, 2024; Konietzko et al., 2023), little is known about how their ecosystems are structured. Therefore, more in-depth investigations into the diverse structures of regenerative ecosystems are needed. Additionally, exploring the emergence and transformation of regenerative ecosystems presents a promising avenue for both researchers and practitioners.

Going beyond traditional sustainability and circularity practices, regeneration has emerged as a critical next step for companies seeking to advance planetary health, societal well-being, and deeper social interconnectedness. This concept-driven approach is strongly recommended for exploration through systems thinking theoretical frameworks, alongside foundational elements from sustainability transitions literature. While fully circular ecosystems remain challenging to implement in practice, envisioning and debating potential structural configurations of regenerative ecosystems can help drive momentum toward broader systemic transitions.

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Chapter 3
Technological Dimensions for Sustainable Business Development: An Integrated Framework Covering Energy, Materials, Circularity, and Digitalization

Manuel Lämmle

Abstract This chapter presents a comprehensive exploration of the technological dimensions for developing and innovating sustainable business models. Historically, sustainability frameworks have centered around three key dimensions—environmental, social, and economic—as introduced in the Brundtland report from 1987 and further reinforced by the UN Sustainable Development Goals. Technological dimensions of sustainability are often overlooked, despite rapid technological and digital innovations and the increasing significance of technology in enabling or hindering sustainability. Focusing on the technological domains of energy, materials, and the circular economy, this chapter highlights their relevance in conserving resources and driving circular business concepts. Digital technologies—such as data science, machine learning (ML), and digital twins—are emphasized as cross-disciplinary tools that enable, accelerate, and optimize digital processes. These four technological dimensions are methodologically derived from the broader definition of sustainability in the context of technology. The chapter also outlines the core competencies required for sustainability leaders, proposing a T-shaped skill model that combines broad technological literacy with deep sustainability expertise. In doing so, the technological sustainability framework serves as the curricular foundation for the technology pillar in the trinational study program "Sustainable Business Development" at Fachhochschule Nordwestschweiz (FHNW), Hochschule Offenburg, and EM Strasbourg Business School.

Keywords Technological sustainability · Sustainable business transformation · Sustainable energy · Material science · Circular economy · Digitalization

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Introduction

Sustainability is a broad, evolving concept aiming to ensure long-term human and ecological well-being. The Limits of Growth by the Club of Rome marked the first global call for awareness about the environmental limits to continuous economic growth (Meadows et al., 1972). The Brundtland report (Brundtland et al., 1987) popularized the idea of sustainable development, defining it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Historically, the concept of sustainability has focused on three key dimensions: environmental, social, and economic. Over time, strategic elements were incorporated into the framework, emphasizing efficiency, sufficiency, and consistency.

In today's technology-driven world, we propose an extension to this framework by integrating a technological dimension. Technology is increasingly becoming a driver and enabler of sustainability, particularly in the transformation toward sustainable businesses. This chapter introduces an integrated technological sustainability framework that explicitly incorporates technology as a core dimension of sustainability. By extending the classical three-pillar model, the framework seeks to more accurately reflect the realities of contemporary sustainable business transformation, where digitalization, renewable energy sources, sustainable materials, and circular economy principles can be a strong driver of sustainability.

Within this framework, we argue that technological competencies are an important skill set for sustainability managers and decision-makers. *In addition to* a deep, fundamental understanding of business administration and sustainability, *technological literacy is becoming increasingly essential*. For each of the four technological domains, we identify the most important *subdomains* and the technical competencies *that managers should possess*.

The key questions guiding this work are as follows:

- How can technology be systematically integrated into sustainability frameworks to reflect its transformative potential, and what are the critical technological domains?
- What skills and competencies are required of sustainability managers to effectively lead technological transformation within businesses?

In the following chapter, we first derive the proposed framework and integrate technology as a new dimension. Section 3.3 defines and explores the four technological domains of energy, materials, circular economy, and digitalization, while Sect. 3.4 discusses these technological domains in greater depth, identifying key competencies necessary to implement their full potential in practice. Finally, Section 3.5 discusses the strengths and limitations of the proposed framework and outlines directions for future work.

Integrated Technological Sustainability Definitions Framework

In the following section, we develop an integrated technological sustainability framework that builds upon the environmental, societal, and economic dimensions. Our proposed framework expands upon these dimensions by incorporating strategies of efficiency, consistency, and sufficiency. In the final step, we integrate the technological domains of energy and material resources, along with transformative strategies of circularity and digitalization.

Dimensions: Environment, Society, and Economy

Sustainability, in its widest and most broadly accepted definition, encompasses the environmental, social, and economic dimensions (Brundtland et al., 1987).

- Environmental Sustainability focuses on the responsible use and management of natural resources, to meet present needs while ensuring future generations can also meet their own.
- Social Sustainability aims to maintain the societal resource base by investing in social infrastructure, which helps ensure equitable access to basic needs. It promotes adequate fulfillment of societal needs and employment, fostering social well-being and stability.
- Economic Sustainability involves transforming existing business models to focus on lifecycle and use-orientation rather than short-term profits. This strategy ensures fairness within and between generations, promoting both economic justice and long-term prosperity.

While the Brundtland definition is historical, it still forms the foundational basis for most contemporary interpretations of sustainability, particularly in policy and academic discourse.

The definition of the 17 Sustainable Development Goals (SDGs) outlined by the United Nations (UN General Assembly, 2017) is based on this framework, with each SDG aligning with one of these dimensions. The three dimensions are often visually depicted as three intersecting circles, as the three pillars of sustainability, or in nested ellipses with a hierarchical dimension. Figure 3.1 illustrates the three dimensions as a triangle, indicating the interconnectedness of the dimensions. The arrows symbolize the interactions that may manifest as trade-offs or amplifying effects.

Kuhlman and Farrington (2010) critically examine the definition of sustainability, particularly the relationship between sustainability and sustainable development. They argue that the common three-pillar model can create ambiguity and that a clearer distinction is needed. Their work highlights the tension between economic

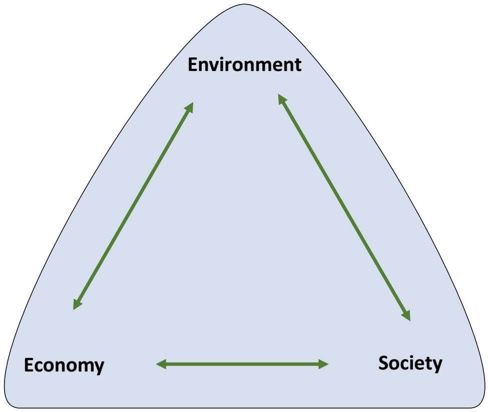

Fig. 3.1 Dimensions of sustainability (own illustration)

growth and environmental conservation, emphasizing the need for trade-offs and a more precise conceptual framework.

Let us discuss the sustainability dimensions with the example of the building construction industry. Environmental sustainability focuses on reducing natural resource use by prioritizing renewable materials and circular design practices to preserve ecosystem functions and ensure resource justice. Economic sustainability encourages creating resilient business models that can adapt and succeed for decades. Future transformations might involve prioritizing circular methods and use-orientation, ensuring fair economic practices both within and between generations, thereby promoting long-term viability in the sector. Social sustainability would involve, for example, investing in social infrastructure, such as affordable housing and community development, ensuring adequate needs fulfillment and employment opportunities for society. The latter is not always a direct goal of the company but is increasingly shaped by regulatory frameworks that require private actors to contribute to broader societal objectives, such as those outlined in the UN SDGs or the EU Taxonomy for Sustainable Activities (EU, 2020). All three dimensions—environmental, economic, and social—are deeply interrelated, meaning progress or neglect in one area inevitably influences outcomes in the others.

Strategies: Efficiency, Consistency, and Sufficiency

Sufficiency, efficiency, and consistency are three elementary approaches to achieve a transformation of the current practices to sustainable business models. According to Huber (2000):

- **Efficiency** aims at improving material and energy use, thereby achieving a relative, possibly even absolute reduction of environmental impact in the economy.

- **Sufficiency** aims at self-limitation of energy and material and thus an equal distribution of remaining resources, thereby keeping an economy within environmental limits.
- **Consistency** aims at a qualitative change in industrial metabolism through technological leaps that mimic the natural resource cycle, thereby allowing for production over the long term on a large scale with negligible negative environmental impact.

Figure 3.2 illustrates the three strategies, addressing principal questions to achieve a more sustainable resource-based system. Rudolf and Schmidt (2025) build upon this concept but stress the fact that two additional dimensions have to be considered: the time scale in which the respective strategy can be implemented, and the feasibility, what can be realistically achieved by each strategy regarding environmental impact and consumption levels.

For the example of the building industry, efficiency focuses on optimizing resource use through sustainable materials, and advanced technologies that reduce construction waste in the construction phase and energy-efficient design and renewable heating technologies in the utilization phase. Consistency involves redesigning construction processes to integrate natural material cycles, for example, using urban mining. Urban mining is the process of reclaiming raw materials from existing buildings and infrastructure, which can be a game-changer when it comes to reducing environmental impacts, particularly in the construction industry. One major material of interest is concrete as a primary contributor to global CO_2 emissions due to its production process (Koutamanis et al., 2018). Urban mining reduces long-term environmental harm and supports a regenerative, circular resource flow across the building's lifecycle. Sufficiency advocates for reducing the overall demand for

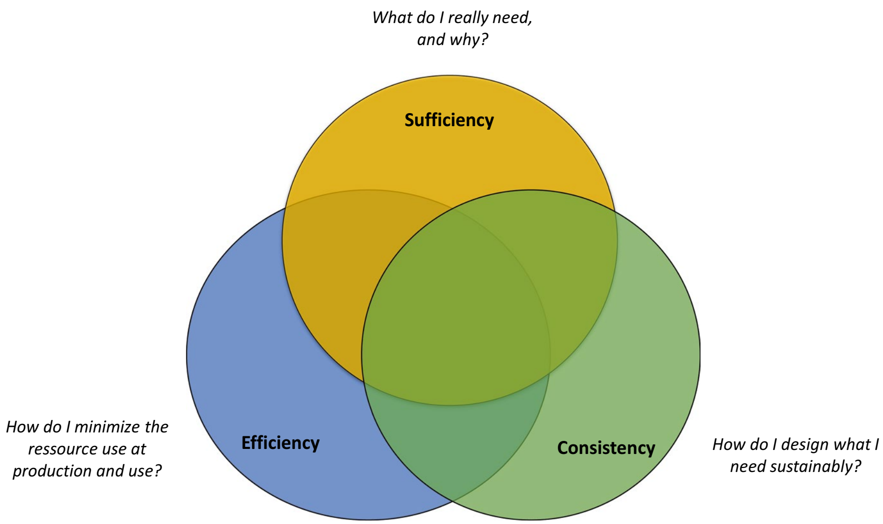

Fig. 3.2 Three strategies to achieving sustainability (own illustration based on Fischer et al. (2023))

buildings, such as encouraging smaller, more adaptable structures or promoting shared living spaces to minimize resource consumption.

The three strategies, sufficiency, efficiency, and consistency, must be evaluated within the broader context of sustainability, encompassing the environmental, economic, and social dimensions. Strategies and dimensions are interconnected and should be integrated into a comprehensive sustainability framework for the transformation of businesses.

Technological Dimensions of Sustainable Businesses

Technologies are an underrecognized dimension of sustainable businesses. While not explicitly integrated into the original sustainability framework, technological advancement can significantly accelerate sustainable innovation. Sustainable business models may or may not have a technological component, depending on the specific business case, and therefore touch upon diverse domains. We therefore extend the existing sustainability frameworks with a new dimension: technology.

Technologies: Energy, Material, Circularity, and Digitalization

We identify four cross-cutting domains of specific interest to any sustainable business model, with the goal of clustering the most significant technological dimensions. According to Kuhlman and Farrington (2010), among others, resources play a central role in sustainability. In our definition, we differentiate between energy and materials as the two key technological resources regarding sustainable businesses:

1. **Energy**: Transitioning from fossil fuels to renewables is crucial for cutting greenhouse gas (GHG) emissions. This requires sourcing renewable energy sources while boosting energy efficiency in industry, transportation, and buildings through renewable technologies and energy efficiency measures.
2. **Material:** Sustainable material use means considering the footprint of all materials along the supply chain. This involves the two main material groups of metallic and non-metallic materials. Polymeric and bio-based materials offer a large potential for sustainable transitions, but lifecycle impacts matter. Additionally, eco-design, material optimization, and closed-loop recycling are vital for minimizing waste and resource depletion.

Next to minimizing the use and footprint of resources, technological strategies may enable a scalable and impactful transformation to sustainable businesses. We propose two central methods:

3. **Circular Economy** is "a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible", and thus "the life cycle of products is extended" (EU, 2023). Circularity can be considered a key technological dimension, due to its central role in sustainable businesses and its impact on product and service design. Achieving circularity requires analysis of materials and energy use, and advancements in material science, design for disassembly, and waste processing, such as bio-based plastics and closed-loop recycling.
4. **Digitalization** is a core discipline, encompassing data analysis, modeling, artificial intelligence (AI), machine learning (ML), and digital twins (DT). These tools optimize resource use, boost efficiency, and enable sustainable operations. AI-powered energy management and digital twin simulations of complex systems minimize waste and environmental impact. Advanced analytics enable proactive resource management.

Figure 3.3 illustrates the technological dimensions of sustainability: as a starting point of a business idea, one has to analyze the resource usage of materials and energy. Circularity and digitalization can be considered as transformative strategies, acting as both implementation enablers and accelerators. All four dimensions need to be considered to fully realize the potential of sustainability and implement strategies into existing and new business models.

The technological dimensions of sustainable businesses depend on the particular focus area and are not confined to specific domains or disciplines. For instance, a sustainable agriculture business might focus on technologies related to precision farming, while a sustainable transportation company might prioritize electric vehicle technology and smart logistics. Therefore, it is necessary to also consider the interplay between different technological dimensions and their impact on the specific sustainability goals of the specific business.

As an example of the building sector, a sustainable construction business integrates energy-efficient heating systems (e.g., heat pumps) with eco-friendly materials (e.g., recycled concrete and high-performance insulation) to minimize the environmental impact of its resources during construction and operation. Circularity principles are applied by reusing construction waste and implementing modular building components for easy disassembly and reuse. Digitalization supports these

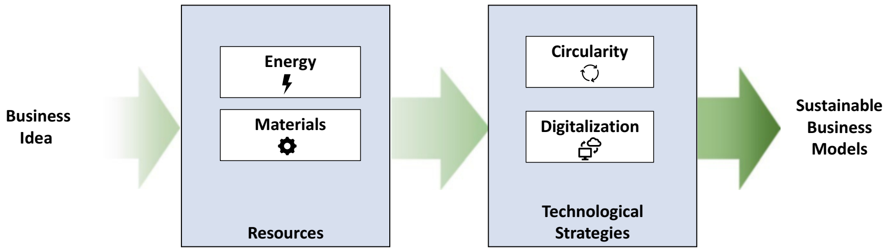

Fig. 3.3 Technological dimensions of sustainable business models: energy and materials as resources and circularity and digitalization as technological strategies (own illustration)

efforts through digital twin technology, enabling real-time monitoring and effective installation, for example, leveraging building information modeling. However, all individual measures and adaptations have to be viewed on a consistent basis, weighing the energy and environmental costs in a broader sustainability context that also involves potential added costs by new and more expensive materials or processes. Together, these technological dimensions might help in creating a sustainable business model that reduces resource consumption, lowers carbon emissions, and extends building lifespans.

Integrated Technological Sustainability Framework

Developing sustainable business models requires a multi-dimensional perspective that integrates environmental, social, and economic dimensions with strategic and technological considerations. This section introduces an integrated sustainability framework that brings together these essential elements, providing a structured approach for developing sustainable businesses with a technological focus.

This integrated framework in Fig. 3.4 comprises four layers:

- The inner layer forms the objective to develop a sustainable business model.
- The second layer represents the technological dimensions that enable and accelerate sustainability transformations. Energy and material resources are the

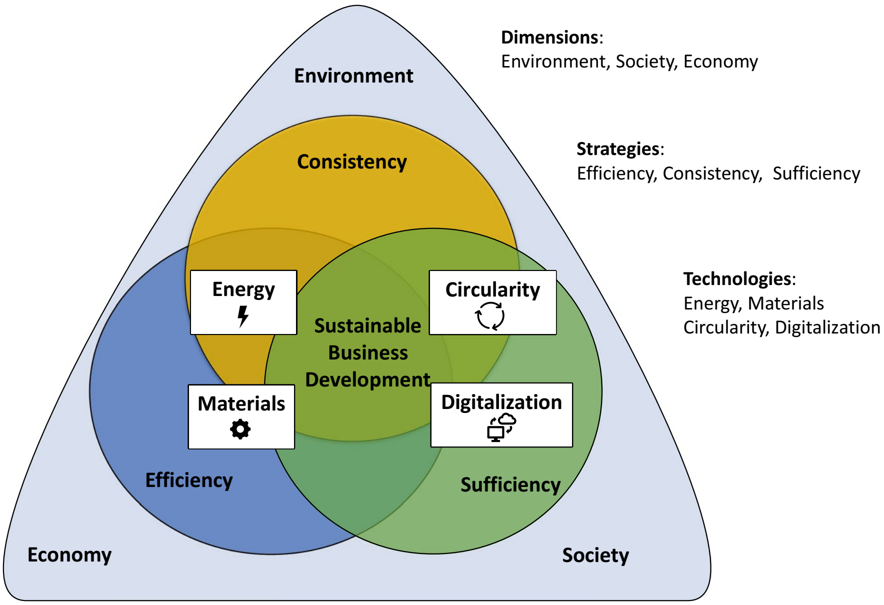

Fig. 3.4 Integrated technological sustainability framework for sustainable business development, including dimensions, strategies, and technologies

primary technological dimensions, with circularity and digitalization serving as key enablers.

- The third layer consists of the strategic approaches of efficiency, sufficiency, and consistency, guiding businesses in transitioning from conventional models toward sustainable operations.
- The outermost layer represents the integration with the three fundamental sustainability dimensions—environmental, social, and economic. These dimensions ensure that business ideas are not only profitable but also contribute to ecological conservation and societal well-being.
- Additional layers can be integrated into this framework, such as political, legal, or governance dimensions, depending on the specific use case, or some layers may be less emphasized.

Figure 3.4 provides a comprehensive visualization of this integrated sustainability framework, illustrating how businesses can systematically incorporate dimensions, strategies, and technologies into their sustainable transformation pathway. This structured approach ensures that sustainability is not an isolated goal but an embedded principle guiding long-term business success.

Domains and Competencies of Technological Dimensions

In the following section, we discuss the four technological dimensions in more detail. In doing so, we also describe key competencies, sustainable business managers need to acquire to apply the central principles.

Energy

Energy technologies play a critical role in achieving sustainability goals by driving efficient energy use and reducing GHG emissions. To successfully implement energy-efficient technologies, a business and sustainability manager must adopt a strategic approach, based on a deep understanding of energy flows and technological opportunities. Key areas with high CO_2 intensity often include transforming existing buildings, mobility solutions, processes, and energy consumption to renewable and sustainable sources. For instance, this could involve transitioning from conventional grid electricity to solar photovoltaic (PV) panels, adopting an electric vehicle fleet, or decarbonizing the company's buildings and industrial processes. While some changes can be implemented onsite, others may require larger-scale adaptations on a regulatory or infrastructure level.

We identified the following subdomains and competencies (see Fig. 3.5) as essential for understanding sustainable energy technologies:

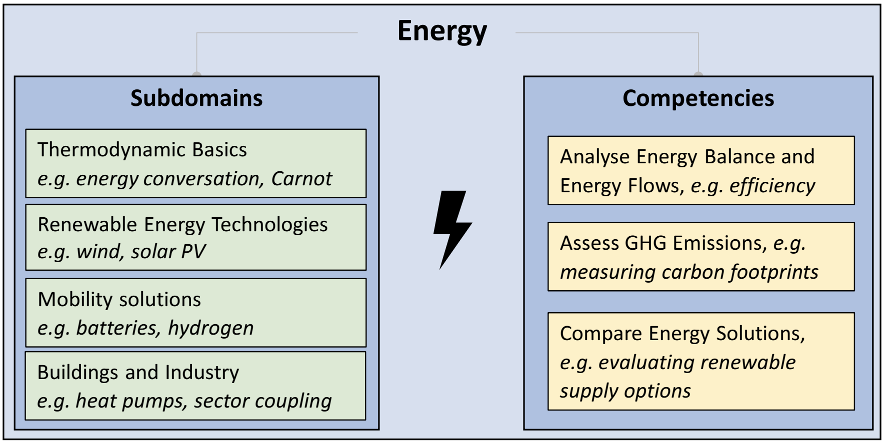

Fig. 3.5 Subdomains and competencies of energy as the first technological sustainability dimension

- **Thermodynamic basics** describe the fundamental principles, such as energy conservation and conversion, heat transfer, and Carnot efficiency, which are essential for understanding energy processes. Concepts such as efficiency limits and entropy help assess the potential and limitations of different energy solutions.
- **Renewable energy technologies** such as solar PV, wind power, and hydropower are pivotal in reducing reliance on fossil fuels. A basic understanding of the technology behind renewable energy is essential for future sustainable business leaders.
- **Mobility solutions** such as electric batteries, hydrogen fuel cells, and hybrid systems contribute to decarbonizing the transportation sector. Innovations in energy storage, charging infrastructure, and fuel cell efficiency are critical to achieving sustainable mobility.
- **Buildings and industrial processes** involve heating and cooling technologies, including energy-efficient technologies such as heat pumps, combined heat and power (CHP) systems, and sector coupling (integrating electricity, heating, and mobility sectors), which aim at reducing energy consumption and emissions in residential, commercial, and industrial settings.

By exploring these technological domains, business managers should cultivate the following competencies:

- **Analyzing the energy balance and flow** of processes, products, and plants is a key ability to evaluate energy input, conversion processes, and output efficiencies. These physical and thermodynamic principles form the basis for energy audits, understanding system losses, and identifying areas for optimization.
- **Assessing** GHG **emissions** involves measuring and analyzing carbon footprints from energy consumption to support climate impact assessments. This competency involves applying methods such as carbon accounting and energy life cycle analysis (LCA) to quantify and reduce emissions.

- **Comparing different energy solutions** involves comparing efficiency, cost, environmental impact, and reliability. For this purpose, renewable and conventional energy supply options have to be considered side-by-side. Decision-making tools such as cost–benefit analysis and multi-criteria analysis support the selection of optimal energy technologies.

Integrating energy technology knowledge and sustainable energy management into business education empowers future leaders to implement sustainable energy strategies. Quaschning (2019) provides a comprehensive coverage of technological concepts even for non-engineering audiences.

Materials

Materials are central to sustainable business development, particularly in material-intensive sectors such as manufacturing, production, construction, electronics, and packaging. The choice of materials directly impacts resource efficiency, carbon emissions, and waste generation, directly through scope 1 but also indirectly through their supply chains. While the service sector typically does not produce physical goods, materials can still play a significant role in the company's sustainability balance through the materials it uses, both directly and indirectly.

Sustainability managers should not only be aware of the trade-offs between performance, cost, and environmental impact in material selection but also understand the financial and environmental costs associated with resources and material usage.

Materials science is a relevant discipline for designing and producing environmentally responsible products and processes. We identified the following subdomains as most generally relevant to the field of sustainable materials (Fig. 3.6):

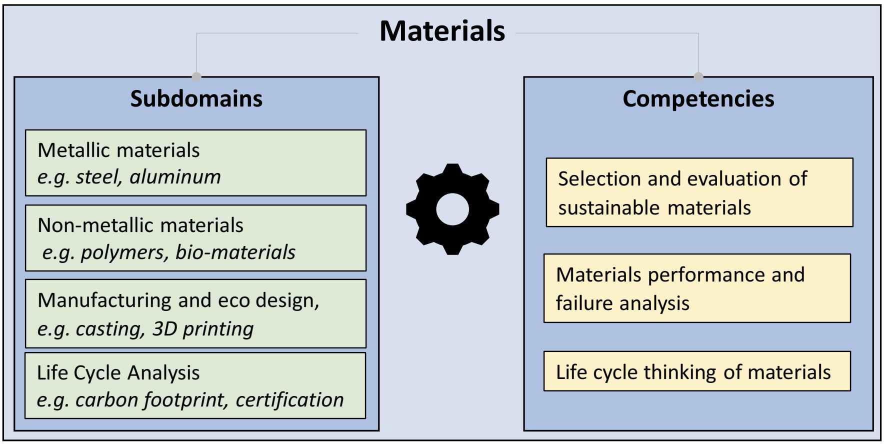

Fig. 3.6 Subdomains and competencies of materials as the second technological sustainability dimension

- **Metallic materials**, such as steel and aluminum, are widely used in construction and manufacturing, requiring innovations in low-carbon production, alloy development, and recycling technologies. These advancements help reduce energy consumption and emissions while improving material longevity.
- **Non-metallic materials**, including polymers, ceramics, and bio-based alternatives, offer sustainable solutions with lower environmental impact. Biodegradable polymers, natural fiber composites, and recycled plastics are gaining prominence as industries seek alternatives to fossil-based materials. Understanding the trade-offs between performance, cost, and sustainability is key to material selection.
- **Sustainable processing and manufacturing** techniques such as eco-design, additive manufacturing (3D printing), or innovative casting help reduce resource consumption and waste. Innovations in remanufacturing and closed-loop production systems enable companies to minimize their carbon footprint while extending product lifespans.
- **Material LCA** evaluates the environmental impact of materials across their life-cycle, from extraction to disposal. Carbon footprint assessments, eco-certifications (e.g., ISO 14040), and circular economy principles play a key role in sustainable business strategies. Companies must integrate supply chain transparency and traceability to ensure responsible material sourcing and compliance with international sustainability regulations.

Integrating sustainable materials science into business education ensures that future leaders make informed, environmentally responsible decisions. With expertise in materials selection, processing, and LCA, graduates will be able to develop strategies that promote environmental stewardship and business success. From these subdomains, business managers should develop essential competencies, including:

- **Materials performance and failure analysis** to understand the technical concepts of durability, degradation, and failure mechanisms with the corresponding material properties and how they longevity and reliability of materials and designs.
- **Selection and evaluation of sustainable materials** to identify, compare, and implement environmentally responsible alternatives based on recyclability, renewability, and life cycle impact.
- **Life cycle thinking of materials** by applying LCA methodologies to optimize resource use, reduce emissions, and drive circular economy strategies. Materials should be viewed and evaluated along their entire life cycle from cradle to grave.

Circularity

Circularity, or the circular economy, is not purely a technological dimension but also a business strategy. However, we include it as a technological dimension due to its central importance in sustainable business practices and due to its technological implications on products and services. Industrial ecology is a similar domain that provides a framework for understanding and optimizing resource flows within production systems (Huber, 2000).

A core concept within circularity is the 9R Framework (Will, 2019), which outlines nine key strategies for resource efficiency: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, and Recycle. These strategies guide businesses in minimizing resource extraction and maximizing material recovery.

However, implementing circular business models can involve significant uncertainties. Linder and Williander (2017) highlight that, despite the potential for cost savings and environmental impact, reduction through reuse and remanufacturing, widespread adoption remains limited due to challenges in uncertainty reduction and capital commitments in product–service systems.

Nonetheless, circular business models are essential for sustainable business models by reducing resource consumption, minimizing waste, and extending product lifespans. The following subdomains outline the technological and strategic aspects of circularity (Fig. 3.7):

- **The 9R framework** with its nine strategies forms the foundation of circularity by promoting resource efficiency and extending product lifecycles through actions ranging from refusing unnecessary products to recycling materials at the end of life.
- **Waste and toxicity management** includes techniques such as sorting, composting, and hazardous material reduction to minimize environmental impact and maximize material recovery.
- **Material and product life cycle management** involves strategies such as maintenance, refurbishment, and end-of-life recycling contribute to closed-loop systems and sustainable product design.

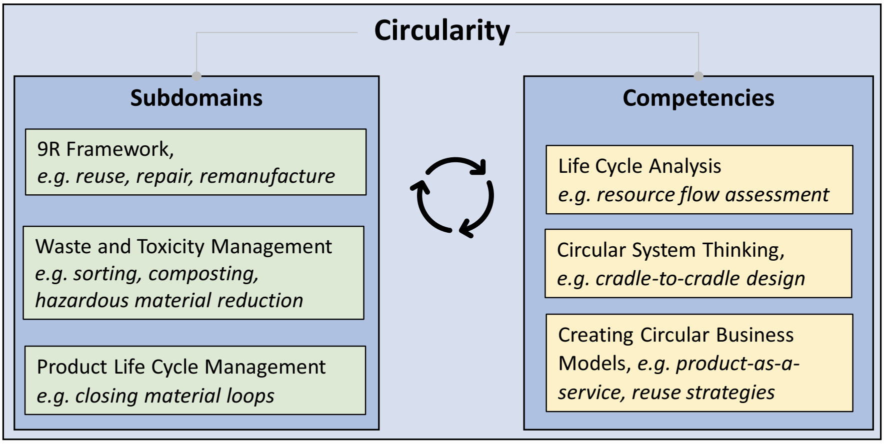

Fig. 3.7 Subdomains and competencies of circularity as the third technological sustainability dimension

Essential competencies for circularity include:

- **Implement LCA** by assessing resource flows and environmental impacts throughout the product lifecycle.
- **Circular system thinking and innovation** by creating cradle-to-cradle and closed-loop designs to minimize waste and maximize resource reuse.
- **Circular business model creation** by developing innovative models such as product-as-a-service and reuse-based solutions that decouple business growth from resource consumption.

Naturally, circular concepts build upon the knowledge of energy and material resources, which is why LCA recurs across all three technological domains.

Digitalization

Digitalization plays a crucial role in sustainable development by enabling real-time decision-making, improving resource management, and supporting scalable solutions to environmental challenges (George et al., 2021). According to the authors, digital innovations can address grand challenges such as climate change and sustainable development by enabling entrepreneurial organizations to implement novel digital sustainability activities. Integrating sustainability into technology design and employing digital tools such as AI, Internet of Things (IoT), and DT can drive innovation and support business implementation processes.

As a cross-cutting competence, digitalization is critical for advancing sustainable technologies and achieving SDGs. Leveraging digital solutions can drive innovation and support implementation processes in businesses.

On the other hand, digitalization is highly energy-intensive and hence comes with significant environmental and economic costs (van Wynsberghe, 2021). AI models demand vast amounts of power for training, deployment, data processing, and storage, and thus contribute to the global rise in energy use. Moreover, the proliferation of IT and IoT devices increases the demand for semiconductors, rare earth materials, and other resources, raising concerns about sustainability. While tools like video conferencing can reduce the need for travel, they still rely on energy-intensive infrastructure. This creates a trade-off between the benefits of digital solutions and their environmental impact, highlighting the need for more sustainable approaches, such as Green IT or Green Computing. Sustainability managers should be capable of analyzing the benefits and trade-offs of digital technologies, ensuring that their adoption aligns with both business goals and environmental objectives.

In a dynamic and rapidly changing digital age, identifying and defining the most relevant subdomains and competencies is challenging, if not impossible. Nevertheless, Fig. 3.8 aims to highlight the most prominent ones:

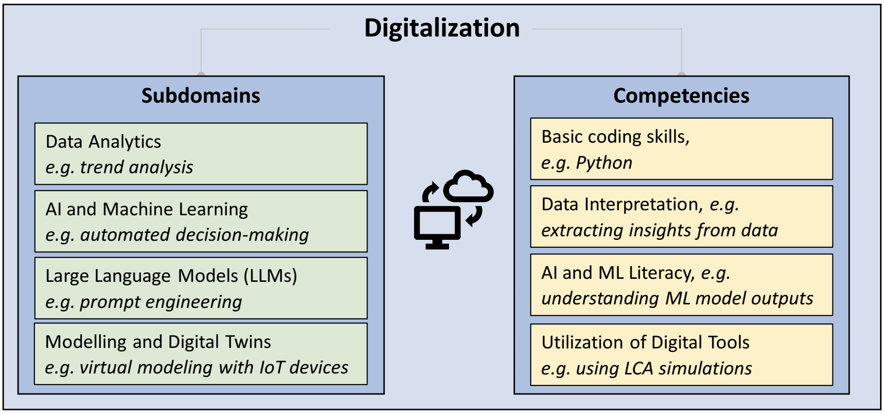

Fig. 3.8 Subdomains and competencies of digitalization as the fourth technological sustainability dimension

- **Data Analytics:** Techniques such as trend analysis and predictive modeling help extract actionable insights, supporting data-driven decision-making for sustainability improvements.
- **AI and ML:** Automated decision-making, pattern recognition, and process optimization drive efficiency and innovation across industries.
- **Large Language Models (LLMs):** Applications such as text generation and conversational interfaces enhance customer support and streamline communication processes.
- DT **and Modeling:** Virtual simulations of processes and systems enable real-time optimization, improving operational efficiency and reducing resource waste.

Incorporating digitalization into business education ensures that future leaders can harness digital tools to implement sustainable strategies effectively. By developing these competencies, business leaders can effectively harness digital technologies to advance sustainable business practices and support informed decision-making in the digital economy. The most essential digital competencies involve the following:

- **Basic programming skills** to understanding coding principles and using programming languages, such as Python, to manipulate data and develop digital solutions with the help of coding assistants.
- **Data literacy** for interpreting data, extracting meaningful insights from analytical outputs, and applying critical analysis for decision-making.
- **AI and ML literacy** to understand the principles behind AI models, recognizing their outputs, and effectively deploying tools like LLM-powered chatbots.
- **Utilization of digital tools** to apply methods such as LCA and DT to evaluate sustainability impacts and optimize processes.

Cross-Domain Synergies in Sustainable Technologies

The four key domains—Energy, Materials, Circularity, and Digitalization—are not perfectly separable but overlap in several aspects, applications, and subdomains. Figure 3.9 illustrates some cross-domain applications of the overlapping technical dimensions. The integration of these technological dimensions can serve as a foundation for cross-disciplinary innovations, driving solutions to complex environmental, societal, and economic challenges.

- **Energy and Digitalization** converge to drive efficiency and intelligence in energy systems. Innovations such as smart grids, DT, and AI-driven energy management systems optimize energy distribution and consumption and support the integration of fluctuating renewable energy technologies.
- Similarly, the intersection of **Energy and Materials** includes energy-efficient manufacturing processes, where new materials and industrial technologies reduce energy use and emissions.
- The overlap between **Materials and Circularity** fosters innovations in sustainable production and resource management. Concepts such as the 9R Framework and circular material systems aim to minimize resource use and extend material lifecycles.
- At the intersection of **Digitalization and Circularity**, tools such as blockchain for supply chain transparency, AI for predictive maintenance, and DT for circular product design enable more efficient resource management and closed-loop systems.
- The convergence of **Materials and Digitalization**, while not being shown in the diagram, underpins advancements such as Industry 4.0 technologies and digital product passports, which enhance traceability and promote sustainable sourcing.

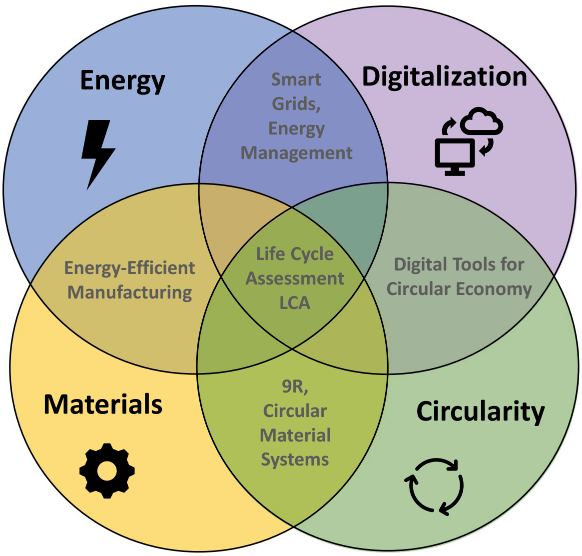

Fig. 3.9 Cross-sectional aspects of sustainable technologies

- The intersection of **Energy and Circularity** is less direct, as energy cannot be recycled in a circular way, but only conserved. Nonetheless, digitalization and circular principles can reduce energy demand through process optimization and energy recovery techniques.

At the heart of these overlaps lies LCA, a central methodology that can integrate all four domains. LCA provides a holistic perspective by evaluating environmental impacts across the entire lifecycle of products, processes, and systems. It highlights trade-offs and opportunities for improvement across energy use, material efficiency, circular strategies, and digital innovation.

Discussion

The technological dimensions of sustainability play a crucial role in addressing global environmental challenges, yet they are not included in most existing sustainability frameworks in favor of environmental, social, or policy-oriented perspectives. To bridge this gap, we propose a framework that integrates energy, materials, circularity, and digitalization as the four key technological pillars of sustainability. This integrated technological sustainability framework in Fig. 3.4 highlights the importance of technology in sustainable business development and integrates the four major technological dimensions.

In the subsequent discussion, we critically reflect on the framework's boundaries by identifying additional technological domains that remain unaddressed. Furthermore, we explore the evolving role of sustainability managers in this context, focusing on whether technological competencies should be viewed as a valuable complement or as an essential core skill set in leading sustainability initiatives.

Technological Dimensions Not Explicitly Included in the Integrated Sustainability Framework

While the four technological dimensions capture key aspects of sustainable innovations, other technological domains are not yet integrated into this framework but also play vital roles in advancing sustainable development. An incomplete and non-exhaustive list of technological topics not addressed includes the following:

- **Sustainable agriculture** with innovations such as eco-friendly fertilizers, organic farming techniques, and bioenergy production may reduce environmental impact and promote long-term agricultural viability.
- In **life sciences,** such as biotechnology and healthcare, the social and human dimensions of sustainability are crucial, emphasizing equitable access to health resources and advancements that benefit communities.
- **Water management,** such as wastewater recycling and desalination technologies, is critical to ensuring sustainable water resources for both industry and

society. Circular principles can be applied to water management, but the previous technological dimensions do not capture the full extent.

- **Resilience** describes technologies that enhance system resilience, from disaster-resistant infrastructure to adaptive technologies for climate change mitigation, which help societies withstand environmental and technological disruptions.

In future work, the integrated technological sustainability framework should be developed further to also integrate the above domains.

Ultimately, sustainability transcends individual technological fields, requiring a cross-cutting, interdisciplinary approach. Every engineering domain must develop tailored solutions that align with their industry's unique challenges, applying the core dimensions—material, energy, circularity, and digitalization—to their specific contexts. Sustainability must therefore be considered as a foundational competence across all technological disciplines.

Technological Competencies for Sustainability Managers: Useful Add-On or Mandatory Core Skills?

As the sustainability and digital transitions increasingly converge, the role of sustainability managers is undergoing a transformation and is becoming more and more interdisciplinary. What was once a function rooted primarily in environmental compliance and reporting is now becoming highly interdisciplinary, integrating strategy, technology, and systems thinking. This shift raises a key question: should technological and digital literacy be considered a core competency for sustainability managers, or is it enough for them to rely on external experts?

Technical domains such as thermodynamics, material science, or advanced digital tools like LLMs are complex and require deep, specialized expertise. This domain expertise can be handled by engineers and domain-specific professionals. Outsourcing such expertise remains essential in supporting the sustainability transformation.

However, a basic and foundational understanding of relevant technologies is becoming increasingly indispensable. Sustainability leaders must be able to comprehend the capabilities and limitations of technologies related to energy systems, material cycles, and digital infrastructures. This literacy enables them to make informed, strategic decisions that integrate sustainability goals with economic viability and technological innovation potential.

We believe that a T-shaped skill profile is ideal: broad literacy in technological domains with deep expertise in sustainability strategy. This vision aligns with Saviano et al. (2015), who advocate for a rethinking of education to cultivate transdisciplinary skillsets. Their work highlights systems thinking and boundary-crossing competencies as critical for navigating complex global challenges such as climate change, social inequality, and unsustainable resource use.

Sustainability managers must cultivate the capacity to bridge technology, sustainability, and strategy. They should develop a technical mindset with the ability and competency to understand and steer technological innovations, and lead in a world where sustainable transformation is deeply intertwined with digital and technological transformation.

Summary

This chapter presents a comprehensive framework for sustainable business models, integrating the key dimensions of sustainability (environmental, social, and economic) with strategic approaches (efficiency, consistency, and sufficiency) and technological dimensions (energy, materials, circularity, and digitalization). We propose recognizing technology as a fundamental addition to traditional sustainability definitions, highlighting its transformative impact on business practices.

The four technological dimensions are examined in detail: energy, focusing on renewable technologies and energy-efficient systems; materials, emphasizing sustainable sourcing and LCA; circularity, promoting closed-loop systems through the 9R framework; and digitalization, which leverages digital tools such as AI, IoT, and DT to enhance resource efficiency.

Additionally, we explore essential subdomains within each dimension and highlight the critical competencies required for business leaders to drive sustainable practices effectively. A T-shaped skill profile combining basic technological literacy with deep sustainability expertise is essential for managers to effectively bridge strategy, innovation, and systems thinking in the face of complex global challenges.

These subdomains and competencies form the curricular basis for the technology pillar in the newly developed trinational study program "Sustainable Business Development" of Fachhochschule Nordwestschweiz, Hochschule Offenburg, and Ecole Management Strasbourg.

By integrating these technological dimensions with strategic and sustainability principles, businesses can systematically advance resource efficiency, drive innovation, and contribute to long-term sustainable business development.

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Chapter 4
Circular Brewery: A Transformational Journey to the Circular Economy

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Abstract This chapter examines the integration of circular economy principles in the brewing industry, focusing on the transition from linear to circular production and resource-efficient models. Through a literature review and the analysis of different brewing companies, the research analyzes how the brewing industry implements circular practices and to what extent these approaches align with established theoretical principles.

Key findings reveal significant potential of revalorizing brewery by-products, transforming these into animal feed, human food, bioactive compounds, or bioenergy. Innovative approaches such as wastewater recycling and biogas production further showcase the industry's ability to close resource loops. Notable examples include a Swiss brewery, which implements advanced heat recovery systems and utilizes biogas for energy needs.

Despite these advances, financial constraints, technical challenges, and regulatory barriers hinder widespread adoption, particularly for small breweries. This chapter underscores untapped opportunities, including Scope 3 emission reductions and enhanced by-product utilization. Achieving a fully circular brewing industry requires long-term investment, stakeholder collaboration, and consumer engagement.

Keywords Circular economy · Business transformation · Supply chain transformation · Brewing industry · Value networks

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Introduction

Beer production has been on the rise in recent years, and the use of linear economic models in production is very common (Amienyo & Azapagic, 2016). This is associated with some environmental damage. Beer production consumes a lot of water and produces a high volume of wastewater (Simate et al., 2011). In addition, the high energy consumption, which is mostly based on fossil fuels, is associated with carbon dioxide (CO_2) emissions. Furthermore, a considerable amount of waste and by-products are produced, which are discarded and not utilized further (Ortiz et al., 2019). Therefore, a transformative shift toward sustainability, driven by the principles of the circular economy (CE), is needed. At its core, circularity reimagines the brewing process, turning waste into resources, optimizing energy use, and reducing environmental impact. This approach is vital for addressing the industry's significant challenges (Rachwał et al., 2020).

One of the key aspects of circularity in brewing is the repurposing of by-products such as spent grain and yeast. Brewery by-products have valuable properties that make them suitable for use in the food industry, but their potential is currently underutilized (Rachwał et al., 2020). Traditionally considered as waste, these materials can be upcycled into animal feed, bioenergy, or even sustainable food products. Similarly, water management strategies, such as advanced filtration and wastewater recycling, play a critical role in minimizing water usage, a pressing issue given the large quantities required in brewing (Pasquet et al., 2024). Moreover, renewable energy integration and waste heat recovery contribute to reducing the industry's carbon footprint while lowering operational costs (Ortiz et al., 2019). By understanding the potential of these by-products, researchers and industry professionals can design innovative ways to utilize what was previously considered waste, contributing to sustainability and resource efficiency in the brewing and food industries (Rachwał et al., 2020).

However, implementing circular practices is not without challenges. Breweries, especially smaller ones, may face financial and logistical barriers in adopting advanced technologies for waste management and renewable energy. Establishing closed-loop systems also requires collaboration across the supply chain and significant upfront investment (Cimini & Moresi, 2021; Pasquet et al., 2024).

To study the transition from linear to circular models in the brewing industry, a qualitative research method is employed to conduct a comparative analysis of theory and practice. For this purpose, a literature review was carried out, and an interview with a beer producer was conducted. Relevant studies in the fields of CE and the brewing industry were systematically searched for. The search involved the use of multiple databases and specific search terms to identify relevant studies. The databases searched included Swisscovery, Google Scholar, ScienceDirect, and PubMed. Each database was queried using a combination of keywords related to the topic. To identify relevant studies, the process began with an examination of the titles of all retrieved studies to assess their relevance to the research. Subsequently, the abstracts of the remaining studies were read and analyzed for their alignment with the research objectives. Studies selected for use were chosen based on their relevance to the research question and their quality. For the interviews, a large beer producer in Switzerland was selected to investigate their CE strategies (Velenturf & Purnell, 2021).

In order to achieve a more profound comprehension of the principles of CE in the context of the beer industry and to support companies in the implementation of relevant strategies, this study will address the following research question: How does the brewing industry implement circular practices, and to what extent do these approaches align with established theoretical principles? The results of the literature review and the interview are reviewed in this chapter to identify common patterns, success factors, and differences in the approaches to circularity among the companies studied.

Theoretical Framework

Overview of CE Principles

Conventional economic models are predicated on a linear approach, whereby natural resources are processed into saleable products, which are then utilized by consumers and subsequently discarded (Xie & Lu, 2022). Linear business models operate under the assumption that resources are infinite, resulting in their inefficient utilization. This leads to substantial levels of waste and pollution (Salvador et al., 2020). According to the principles of the CE, the transition from linear models to a closed-loop system is essential (Xie & Lu, 2022).

The concept of a CE has been defined in a wide variety of ways. Nitkiewicz and Pachura (2022, p. 384) provide the following definition: “Circular economy refers to the synchronization of forward and backward flows of goods and materials in a way to support the closure of all loops, through application of different processes, such as reuse, repair and refurbishment, remanufacturing and recycling.” Geissdoerfer et al. (2017, p. 766) define CE as “a regenerative system in which resource use and waste, emissions and energy losses are minimised by slowing, closing and tightening material and energy cycles.” The common denominator of the various definitions is the objective of optimizing the use of resources, although the criteria for what constitutes “optimization” remain open to discussion. The overall objective of a CE is to reduce the rate of depletion of resources, minimize their exploitation, develop waste prevention, and restore and regenerate the environment. Circular products are created with durability, repairability, and recyclability in mind. For example, modular designs allow components to be replaced or upgraded rather than discarded. Materials are preserved in use through a series of feedback loops. The objective of recyclability is to establish a closed-loop system. Biological materials are subjected to composting processes, which, in turn, are returned to the soil, while technical materials such as metals and plastics are refurbished or recycled. To minimize waste and ensure efficiency, products must be designed accordingly (Favi et al., 2017).

A CE is based on three principles: Reduce, Recycle, and Reuse (Ketenci, 2024). The CE's primary principle is the elimination of waste and pollution, contradicting the current economic models that operate on a linear "take-make-waste" system (Xie & Lu, 2022). The second principle of the CE focuses on maximizing the value of products and materials throughout their lifecycle. This principle advocates for keeping resources in active use for as long as possible, in one of three forms: as complete products, as components of other products, or as raw materials for new products. The goal is to create a closed-loop system where nothing is wasted, and the inherent value of materials is preserved. The CE's third fundamental principle focuses on regenerating nature. By transitioning from a linear economic model to a circular one, opportunities are created to support and enhance natural processes. This shift allows the reduction of pressure on natural resources, to minimize pollution and waste, restore degraded ecosystems, and enhance biodiversity (Morseletto et al., 2022).

To achieve the objectives of the CE, a variety of strategies have been developed (Alamerew et al., 2020). A significant strategy is the 9-R strategy. This framework consists of strategies that range from the most circular to the least circular. The following is a list of the strategies (Morseletto et al., 2022; Alamerew et al., 2020):

- Refuse: Avoid purchasing unnecessary or unsustainable products.
- Rethink: Reconsider consumption and production patterns to reduce their environmental impact.
- Reduce: Limit the consumption of resources and the production of waste.
- Reuse: Use products again in their current form.
- Repair: Extend the life of products by repairing them.
- Refurbish: Restore or improve existing products.
- Remanufacture: Manufacture new products from used parts.
- Repurpose: Find new uses for products or their components.
- Recycle: Transform waste into new raw materials.

The effective implementation of circularity requires a holistic consideration of the economic, environmental, and social dimensions. For a product to be considered circular, it must align with all three dimensions. In that regard, social aspects need attention to generate intergenerational equity and broader social justice issues. Most discussions on social benefits focus narrowly on job creation, neglecting to address broader issues such as social equity, resource distribution, labor exploitation, and power dynamics within value chains. It is also focused on preserving and regenerating natural capital, transitioning to restorative practices that deliver environmental net-gains. Ultimately, the viability and sustainability of circular practices depend on their profitability (Terra Dos Santos et al., 2023).

Transition from Linear to Circular in the Brewing Industry

The transition to a circular model holds considerable potential in the field of beer production, offering novel perspectives on resource reuse (Ortiz et al., 2019; Pasquet et al., 2024). This shift not only enhances brand value but also provides competitive advantages and mitigates the risk of future regulatory changes (Julkovski et al., 2023).

The production of beer is a process that requires four fundamental ingredients: malt, hops, yeast, and water. Depending on the specific recipe, other ingredients such as wheat, rye, or barley may also be incorporated (Pasquet et al., 2024). The production of beer involves a series of process steps, including mashing, boiling, fermentation, and filtration. These steps result in the generation of various by-products such as brewers' spent grain (BSG), brewers' spent yeast (BSY), brewers' spent hops (BSH), and brewery wastewater (BWW). The process entails the removal of solid materials through a series of separation and filtration steps (Cimini & Moresi, 2021; Pasquet et al., 2024). One of the biggest by-products of the brewing process is the spent grain (Sganzerla et al., 2021). Many breweries work with farmers who use it to feed their livestock (Ortiz et al., 2019). While this is already a good alternative to disposal, there is still greater potential for its utilization, such as recovery of bioactive compounds, valorization as human food, bioconversion, and more. For example, a variety of extraction technologies can be used to recover lipid, protein, carbohydrate, lignin, and related bioactive compounds. These can then be used in the food and biotechnology sectors (Pasquet et al., 2024). One other by-product is yeast, which can be recovered at the end of fermentation and reused for the next batch. However, it should be noted that the performance is slightly reduced (Pasquet et al., 2024).

Another circularity strategy is the use of stale bread instead of malted grains to make beer, which has shown positive results in terms of taste and similar physio-chemical properties. This could reduce brewers' consumption of malt and avoid food waste (Pasquet et al., 2024).

A different possible use of by-products is the production of biogas and electricity. Methane can be produced by fermenting the biomass. This methane can be used to generate electricity and heat. Those can either be used directly in the brewery or fed into the grid (Pasquet et al., 2024). Furthermore, a way to make the brewery's energy consumption more sustainable is to implement and use renewable energy such as solar or wind power (Cimini & Moresi, 2021). The main energy consumed in the brewing process is the thermal energy required for the heating and cooling steps during the process. The use of heat exchangers and the general minimization of heat losses, as well as the use of the methods mentioned above, can be useful in reducing energy requirements (Ortiz et al., 2019).

Brewing beer produces a lot of wastewater, which is often not reused and ends up in the environment. This wastewater could be put to good use in agriculture, as it has been shown to have a positive effect on plant growth by using the nutrients in the wastewater as fertilizer. This would reduce the amount of fresh water needed and reduce the amount of fertilizer needed to be used (Pasquet et al., 2024).

The production of glass and aluminum packaging is another resource-intensive process. By using reusable glass bottles and steel kegs, the energy, raw material, and overall carbon footprint can be reduced. However, compared to disposable bottles, they still produce more waste and use more water, even after multiple uses. To keep the carbon footprint as small as possible, it would be advantageous to reduce the weight of the packaging, reuse the bottles as often as possible and recycle them at the end of their life cycle, and produce new bottles from a high proportion of recycled material (Cimini & Moresi, 2021).

Circular Practices in the Brewing Industry

Methodology

To evaluate whether circular practices are already being implemented in the brewing sector, it is logical to examine practical examples of implementation. For the purpose of this paper, one company example was examined through an interview, and other examples with public information.

The interview was conducted with Feldschlösschen, a large brewery near Basel, Switzerland, founded in 1876 (Feldschlösschen, 2025a). To investigate the sustainable and circular practices implemented at Feldschlösschen, an interview was conducted. A qualitative interview approach was selected to emphasize openness, flexibility, and responsiveness to context. As it involves iterative steps to gain specific insights and allows for establishing a more personal connection, conducting the qualitative research as an interview was deemed appropriate (Busetto et al., 2020).

A qualitative interview is a communication process that results in text as data. Interviews are, therefore, one of the most commonly used data evaluation methods. They are not conducted to get the objective truth but to gain subjective insights and examples from the industry (Hollenberg & Kaup, 2023). This use case is based on an interview conducted with the Chief of Technology and Sustainability of Feldschlösschen. The interview was structured as an online expert interview to gather insights into Feldschlösschen's practices and was conducted end of 2024 (Hollenberg & Kaup, 2023).

Although Feldschlösschen has a sustainability report, reports are typically prepared to meet the requirements of specific stakeholders; therefore, obtaining more detailed information was essential (Amstutz, 2023). The interview was semi-structured, aiming to gain insights into personal perspectives, experiences, and opinions (Busetto et al., 2020). A semi-structured interview is based on an incomplete script. It includes prepared questions, but those are improvised during the interview (Myers & Newman, 2007). A semi-structured interview guide was prepared. The questions were collected, reviewed, refined, and organized to ensure a structured interview process.

The interview was transcribed using the Microsoft Teams transcription function, which can transcribe Swiss German. Subsequently, the transcription was reviewed and refined using ChatGPT to enhance its clarity. Filler words and redundant phrases were removed, the dialect was converted to High German, and linguistic errors were corrected to ensure the interview was comprehensible (Busetto et al., 2020). Furthermore, ChatGPT was used to code the interview and assist in identifying topics, categories, and concepts. Complete sentences were coded within specific subtopics related to circular brewing (Kuckartz & Rädiker, 2024).

Use Case of Feldschlösschen

The interview with the person responsible for sustainability at Feldschlösschen covers the brewery's implementation of circular practices, as well as the opportunities and challenges associated with the use of such practices. Hereby, Feldschlösschen has published sustainability reports since 2014 (Feldschlösschen, 2025b). However, according to the Chief of Technology and Sustainability at Feldschlösschen, the brewery has employed various methods and partnerships since 1975 and has progressively implemented more measures over the years. Their sustainability initiatives encompass multiple areas, though the focus of this chapter is on the implementation of circular measures. To identify these measures, statements from both the sustainability report and the interview are referenced and analyzed in the following.

Feldschlösschen utilizes several by-products of its production for various use cases. Brewer grains, for instance, are repurposed as high-quality raw materials in Switzerland, primarily as animal feed. In 2023, the brewery had 40,000 tons of brewer's grains as a by-product, of which 10,000 tons were used to replace imported animal feed, which is otherwise often transported from overseas (Amstutz, 2023). Ensuring that these materials are utilized without extensive supply chains is crucial for Feldschlösschen. They classify brewer's grains as high-quality products and sell them. Another by-product used by Feldschlösschen is yeast, which is used as animal feed or in the cosmetic industry. Feldschlösschen strives to position yeast as high as possible in the value chain. However, utilizing yeast for human consumption requires stricter hygiene and control mechanisms. Additionally, the alcohol produced as a by-product of non-alcoholic beer production is used to heat up the brewery, accounting for 35.3% of its required fuel energy (Amstutz, 2023).

In the interview, the production of biogas as a circular initiative, derived from wastewater fermentation, was highlighted. Biogas provides 37.2% of the brewery's required fuel energy and is used as heat energy (Amstutz, 2023). Approximately 1.2 million cubic meters of biogas are produced annually. However, the volume has been decreasing due to optimizations in wastewater production, which is preferable, as preventing by-products is more beneficial than reusing them.

Another circular measure is the utilization of waste heat. In the interview, it was explained that waste heat is used in collaboration with the Wärmeverbund Rheinfelden district heating system, which has supplied heat for commercial and residential applications throughout the city since 2014. Additionally, steam released during the wort boiling process is condensed via a turbine and reused. The condensed steam is employed in a heat exchanger to reheat the wort, with the process maintained by a mechanical vapor recompression. Furthermore, wort exiting the brewhouse at approximately 97 °C is cooled through a heat exchange process with cold brewing water. This brewing water is heated during the exchange and is reintegrated into the brewhouse process, effectively recycling thermal energy and reducing overall resource consumption.

The expert at Feldschlösschen emphasizes the importance of bottle recycling and reuse for achieving circularity. However, this process is constrained by bottle wear and tear and infrastructural challenges, such as the availability of reuse systems in gastronomy and supermarkets. Currently, 190 products of Feldschlösschen are sold in reusable packaging. For non-reusable packaging, the brewery uses plastic or aluminum. The plastic used is 100% recyclable, and the aluminum used is 66% (Amstutz, 2023). The Chief of Technology and Sustainability at Feldschlösschen underscores the necessity of political and legal frameworks to establish a comprehensive system for achieving circularity.

Overall, both environmental and economic opportunities in implementing circular brewery systems were identified in the interview. The circular projects implemented at Feldschlösschen do not generate revenues, but they are economically viable. In the interview, Feldschlösschen was considered a pioneer in sustainability issues, as it has implemented measures for many years and is gaining a competitive advantage through sustainable and circular practices. The projects positively influence the company's reputation, garnering substantial positive feedback from customers. The expert at Feldschlösschen advocates for stronger legal and governmental regulations to enhance circularity further in the brewery sector.

Nevertheless, several challenges were acknowledged in the interview. Technical challenges include managing, for example, the wastewater plant, where it is difficult to cope with peak times when very large volumes of wastewater are suddenly produced. Additionally, low temperatures reduce the efficiency of the fermentation process. Realizing large-scale projects entails high costs, as they only pay off over extended periods. Therefore, it is crucial for stakeholders to adopt a long-term perspective and invest sustainably. The Chief of Technology and Sustainability at Feldschlösschen stresses that profitability is a prerequisite for enterprises to implement circular practices. The most significant challenge for Feldschlösschen will be addressing Scope 3 emissions, as substantial measures have already been implemented for Scope 1 and 2, and further progress will become increasingly difficult.

Other Examples of Circular Practices

While Feldschlösschen is a prominent example of circularity in the DACH region, other breweries have also adopted innovative strategies to integrate CE principles into their operations. Notable examples include HopfON, a startup in Munich, Germany; Kronenbourg, an established French brewery; and Heineken France, which has implemented a large-scale circular initiative through its Project Circle. Together, these cases illustrate how both emerging and established actors are addressing the brewing industry's environmental challenges through diverse and impactful circular approaches.

HopfON focuses on addressing the significant waste generated during hop harvesting. For every kilogram of usable hops, approximately 3.5 kg of residual biomass—comprising leaves, spines, and vines—are produced (Dazio, 2024). Typically discarded or posing challenges in disposal, this waste is repurposed by HopfON into sustainable building materials such as acoustic panels and thermal insulation. By converting waste into valuable products, HopfON reduces landfill contributions and decreases demand for conventional construction materials, minimizing its environmental footprint.

Furthermore, HopfON operates a closed-loop system that encourages customers to return used products for recycling into new materials. This approach ensures resource efficiency and demonstrates how breweries can extend their sustainability efforts beyond beer production to encompass their entire value chain (Dazio, 2024).

In contrast to HopfON's startup model, Kronenbourg, with a history dating back to 1664, exemplifies how large-scale breweries can integrate CE principles. Its strategies span by-product valorization, energy transition, sustainable packaging, and public engagement. Kronenbourg has implemented effective strategies for managing by-products from its brewing process. For instance, in 2022, the company repurposed 76,000 tons of BSG as animal feed, supporting local farmers and reducing waste-related emissions (Kronenbourg, 2023). Additionally, 9000 tons of spent yeast were redirected to the French food industry, particularly for bakery applications, illustrating how industrial by-products can be integrated into broader supply chains to enhance resource efficiency (Kronenbourg, 2023).

Kronenbourg has also invested significantly in reducing its carbon footprint, showcasing its commitment to sustainability. A €9 million investment transformed the logistics fleet at its Obernai brewery to fully electric vehicles, thereby improving energy efficiency (Usine Nouvelle, 2023). Additionally, renewable energy and heat recovery systems have been integrated into its operations, further reinforcing the company's dedication to sustainable energy use. While these initiatives align more closely with sustainability than circularity, both approaches share the common goal of reducing environmental impact and promoting resource efficiency.

The company also actively engages the public through initiatives such as the "Recycler c'est gagner" campaign, which promotes recycling awareness during events and festivals. Moreover, its long-term sustainability program, "Ensemble vers un impact zéro," aims for zero carbon emissions, zero water waste, and zero packaging waste. While these goals primarily emphasize sustainability, they complement CE principles by addressing systemic environmental challenges and fostering responsible resource use (Kronenbourg, 2025).

In addition to the initiatives undertaken by breweries such as Kronenbourg and innovative startups like HopfON, Heineken France stands out as another key player in the brewing industry's transition toward circularity and carbon reduction. In partnership with the European LIFE Programme, Heineken France has developed an ambitious CE initiative known as Project Circle. The LIFE Programme, launched by the European Climate, Infrastructure and Environment Executive Agency (CINEA), supports public and private initiatives in the fields of environment and climate action. With a budget of €5.4 billion, it operates through four sub-programs, including Circular Economy and Quality of Life, and aims to foster innovation across the European Union (European Commission, 2025).

Project Circle exemplifies the integration of upcycling and renewable energy production within brewery operations. It focuses primarily on the revalorization of BSG, which constitutes around 20% of the output of beer production and accounts for approximately 85% of total co-products generated by the brewery (Heineken France, n.d.). Through a long-standing partnership with the Duynie Group, Heineken has implemented an innovative mechanical process that is entirely solvent- and chemical-free for separating the proteins and fibers contained in the spent grain. This upcycling approach transforms what was previously treated as waste into high-value inputs for other sectors.

On one side of the process, proteins are refined to retain their properties and improve yield, resulting in a final product concentrated to over 70%, suitable for multiple applications in the agri-food industry. On the other, the fibers are dried and combusted in a dedicated biomass boiler to produce renewable steam energy. This steam not only powers a significant portion of the brewery's energy needs but also supports the internal drying processes for both the fibers and proteins, forming a closed-loop energy system.

A notable advantage of the Circle system lies in the internal revalorization of BSG within the brewery itself. Previously, Heineken sold its spent grain to external buyers, and distribution was carried out via truck transportation, thereby contributing to the brewery's carbon footprint. With Project Circle, not only is the material still revalorized, but it is also done locally, eliminating the need for external transport. This localization significantly enhances the circular nature of the process while reducing associated CO_2 emissions, demonstrating how circularity and carbon efficiency can be mutually reinforcing when integrated into site-level operations.

According to Heineken France, the implementation of Project Circle at its Mons-en-Barœul site has led to an annual saving of approximately 20,000 tons of CO_2 equivalent, factoring in both the site's emissions and the avoided emissions from reduced transportation (Heineken France, n.d.). With its proven impact, Heineken aims to extend the Circle system to six breweries across France by 2027, reflecting a scalable and replicable model of circular innovation within the industry.

In addition to examples from Europe, recent research highlights the growing adoption of CE principles among craft breweries in southern Brazil. According to Julkovski et al., these breweries are increasingly integrating both biological and technical resource loops into their operations, demonstrating how small- and medium-sized enterprises (SMEs) can contribute meaningfully to sustainable transitions in the brewing industry (Julkovski et al., 2024). Among the most common strategies observed is the revalorization of brewing by-products, including malt residues, yeast, and trub, which are often repurposed as animal feed, compost, or incorporated into food products such as bread and cookies. Furthermore, industry initiatives such as those led by the Brewers Association are encouraging microbreweries to adopt practices that reduce water and energy consumption, thereby supporting a sustainable transition. The rise of certifications such as B Corp is also encouraging breweries to rethink their governance and environmental impact, like New Belgium Brewing, a pioneer in renewable energy and responsible packaging management.

Water reuse and closed-loop water systems also feature prominently, with some breweries investing in effluent treatment and water-saving technologies to reduce freshwater consumption—a critical concern in water-intensive processes like beer production. In terms of energy, several breweries have adopted solar panels and low-consumption equipment, contributing to carbon footprint reduction and increased energy self-sufficiency. Additionally, efforts to reuse or recycle packaging, such as glass bottles and biodegradable materials, show alignment with technical cycle strategies, even though challenges remain in scaling such practices.

Notably, innovation plays a central role in these transitions. Breweries identified in the study often pair circular strategies with product and process innovations, including the use of vegan inputs and partnerships with local cooperatives for waste collection and sorting. While some breweries have adopted a more reactive approach, others actively pursue systemic and proactive circular models, positioning themselves as local leaders in sustainability. Overall, the Brazilian craft brewing sector illustrates how CE principles can be successfully localized and adapted, even within smaller-scale, resource-limited contexts (Julkovski et al., 2024).

It is evident that, also in the DACH region, an increasing number of brewing companies are implementing circular measures within their operations. Extensive research has identified numerous examples of such implementations, with breweries integrating circularity in diverse ways. For instance, Bitburger repurposes brewer's grains as animal feed (Bitburger Braugruppe, 2025), while Gruibinger Bier (2025) and Orca Brau incorporate surplus bread from bakeries as an ingredient in their beer (Karmann, 2021). Additionally, Schweiger Bräu utilizes its wastewater for heat and electricity generation (Domke, 2022). Numerous other cases demonstrate the adoption of at least one circular principle within brewing companies.

Discussion

As demonstrated by the practical examples, the brewing industry has already implemented many circularity practices identified in the literature research. Feldschlösschen, in particular, has incorporated numerous circular measures identified in the literature review within the company. Most methods for implementing circularity in the brewing industry are used in some way at Feldschlösschen. The company can be regarded as a pioneer, having implemented several measures over many years and made long-term investments. However, it is important to note that both the interview and the sustainability report are subjective and likely aim to enhance Feldschlösschen's reputation. Statements should be critically assessed, and areas for improvement must be identified. Feldschlösschen is focusing on all aspects: reputation, economic benefits, and sustainability. The company's overall strategy does not seem to focus on becoming a circular business but rather on maintaining profitability. In the interview, it is highlighted that some measures are implemented for reputational benefits. Long-term investments also have to impact future revenue streams. There is still room for improvement in terms of circularity. While many measures are already implemented, the expert at Feldschlösschen acknowledged potential advancements, particularly concerning Scope 3 emissions and in increasing the utilization of by-products, wastewater, and waste heat. Some methods discussed in the literature, such as using methane for electricity and heat generation or collaborating with stakeholders to repurpose materials like stale bread instead of malted grains, have not been implemented (Pasquet et al., 2024), but sometimes new other innovative principles are used.

Examples from HopfON, Kronenbourg, and Heineken France highlight the brewing industry's overall potential to effectively integrate CE principles. HopfON illustrates innovative, small-scale approaches, such as repurposing hop waste and establishing closed-loop systems (HopfON, 2025). In contrast, Kronenbourg demonstrates how large, established breweries can combine industrial innovation, community collaboration, and public engagement to reduce their environmental impact (Kronenbourg, 2025). Similarly, Heineken France exemplifies how circularity can be embedded within large-scale operations through technological innovation, local revalorization of by-products, and renewable energy integration, all of which contribute significantly to emissions reduction and circular resource use (Heineken France, n.d.).

While the brewing industry has made notable progress in integrating CE principles, there are still several untapped opportunities. For example, advanced valorization of brewery by-products by recovering various compounds such as lipids, proteins, carbohydrates, lignin, and related bioactive compounds and their further reuse in the food and biotechnology sectors (Pasquet et al., 2024). In addition to by-product utilization, breweries can explore alternative raw materials to reduce their environmental footprint, like the use of food waste, such as stale bread, as an alternative to malted barley (Pasquet et al., 2024), an approach that has already been implemented by some of the companies discussed earlier. Another key factor in the brewing industry's transition to circularity is related to energy consumption. While breweries have increasingly adopted biogas and solar energy, broader integration of renewable technologies could further reduce dependence on fossil fuels (Pasquet et al., 2024) & (Cimini & Moresi, 2021). In addition, reducing the energy required by using innovative methods, such as heat exchangers and generally minimizing heat losses, would be beneficial to reduce the energy required (Ortiz et al., 2019). Furthermore, breweries consume significant amounts of water, yet current efforts to recycle wastewater remain limited. Moving to a circular approach, where all wastewater is treated and reused, could significantly reduce water consumption (Pasquet et al., 2024). Another key area for circularity improvement in the brewing sector is the improvement of reusable packaging through maximum reuse, as well as packaging weight reduction and logistics innovations (Cimini & Moresi, 2021). Addressing these opportunities could further improve sustainability, reduce waste, and create new revenue streams for breweries.

However, there are several potential challenges to the application of circular strategies. While several studies have indicated the potential use of brewery waste products, the majority of these studies have been conducted at the laboratory scale, and there is a lack of cost-benefit or market analysis and industrial trials (Cimini & Moresi, 2021). A further factor that must be considered is the consumer acceptance of the solutions proposed, which plays a crucial role in determining their overall acceptance (Duong & Saphores, 2015). In addition to the challenges mentioned, there are technical issues to be addressed. For instance, the high moisture content of the by-products gives rise to microbiological risks and requires additional processing steps, such as drying. This challenges the economic feasibility (Cimini & Moresi, 2021). A study by Ortiz et al. (2019) demonstrated that not all solutions are appropriate for small breweries, as they are neither energetically nor economically profitable. Therefore, it can be concluded that there is no universal solution applicable to all breweries, since the selection of an appropriate solution is contingent upon factors including the size of the brewery in question and its economic background (Pasquet et al., 2024).

One other key reason why companies are reluctant to transition toward circular business models (CBMs) is the lack of a strong legal framework that encourages or mandates circular practices. Currently, there are no binding regulations or sufficient incentives that push businesses to reduce their environmental impact or adopt circularity (Assmann et al., 2023). Without such external pressure, most companies continue operating within linear models, as they are already optimized for cost efficiency and short-term profitability.

Another significant barrier is the perception gap among managers. While CBMs offer benefits such as cost savings through resource efficiency, increased supply chain resilience, and improved market differentiation, these advantages are often poorly understood or undervalued by decision-makers. Companies may also fear the risk of cannibalization, where longer-lasting products reduce sales volume, impacting profitability in traditional models (Assmann et al., 2023). Furthermore, the financial and operational costs of transitioning are high. Implementing a CBM requires substantial upfront investments, new technologies, and a restructuring of supply chains. The complexity of this shift, combined with uncertainties in taxation policies, customer acceptance, and supply chain adaptation, makes companies hesitant (Assmann et al., 2023). Even if regulation were introduced, companies would still need a clear roadmap, financial support, and collaboration with supply chain partners to make the transition feasible. However, as seen in the Swiss referendum on February 9, 2025 (Tombez, 2025), both businesses and the public remain cautious about committing to CE policies, further delaying widespread adoption (Assmann et al., 2023). Without stronger political will, regulatory support, and awareness-building, CBM adoption will likely continue to progress slowly. As the industry partly transitions from linear to circular models, challenges such as economic feasibility, regulatory barriers, and consumer acceptance must be addressed.

Another important aspect of this is artificial intelligence (AI), which plays a fundamental role in enabling the transition toward a CE by optimizing resource use, enhancing decision-making, and transforming business models. AI-powered tools such as machine learning, deep learning, and predictive analytics help optimize material flows, improve waste management, and support sustainable supply chains (Madanaguli et al., 2024). AI enhances CBMs through four key capabilities: integrated intelligence, for example, by using real-time data analysis for decision-making, process automation, for example, by reducing waste through predictive maintenance, AI infrastructure and platforms, for example, by supporting circular supply chains, and ecosystem orchestration by facilitating collaboration among stakeholders (Madanaguli et al., 2024).

Additionally, AI facilitates CE by supporting system optimization, redesigning business models, and fostering ecosystem innovation (Tutore et al., 2024). Using the ReSOLVE framework (Regenerate, Share, Optimize, Loop, Virtualize, and Exchange), AI enables companies to design circular strategies that extend product life cycles, enhance resource efficiency, and develop digital solutions to replace physical products (Tutore et al., 2024). By leveraging AI, businesses can transition from linear to circular models more efficiently, reducing environmental impact while maintaining profitability. However, successful adoption requires investments in AI infrastructure and regulatory support to overcome current implementation challenges (Madanaguli et al., 2024; Tutore et al., 2024).

Nonetheless, adopting circular practices will be essential for achieving sustainability goals and ensuring the long-term viability of beer production. While the brewing industry has already integrated many circular practices identified in the literature, there remains significant room for improvement. A full transition to a CBM, rather than simply incorporating circular elements, will be key to maximizing sustainability impact. Whether through the adoption of advanced technologies such as AI or the implementation of robust legal frameworks, there is immense potential to transform our current economic models. By leveraging these innovations and regulatory measures, industries can accelerate the shift toward a truly CE, fostering both environmental and economic resilience.

Conclusion and Outlook

At the outset of this chapter, skepticism regarding the brewing industry's compatibility with the principles of a CE was prevalent. A more detailed analysis revealed significant potential for circularity within this sector. However, it should be noted that only some breweries were analyzed in detail, which limits the results of this paper.

The industry heavily relies on numerous components essential for beer production, many of which are discarded despite retaining considerable value. This observation underscores a substantial opportunity for the sector to position itself as a pioneer in the revalorization of by-products. By revalorizing by-products such as BSG and BSY for animal feed, bioenergy, and food production, the brewing industry is implementing circular practices. Innovative approaches include wastewater recycling for agriculture, methane production for energy, and sustainable packaging solutions such as reusable bottles and kegs. These practices align with theoretical principles of the CE, such as the 9-R strategies (e.g., reuse, recycle, and repurpose), and emphasize minimizing waste, optimizing resource use, and regenerating natural ecosystems.

This model of circularity goes far beyond traditional views by promoting a systematic transformation of production processes. It emphasizes waste reduction and resource optimization while fostering sustainable economic growth. The findings highlight that circular innovation has the potential to enhance competitiveness and stimulate development within the brewing sector. While the brewing industry has made considerable progress in adopting CE principles, significant untapped opportunities remain. Challenges such as scalability, financial barriers, and regulatory constraints highlight that it requires further alignment and development to fully realize the potential of circular practices.

Furthermore, the CE extends beyond environmental commitments, offering practical solutions to pressing climate and economic challenges. By revalorizing underutilized resources and rethinking industrial processes, this model significantly reduces emissions while providing viable solutions to contemporary economic issues. The insights emphasize the necessity of promoting CE principles across various sectors, including brewing, to unlock their potential for achieving a sustainable and resilient future.

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Chapter 5
Overcoming Barriers: How Information Gaps Hinder Recycling and Circularity

Barbara Eisenbart and Josua Käser

Abstract Moving from a linear to a circular economy supports sustainable material use through recycling and other measures. However, information gaps act as a barrier to effective waste and recycling implementation. This chapter examines different information gaps and their impact on circular economy practices in the construction industry, with a focus on plastic roof membranes.

This study employs the design science research methodology. To identify barriers, seven interviews and a workshop were conducted at an international roof system company headquartered in Switzerland. This chapter uses theories on information gaps to analyze barriers to recycling and the significant challenges associated with their practical implementation. It explores how different information gaps hinder collaboration between different stakeholders in the construction industry.

The study identifies various information gaps in the three interrelated areas: material composition, process flows, and stakeholders. It also categorizes key stakeholders into three relevant groups: manufacturing and production, construction and demolition, and waste management and recycling. A key finding is that the existing literature lacks details on the concrete challenges and problems that stakeholders face in practice. A detailed understanding of information gaps highlights the complexity of the recycling process and encourages recycling implementation. By addressing these gaps, businesses can better align sustainability goals with practical challenges.

The study bridges the gap between business challenges and sustainability goals. Closing information gaps in material composition helps identify diverse types of waste, enabling tailored disposal or recycling strategies. Improved process flows reveal inefficiencies and enable targeted improvements. Stakeholder engagement

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ensures collaboration, which is essential for waste management efforts. While the findings focus on the construction industry, the approach can inspire similar efforts in other industries, driving the transition to a circular economy.

Keywords Circular economy · Information gaps · Stakeholders · Implementing recycling

Introduction

With 37% of global emissions (UNEP, 2023), the construction industry is one of the largest greenhouse gas emitters, generating waste from materials and demolition (Giorgi et al., 2022). The production and use of natural materials such as cement, steel, aluminum, and plastic have a significant carbon footprint due to the industry's adherence to a linear economy model. In this model, products are manufactured, utilized, and eventually disposed of, requiring continuous raw material extraction to produce new items.

In recent years, there has been a shift from this "take-make-dispose" linear approach to a "closed loop" circular value chain and "cradle-to-cradle" strategies, where "valuable resources" (Guldmann, 2017) are kept longer in the loop to maintain their value (Ellen MacArthur Foundation, 2013) through reuse, recycle, and, finally, disposal (Benachio et al., 2020). With natural resource scarcity becoming increasingly apparent, the circular economy paradigm can minimize waste and reduce demand for raw materials (Benachio et al., 2020), leading to reduced environmental impacts and enhanced resource efficiency (Geissdoerfer et al., 2017). Various sustainable business models, such as refurbishment, remanufacturing, reuse, and recycling, have been developed to support this transition (OECD, 2022; Lüdeke-Freund et al., 2019; Reim et al., 2021). Additionally, as the European Union enforces Extended Producer Responsibility (EPR), producers are increasingly accountable for their products across their entire lifecycle, including post-consumer waste (OECD, 2022; Jonker et al., 2022). The construction industry is pressured to decarbonize building materials through three strategies: "1. Avoid unnecessary extraction and production, 2. Shift to regenerative materials, and 3. Improve decarbonization of conventional materials" (UNEP, 2023).

This chapter addresses the third UNEP strategy, "improving decarbonization of conventional material" (UNEP, 2023), in the context of industrial buildings, particularly those with a history of material composition. It studies the "Extended Producer Responsibility" (OECD, 2022) for construction material producers in Switzerland, specifically examining plastic roof membranes and their waste collection stage.

Information gaps in waste collection within the construction industry can present critical challenges that hinder effective waste management practices. Information gaps refer to crucial or necessary information that is lacking, incomplete, insufficient, or inadequately shared among stakeholders (Kee & Fu, 2024). These gaps lead to misunderstandings of the circular economy and a lack of action and failure to implement circular principles (Brunner and Rechberger, 2016; De Angelis et al., 2018; Ghisellini et al., 2018; Reim et al., 2021; Silva de Souza Lima Cano et al., 2022; Takacs et al., 2022; Terzi et al., 2010). To address these challenges, this study investigated three key pillars—material composition, process flows, and stakeholders' involvement. Addressing these pillars is fundamental for reducing uncertainty in the decision-making process at the end-of life stage of high-value materials. For example, determining whether to collect plastic roof membranes from existing buildings for recycling (high quality, circular economy strategy) or discard them as waste (low quality) (Byers et al., 2024) is a key challenge.

Business Relevance

The construction industry is a major global waste producer, and in recent years, it has increasingly shifted toward a Circular Economy model. Despite its potential benefits, businesses continue to face significant challenges in the practical implementation of recycling. For instance, only 9% of plastic waste is recycled globally, underscoring the need for improved recycling practices (see Fig. 5.1 for more details). Most plastic waste is landfilled, while 22% is mismanaged (OECD, 2022).

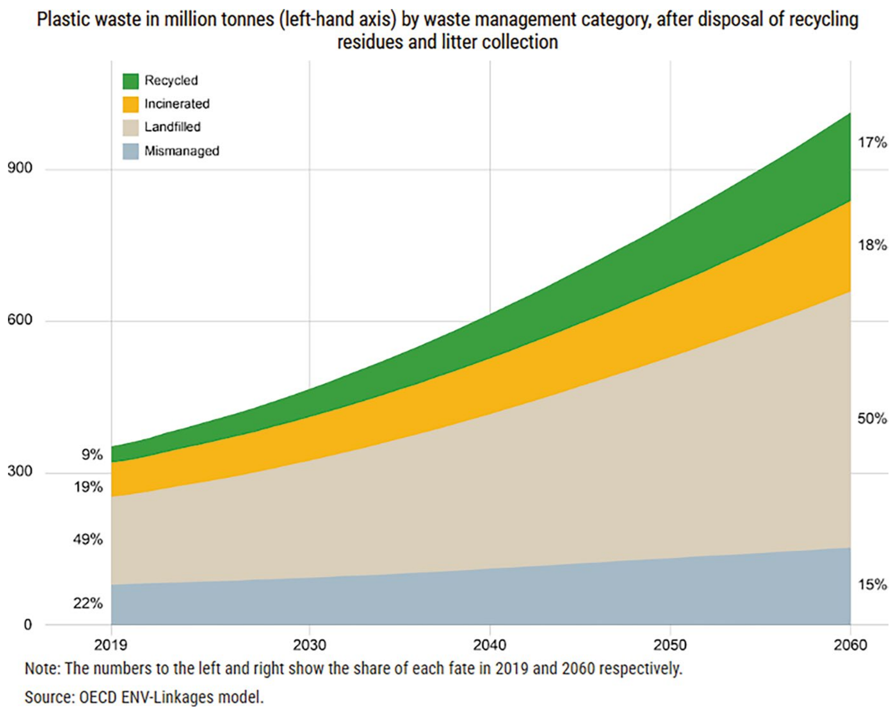

Fig. 5.1 Plastic waste prediction. Source: OECD (2022)

For example, in Switzerland, 80% of plastics are still incinerated (Bundesamt für Umwelt, 2025).

Effective waste collection plays a crucial role in materials being successfully recycled. If materials are misidentified or not properly segregated, they are often disposed of in landfills or burned, instead of being recycled. The complex information requirements of the recycling process can create barriers and hinder progress.

The low recycling rates of materials such as plastic highlight the slow progress and complexity involved in recycling implementation, emphasizing the need for further research. Furthermore, there is growing pressure for global legislation to encourage the plastic industry toward circular economy practices, with more regulations anticipated in the future.

This chapter focuses on identifying and tackling the key information gaps between different stakeholders in the construction industry. It explores how information gaps can be overcome. The goal is to enhance effective collaboration within a circular system through increased information sharing and transparency (Daaboul et al., 2016), ultimately bridging the gap between business challenges and sustainability goals.

Key Concepts and Theoretical Relevance

The circular economy adoption model introduced by Hossain et al. (2020) provides a framework for implementing a circular economy in the construction industry. To thoroughly explore this model, it is helpful to categorize its components into three distinct yet interconnected areas: material composition, process flows, and stakeholders (Hossain et al., 2020). Each category is vital for forming a complete circular economy framework. The material compositions dictate what can be recycled and reused. Process flows determine how these materials are handled throughout their lifecycle. Stakeholders influence every stage of this process through their decisions and actions.

Material Composition

This study concentrates explicitly on thermoplastic materials and explores how various components within thermoplastic roofing sheets complicate the waste collection stage. Understanding the material composition, we argue, is essential for assessing the recyclability and sustainability of these products.

A protective membrane is applied to roofing systems to protect them from weather conditions such as sunlight, rain, wind, or snow. In Switzerland, membranes are usually incinerated at their end of life. Historically, roofing relied on bitumen and coal tar for protection. However, since the 1960s, plastic roof membranes, such as polyvinyl chloride (PVC), thermoplastic olefin, and ketone ethylene ester, have been successfully introduced and have since become integral to the roofing industry (Agarwal & Gupta, 2017). Single-ply roofing membranes typically include a reinforcing layer of materials such as short-glass fiber mats, polyester scrims, or nonwoven polyester mats (Paroli et al., 1999). In the context of waste management and recycling planning, it is essential to consider that the membranes include these distinct reinforcing layers that introduce complexities in material separation and recycling processes.

In Switzerland, roof membranes are typically either asphalt-based or polymer-based. Polymer-based membranes can be categorized into thermoplastics or thermoset materials (Agarwal & Gupta, 2017). For a successful adoption of circular economy models, the construction industry requires information about material composition to enhance recycling efficiency (see Fig. 5.2).

Process Flows

This concept represents the flow of activities and procedures involved in the waste collection phase within the construction industry. The collection phase, as defined in this study, commences after the end-of-life phase with the segregation of waste materials at construction sites or designated collection points. The collection phase concludes when the gathered waste materials are securely loaded and transported to their designated destinations. This might include recycling facilities, where recyclable materials are processed, or disposal sites, such as landfills or incineration plants for non-recyclable waste.

Ruiz et al. (2020) describe five stages of the circular economy in the construction and demolition sector. This chapter specifically focuses on the collection process, which can further be divided into handling techniques, segregation, and transportation. In Switzerland, plastic roof membranes are currently not recognized by recycling companies, meaning that they are sorted on-site rather than at off-site plants (Bovea & Powell, 2016). Few specialized recycling companies are currently able to mechanically recycle membranes, and chemical recycling is still in development.

Improving and sharing information on the efficiency and sustainability of these process flows is critical for advancing the circular economy, as it determines how resources are utilized and conserved.

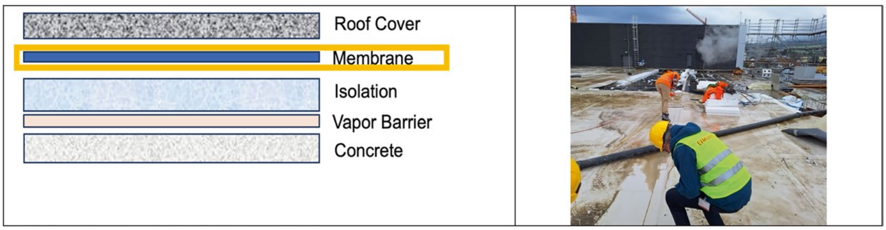

Fig. 5.2 A typical industrial flat roof. Source: Own illustration, own picture

Stakeholders

Stakeholders refer to any entity, human or non-human, that plays an active role in the network. Hsu et al. (2022) listed stakeholders in the plastic waste collection phase without a specific focus on one industry. Studies by Hossain et al. (2020) and Giorgi et al. (2022) on the circular economy in the construction industry show that information gaps, uninformed decisions, and reduced interaction between stakeholders hinder the implementation of the circular paradigm.

Research Gap on Information Gaps

While much of the recent literature focuses on the transition to a more circular paradigm, there is a need for granular insights into the practical implementation of circular strategies (Byers, B. et al., 2024; Pietrulla, F. & Frankenberger, K., 2022). Studies on the construction industry have classified information acquisition for reuse and documented examples of material reuse in buildings (Byers, B. et al., 2024). They highlight the complexity of implementing material reuse in existing buildings and the need for further studies to understand how information gaps can be overcome through in-depth analysis. Data gaps exist across a construction project's lifecycle, including the end-of-life recycling phase. To bridge these gaps, further research should explore information along the recycling value chain and improve collaboration to help manufacturers and recyclers reach new and effective circular solutions (Azizi et al., 2023).

Methodology to Explore the Topic

Research Design

This study used the design science research (DSR) methodology to explore data exchange and decision-making among key stakeholders in the production and recycling value chain. DSR is a problem-solving paradigm that seeks to enhance human knowledge via the creation of innovative artifacts (vom Brocke et al., 2020) in the information system research cycle (Hevner & Chatterjee, 2010).

The collection and analysis of data will follow the four phases of the DSR methodology: awareness, suggestion, development, and feedback and evaluation (Hevner & Chatterjee, 2010). The primary methods of data collection include relevant literature, two rounds of interviews with stakeholders (n = 7). Throughout the first round of interviews, data were collected to identify challenges and suggest strategies and solutions to overcome information gaps. Based on these insights, an artifact was created in the form of a prototype digital management system, which was then tested and refined through feedback received in the second round of interviews and a workshop with Swiss industry experts.

The goal was to identify key concepts of information gaps in the construction industry and compare the results with findings from the literature to create the prototype digital management system to address these gaps. For the purposes of this chapter, we focus solely on phases 1 and 2 of the DSR methodology with the first round of interviews and will not address the artifact with the second round of interviews and workshop (phases 3 and 4).

Data Collection and Analysis

In the awareness phase, information gaps in the waste collection phase were identified from the literature. During the suggestion phase, semi-structured interviews were conducted with experts in waste collection (n = 4) to get an overview of existing solutions for information on material composition. These interviews involved key stakeholders within the network of a Swiss multinational manufacturing company specializing in plastic roof membranes, listed on the stock market and employing over 30,000 people worldwide.

Interviews were conducted only in Switzerland. Most of the interviews were with the manufacturing company in various hierarchies and functions, such as R&D Lead Sustainability, R&D Recycling Process Responsible, Sales Representative, and Application Trainer, to get an overview of recycling activities. Other interview partners included roofing specialists partners such as CEOs of roofing companies to get an insight into motivation to recycle and a recycling project manager of a construction services company for an overview of recycling projects. Considering multiple perspectives from different hierarchies and roles provided insights into how role and power influence viewpoints.

The interviews, lasting between 30 and 40 min, were audio-recorded and transcribed. The questions focused on several key topics, including the main motivation for recycling roof membrane, the impact of recycling on the CO_2 emissions within the company's broader context, challenges in information data collection at products' end of life, roof owners' access to roofs, challenges in identifying roofs available for recycling, and understanding which materials are recyclable. Other topics included current viable solutions, their effectiveness and limitations, and potential applications for enhancing data collection and tracking during the waste collection phase.

The data analysis involved handling audio recordings and field notes, transcription, and coding using the Atlas.ti software based on the methodology of Mayring (2000). The qualitative analysis organized data into stakeholder groups to identify patterns, themes, inconsistencies, and outliers. A cross-analysis compared the literature with interview findings, identifying information gaps hindering recycling and possible sustainable practices.

Results

Information Gaps in Recycling

Based on the existing scholarly literature, the awareness phase identified various information gaps in recycling, with the most common illustrated in Fig. 5.3, grouped by the three pillars of this study: material composition, process flows, and stakeholders (Hossain et al., 2020).

Material Composition Scholars have identified several common information gaps in the construction and recycling sectors. These include: (1) unclear labeling, which complicates the segregation process and effective waste management (Hsu et al., 2022), (2) missing information on material composition and quantities (Ghisellini et al., 2018) due to the complexity and variability encompassing heterogeneous materials such as concrete, wood, metals, plastics, and insulation materials that are often interwoven, and (3) insufficient material tracking for waste collection, with data tracking adding significant effort along the value chain (Hsu et al., 2022; Rumetshofer & Fischer, 2023). Furthermore, previous use of toxic materials like PVC with specific polymer additives adds complexity to recycling efforts (Lewandowski & Skórczewska, 2022).

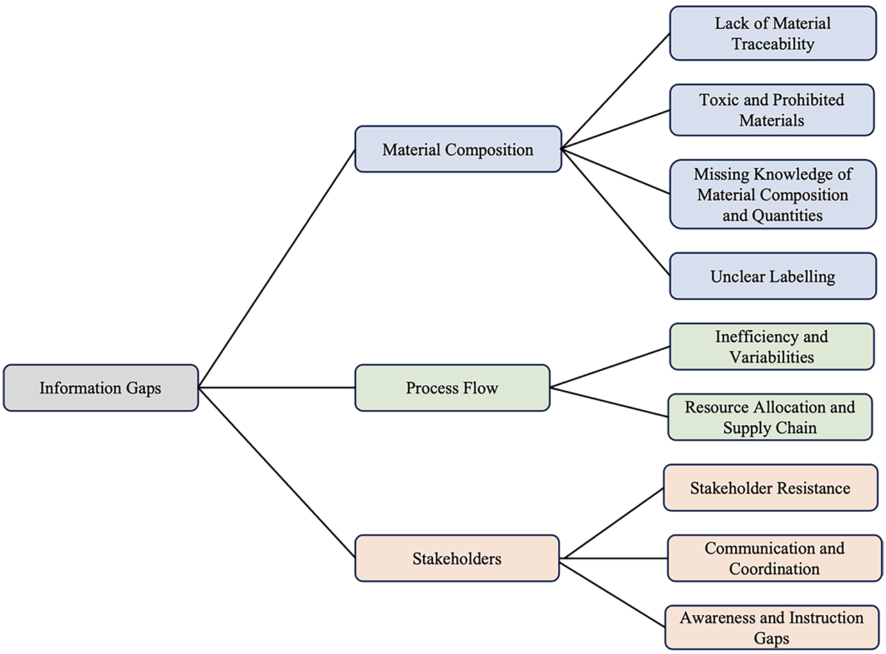

Fig. 5.3 Information gaps in recycling. Source: Own

Process Flows Identified gaps include inefficiency and variabilities resulting from the limited consideration of process variations due to the different types of buildings, quantities, and waste streams (Banias et al., 2011). A major issue in waste disposal is the lack of knowledge on sorting different materials (Ghisellini et al., 2018; Huang et al., 2018). Additionally, missing concepts on separating heterogeneous materials pose a challenge for recycling (Ghisellini et al., 2018). Other challenges include resource allocation and supply chain issues, such as the unstable and insufficient supply of recovered material (López Ruiz et al., 2020).

Stakeholders Several information gaps exist in the literature regarding stakeholders in the construction and recycling industries. These include a lack of awareness on the environmental costs of waste management (López Ruiz et al., 2020), instruction gaps that lead to limited workforce training on material handling in recycling (Jin et al., 2017; Maerckx et al., 2019), and stakeholder resistance due to the absence of incentives for adopting sustainable practices (Gálvez-Martos et al., 2018). Limited communication and coordination are reflected in their complex decision-making processes, and varied responsibilities complicate the implementation of standardized practices (Gálvez-Martos et al., 2018). A lack of communication with clients, designers, and subcontractors further exacerbates these issues (Hossain et al., 2020).

Key Insights from Interviews with Stakeholders

According to Ruiz et al. (2020), five lifecycle stages can be identified in the construction industry from preconstruction, construction and building renovation, collection and contribution after demolition, end of life, and possibly material recovery and production. The study shed further light on the role of main stakeholders involved in the lifecycle stage of the construction and recycling industries, focusing on stakeholders from three areas: manufacturing and production, construction and demolition, and waste management and recycling (see green colored box in Fig. 5.4). They play vital roles in determining how materials are handled from the production stage to their eventual disposal or recycling, with collaboration between the different stakeholders.

This study focused on stakeholders from three areas: manufacturing and production, construction and demolition, and waste management and recycling. They play vital roles in determining how materials are handled from the production stage to their eventual disposal or recycling, and their collaboration and communication are crucial for overcoming information gaps. Table 5.1 details each group and categorizes their roles and interactions.

Manufacturing This group includes construction workers and roofing companies. Construction workers, who handle plastic roof membranes from installation to disassembly, offer valuable insights into waste collection challenges and recycling

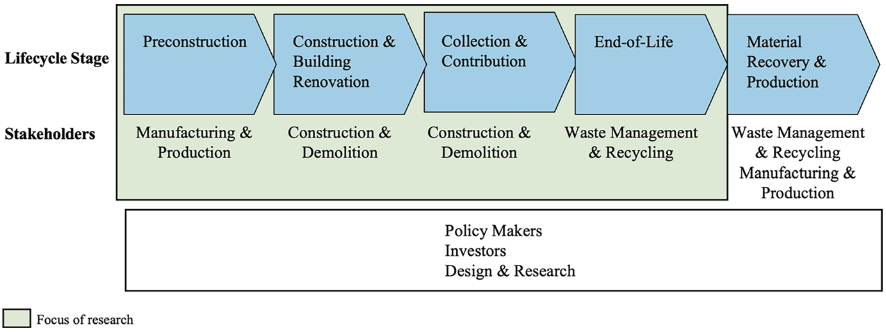

Fig. 5.4 Lifecycle stages and stakeholders in construction industry. Source: Own, based on Ruiz et al. (2020)

feasibility. An interview with an application instructor provides insights into the daily struggles of applications. Specialized roofing companies are involved in removing or refurbishing roofs and the complexity of sorting roofing materials for recycling, and provide valuable expertise on membrane installation, maintenance, and removal. A roof company owner was interviewed to understand their motivation for collecting used plastic roof membranes.

Construction and Demolition and Waste Management and Recycling These stakeholders manage the post-use phase of materials. Construction companies recycle based on personal motivation, regulatory pressure, and environmental consciousness (Jain et al., 2020). Specialized construction recycling companies manage demolition waste, including transportation and recycling. For their decision on demolition waste management, see Van der Berg (2023). As owners or project managers from demolition or recycling companies decide whether a membrane is recycled or burnt, they were also interviewed to collect their insights.

Other relevant stakeholders for improving information exchange were identified across key groups: policymakers, investors, design and research, as well as stakeholders pertaining to supply chain and distribution, manufacturing and production, construction and demolition, and waste management and recycling (see Fig. 5.4).

Mapping the different stakeholders as actors in the lifecycle stage helps to identify suitable interview partners and ask the right questions about the three layers of analysis of material composition, process flows, and stakeholders connected to the information gaps. Based on the interviews we conducted, different categories were identified for overcoming information gaps. Information gaps categories include must-have as well as should-have criteria; for more information details, see Fig. 5.6. Must-have criteria of information were identified mainly for material composition and process flow.

Based on the identified information gaps, the following elements must be addressed:

Table 5.1 Key stakeholders involved in this study. Source: Own analysis

Areas	Key stakeholders and authors	Role	Interactions
Manufacturing and production	Manufacturers (Hossain et al., 2020; Hsu et al., 2022; Giorgi et al., 2022) Owners (Hsu et al., 2022)	Manufacturers create the materials fundamental to the construction industry. Their focus on recyclability can drastically improve the outcomes of waste collection. Brand owners can drive the demand for sustainable materials by choosing those that are more easily recycled	These businesses produce and sell roofing sheets to roofing or general construction companies. Create materials fundamental to construction through a production process, focusing on recyclability and improving waste collection outcomes. The type of products they make is influenced by the rules set by policymakers and investors' investment priorities. The financial sector of banks can drive innovation in waste collection by funding sustainable construction projects and technologies
Construction and demolition	Construction companies (Giorgi et al., 2022) Demolishers (Giorgi et al., 2022)	These stakeholders are critical in the initial and final stages of a building's life. Their commitment to responsible waste collection and sorting can greatly enhance the recycling of construction materials, thereby contributing to the reduction of construction-related waste	These firms tear down buildings and manage construction waste. Regulations regarding safe demolition practices and waste disposal influence them. Critical in the building's final stage, responsible waste collection and sorting enhance the recycling of materials
Waste management and recycling	Recycler (Hossain et al., 2020) Physical recycler (Hsu et al., 2022) Chemical recycler (Hsu et al., 2022) Waste management companies (Hsu et al., 2022; Giorgi et al., 2022)	These stakeholders are essential in processing and repurposing construction waste. They have the technology and expertise to convert waste into valuable resources, thus directly reducing the environmental impact of construction	They process and repurpose construction waste, directly reducing the environmental impact of construction

- **Material Traceability**: Full traceability of materials from end of life to reuse is crucial for compliance and efficient management. Ensuring traceability among partners is essential for the value chain of the plastics industry.
- **Toxic and Prohibited Materials**: Identifying toxic and prohibited materials before recycling is mandatory to meet regulations.

Additionally, the following elements should *be* addressed as well:

- **Resource Allocation and Supply Chain**: Implementing an efficient management system can minimize resource demands and improve coordination. Collaborative tools among various stakeholders could promote a circular economy in the construction sector.
- **Stakeholder Resistance**: Addressing stakeholder resistance is crucial, as it is one of the biggest barriers to implementing a recycling process. Collaboration among different stakeholders is necessary for successful recycling initiatives.
- **Communication and Coordination**: Communication and coordination need to be facilitated between different stakeholders to increase productivity and streamline the recycling process.

Comparing Literature Results with Interview Insights

This section describes the differences between existing literature and empirical findings from interviews. While literature provides a broad framework, it often overlooks the practical challenges faced by stakeholders in real-world recycling processes.

Material Composition

Lack of Material Traceability Hsu et al. (2022) highlight the lack of practical advancements in material tracking for waste collection practices. Rumetshofer and Fischer (2023) further emphasize that data tracking of materials leads to additional effort along the value chain, complicating the process and adding to the bureaucratic burden. Practitioners in the field confirm the observations made in the literature. The bureaucratic burden identified is confirmed by demolition and recycling companies, which report that the extensive data tracking requirements can limit the quality of the data collected. While the literature identifies the need for advanced material tracking systems, the sentiment on the ground shows that these systems are not only lacking but also require substantial effort and resources to be implemented effectively.

Toxic and Prohibited Materials The literature identifies the challenges with recycling toxic and prohibited materials, particularly PVC, due to strict regulations. The interviews with industry professionals confirm these issues. A manufacturing company highlights the difficulties in PVC recycling due to forbidden substances per guidelines and notes that while compliance with these regulations is essential, it adds significant complexity to the recycling process as the regulatory framework changes over the years. According to the current framework, roof membranes that were compliant at the point of production now contain forbidden substances. These substances need to be removed to recycle roof membranes, which does not allow for a physical recycling process but requires a chemical process.

Lack of Specialized Knowledge on Materials The skill gap on the construction site has been identified as one of the key barriers to material identification (Jin et al., 2017; Maerckx et al., 2019). Research mainly focuses on off-site sorting techniques; however, on-site sorting is required for streamlined processes. For on-site sorting, different devices are described, such as infrared spectroscopy, but results from the sentiment on the construction site show that these devices seem to be too unreliable to be of practical use. Different devices are also needed for different materials, which further complicates the material identification.

Unclear Labeling Hsu et al. (2022) identify that missing labels complicate the segregation process, a point further compounded by Arbeláez-Estrada et al. (2023), who note the added complexity of uncontrolled dirt affecting identification. Interviews confirm these claims and expand on them, highlighting that different materials often share the same color coding and that the production ID of the membrane, essential for linking to the material, is not always present at construction sites.

Process Flow

Inefficiencies and Variability in the Process Flow Supply challenges and the different processes that are followed for different waste streams are largely described in the literature (Gálvez-Martos et al., 2018; Hsu et al., 2022; Ruiz et al., 2020; Banias et al., 2011). The interviews provided further insights into the inefficiencies and variabilities. Current processes vary based on the location of the roof. In industrial areas, there is usually enough space to store containers, and roof sizes are larger, therefore allowing a more efficient process. In residential areas, the space can be scarcer, and roof sizes can be smaller. Also, there are different types of roof coverage, whether it is a naked flat roof, a gravel roof, or a green roof. Production numbers of the rooftop material can sometimes not be identified, which obstructs sorting for recycling. These inefficiencies during recycling occur, such as the contamination and mixing of plastics described as consistent challenges in the literature (Ghisellini et al., 2018). According to the interviews, the type of containers used also influences the behavior of the construction workers. For example, if large containers are used to collect roof membranes, contamination with other plastics seems to be more likely, as large containers are usually used for mixed garbage, whereas palettes promise less contamination as they are used to collect specific materials.

Resource Allocation and Supply Chain Challenges Literature such as Milios et al.'s (2018) work acknowledges the need for additional coordination for recycling prompts; this need is also highlighted by the manufacturing company, which even plans to create new positions dedicated to recycling. Unsecured materials are generally described as safety hazards (Martinez et al., 2020). The interviews applied this knowledge to roofs and identified a safety hazard due to wind that can blow away unsecured roof membranes. The literature also describes insufficient recovered materials (Ruiz et al., 2020). This is confirmed by the interviews, which also add that the recycling companies have limited resources, which forces manufacturing companies to work with several partners for the recycling process.

Stakeholders

Stakeholder Resistance The absence of incentives to recycle is identified as a significant barrier to recycling practices (Gálvez-Martos et al., 2018); the empirical results of this study identify two different groups with different incentives to recycle: the manufacturing companies that see the cost advantage of virgin materials versus the secondary materials, and the waste collectors that have to invest more time in the tedious recycling process. Motivation of recyclers focuses on cost and time without conscious decisions between different waste management strategies (such as reuse, recycle, and recover) by evaluating their impacts in terms of technical feasibility, economic costs, environmental gain, and social gain (Van der Berg et al., 2023).

Communication and Coordination The lack of communication and coordination tools described in the literature (Hossain et al., 2020; Borner & Eisenbart 2024) poses a challenge to the different stakeholders interviewed. They currently mostly communicate by email and phone, which may work for small quantities of recycling materials but is not sustainable for larger quantities.

Awareness and Instruction Gaps Ruiz et al. (2020) highlight the general lack of awareness regarding the environmental costs of waste management, a problem that extends to the roofing industry. This lack of awareness begins with the selection of roofing products, such as bituminous or plastic roof membranes. End clients often overlook the environmental benefits of choosing recyclable materials. Reasons might be that the replacement offer describes the roof cover but not as detailed as the membrane used, clients do not do a cost–benefit analysis of perceived benefits and costs or do not have sufficient information or perceived control to make rational choices.

Discussion, Conclusion, and Further Research

Comparing insights from the interviews with literature in material composition, process flow, and stakeholders reveals multiple interests and boundaries. Overcoming information gaps is complex due to the different roles, priorities, and sometimes conflicting interests among stakeholders. These gaps directly impact decision-making, particularly for the three key stakeholder groups: manufacturers (production), roofing companies (installation), and demolition and recycling firms. This study focuses on recycling plastic roof membranes, where manufacturers are the most feasible entities to introduce a recycling system. However, these companies typically specialize in specific roofing products, such as membranes, and do not offer a comprehensive range of roofing materials. As a result, any recycling initiative would likely be product-specific and limited in scope.

From a roofing company's perspective, this limitation is problematic as they must recycle all roof components, including concrete, vapor barriers, insulation, membranes, and, if not a bare roof, covering materials (gravel, green roofs). Similarly, demolition and recycling companies must handle entire buildings. Thus, the system's boundaries are crucial.

– Manufacturers focus on their product line.
– Roofing companies handle the entire roof.
– Demolition and recycling companies manage the full building structure.

Figure 5.5 illustrates these overlapping yet distinct scopes, emphasizing the need for a broader, integrated approach to recycling.

Among stakeholders, manufacturing companies have the highest interest in recycling due to several factors:

- Global manufacturers of plastic roofing have a different interest in sustainability, contrary to local waste collectors, which might not need sustainable reporting.
- Global manufacturing companies have internal CO_2 and recycling targets.
- Circular framework legislations apply pressure on manufacturing companies to be responsible for the whole lifecycle of products.

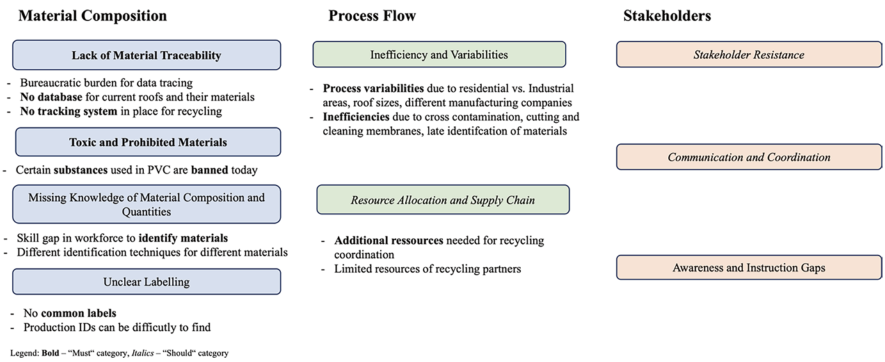

Fig. 5.5 Perspective of different stakeholders. Source: Own

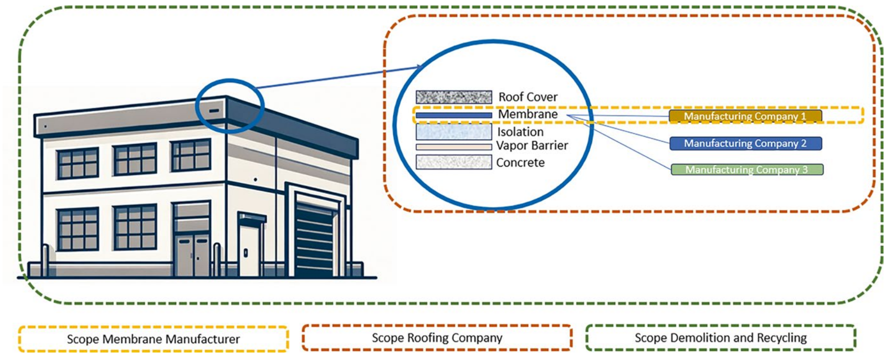

Fig. 5.6 Information gaps categories of must and should have. *Source: Own contribution*

Contribution

By employing DSR methodologies, the study sought to provide a comprehensive understanding of the main barriers in roof membrane recycling, more specifically in waste collection. The literature is missing concrete challenges and problems that stakeholders face in practice. The objective of this research was to identify the information gaps that obstruct the collection of roof membrane waste and to examine whether addressing these gaps can enhance the process of information gathering, thereby improving the overall recycling process. The gaps collected from the literature were categorized into three categories: material composition, process flow, and stakeholders. The study identifies three relevant groups of stakeholders: manufacturing and production, construction and demolition, and waste management and recycling. The interviews confirmed these information gaps and that they are barriers to the overall recycling process of roof membranes (Fig. 5.6).

A detailed analysis of information gaps highlights the complexity of the recycling process and the need to integrate stakeholders' challenges into the theorization of circular economies. This would contribute to future scholarship. Clear data on material composition enables tailored disposal or recycling strategies, optimized process flows improve waste management efficiency, and stronger stakeholder engagement ensures collaboration, which is essential for waste management efforts. While the findings focus on the construction industry, the approach can inspire similar efforts in other industries, driving the transition to a circular economy.

Limitations

The study acknowledges potential limitations arising from the methodology employed, particularly the reliance on a limited number of interviews, which may affect the generalizability of the findings. Future research is encouraged to incorporate broader quantitative methods and a wider geographic sampling to validate and expand upon the preliminary insights obtained. Future studies could benefit from exploring business cases to encourage recycling.

Further Research

The construction industry undergoes a rapid transformation of digitalization and new technologies. Further research could investigate the introduction of granular plastic labels, which could enhance material identification. While this study demonstrates the importance of identifying information gaps between stakeholders, further research is needed to develop a comprehensive digital recycling system that integrates data from key stakeholders, such as manufacturers and recyclers, with more details on material quality and traceability. This expansion is crucial to address the current fragmented landscape, where each material, or even each component, often follows its own process with its own documentation of data details. Integrating these processes into a unified system would better meet the needs of various stakeholders in the recycling chain. This would enable the move from end of life to recycling, identify toxic and prohibited materials, reduce inefficiencies and variability in the process, decrease resource needs for material handling, address stakeholder resistance, and enhance communication and coordination among stakeholders.

Future research should also investigate whether the proposed prototype for plastic roof membranes can be generalized to other materials and stakeholders. The dynamic interplay between recycling collectors, such as roofing companies and demolition/recycling companies, and manufacturing companies, and the optimal balance needed to maximize recycling efforts across the entire chain could also be a subject of further research. There appears to be a need within the construction industry for overarching systems that allow recycling processes for a wide range of materials.

Today, roofing membranes are made of plastics of fossil origin due to their special requirements. There is a search for durable roofing materials based on recycling plastics, which includes the possible use of recycled membranes from roofs. Further life cycle analysis needs to be carried out to understand the suitable use of recycled plastics and compounds, including the use of additives, regarding their functionality of structural durability and system reliability (Fraunhofer CCPE, 2025).

In the last years, policymakers have called for a "circular economy," based on principles of the reuse of materials through recycling. Closing the loop through recycling and other principles is considered beneficial for both the environment and the economy. However, research found that the overall economic impact is not so clear (Zhou & Smulders, 2021). Recycling of, for example, plastic material, requires mechanical or chemical treatment, and each recycling cycle quality as well as performance of the material is reduced. Further research is needed to understand the true financial and environmental costs of recycling.

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Part II
Social Impact

Chapter 6
Job-Related Stress, Employee Embeddedness, and Hedonic Workplace Well-Being: A Study of Employees in Knowledge-Intensive Services in Vietnam

Nguyen-Hau Le and Khanh-Ngoc Nguyen

Abstract In the modern working environment, job-related stress has become a common issue that threatens the well-being of the workforce in many companies worldwide. Drawing on the employee embeddedness perspective, this study examines how job-related stress impacts employees' hedonic workplace well-being. A structural model has been developed and tested on the dataset comprising 193 professionals in IT consulting services in Vietnam. The findings indicate the positive effects of perceived job fit and organizational links on employees' hedonic workplace well-being. Moreover, job-related stress affects hedonic workplace well-being directly and indirectly through perceived job fit. However, job-related stress does not impact perceived organizational links, a significant driver of well-being. Theoretical and practical implications are then discussed.

Keywords Job stress · Employee embeddedness · Workplace well-being · IT consulting services

Introduction

Nowadays, many business firms worldwide face a fast-changing and turbulent environment that creates continuing challenges threatening their sustainable development. This situation also entails challenges and stresses that erode their employees'

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well-being (Le and Le, 2024). Therefore, to pursue sustainability, firms need not only to prepare their resources for long-term business development but also to sustain their employees' well-being. This important issue has been highlighted in Sustainable Development Goal (SDG) #3 of the 17 United Nations' SDGs (UN, 2015). In service research, the topic of enabling and improving employee well-being, especially in the work domain, is emphasized in the list of seven research themes suggested by Russell-Bennett et al. (2024). This issue is especially salient for IT consulting firms (ITCFs) that provide knowledge-intensive services due to their sensibility to the mentioned environment.

Although there have been many studies on employee stress at work, more works on the nuanced relationships between stress and employee well-being are still needed and encouraged (Khalid and Syed, 2024; Perrewé & McAllister, 2024; Trougakos et al., 2020). To address this problem, this study considers the ways in which stress impacts the hedonic workplace well-being of employees. Given that stress can be triggered by different types of stressors (Lazarus, 2013), it is argued that different types of stress affect well-being through different routes. In the context of IT technology consulting firms described above, we focus on examining the impacting routes of job-related stress through employee perception of job fit and organizational links. These two factors are drawn from the concept of job embeddedness (Mitchell et al., 2001). Although job embeddedness was created to explain employee retention, we argue that it captures the main aspects of an employee's work life that are critical for examining his/her workplace well-being. Specifically, our objectives are to address two research questions. First, how do relevant components of job embeddedness, namely, perceived job fit and organizational links, sustain employee workplace well-being? Second, how does job-related stress directly and indirectly affect workplace well-being through job fit and organizational links?

The empirical setting to test the proposed hypotheses is the IT consulting service sector in Vietnam, an emerging economy in Southeast Asia. In this country, the IT industry is rapidly developing and has become a significant business sector (Le, 2025). However, many IT consulting employees face continuous challenges such as quick technological advancement, heavy workloads, and working overtime. Consequently, job-related stress is a common occupational issue for employees in this sector (Padma et al., 2015). In another aspect, Vietnamese employees (including those in the IT sector) are inclined toward collectivism as a national culture (Nghia, 2022) in which relationships with others are important in their perception of organizational links. Therefore, this empirical setting offers a special context for testing the research hypotheses. It contributes to the literature on human resource management (HRM) and organization studies by providing empirical evidence on the specific routes where job-related (not relationship-related) stress affects the workplace well-being of employees in a collectivistic culture. Moreover, this study enriches the theory of job embeddedness by providing evidence that it not only predicts employee retention but also plays an important role in sustaining employee well-being in the workplace.

Conceptual Background

Job Stress

Job stress is defined as a negative emotional state experienced by employees due to the perceived poor fit between job demands and their resources to cope with them (Lazarus, 2013). Stress can manifest in various signs such as anxiety, fatigue, reduced concentration, or depression. Literature shows several theories explaining this phenomenon in the workplace. Among these theories, the job demand-resources (JD-R) model (Demerouti et al. 2001) is among the most comprehensive theories on job stress (Perrewé & McAllister, 2024). This theory classifies all job characteristics as either demands or resources. Job demands refer to various aspects of a job that require sustained physical and psychological effort and costs from employees (Demerouti et al., 2001). Job resources include those physical, psychological, social, or organizational aspects of the job that fulfill job demands, facilitate goal achievement, reduce physical and psychological costs, or stimulate personal growth and development. Essentially, job demands, job resources, and the gap between them affect job stress (Bakker and Demerouti, 2007). Particularly, job stress occurs when job demands increase, job resources decrease, or a gap exists between perceived job demands and job resources (Demerouti et al., 2001). Moreover, job resources can moderate the undesirable impact of job demands on job stress and boost the desirable impact of job demands on work motivation (Bakker and Demerouti, 2017).

Previous studies show that job stress can result from antecedents such as excessive workload, lack of control, role ambiguity, role conflict, ethical ambiguity, and interpersonal conflict (e.g., Dodanwala et al., 2023; Zang et al., 2022), unethical leadership (Schwepker Jr. & Dimitriou, 2021), participatory leadership (Abd et al., 2023), and job crafting (Harju et al., 2021; Sahay et al., 2022). On the other hand, job stress results in work-related outcomes such as reduced work motivation, job exhaustion, burnout, irritable moods at work, frequent absence, conflict with colleagues or supervisors, poor job performance, and reduced job satisfaction (e.g., Babapour et al., 2022; Bakker and Demerouti, 2017; Dodanwala et al., 2023). For employees individually, experiencing continuing stress may lead to mental and physical health problems, work–life imbalance, and poor well-being (Ganster and Rosen, 2013; Hirschle and Gondim, 2020).

Job Embeddedness: Job Fit and Organizational Links

The concepts of job fit and organizational links are borrowed from the theory of job embeddedness, which represents the psychological ties of an employee to their company that restrain him/her from leaving (Mitchell et al., 2001). Initially created to explain why an employee leaves a company, job embeddedness comprises several on-the-job and off-the-job factors related to the employee's fit with the job, his/her links to people, and the perceived sacrifice if he/she leaves the firm. The current study only focuses on employees' on-the-job fit (i.e., job fit) and links (i.e., organizational links) for two reasons. First, we confine our examination to the well-being of employees in the workplace. Thus, off-the-job factors are beyond our scope. Second, within on-the-job factors, the perceived sacrifice is relevant in explaining employee leaving, while the current study is interested in the employee's work in the current company.

Job fit reflects employees' feelings about the alignment between themselves and their jobs, which can result from two aspects. First, values alignment—employees feel an alignment between their job characteristics and their values or personalities (Lauver and Kristof-Brown, 2001). When there is a high level of value alignment, employees are likely to be intrinsically motivated to deeply engage in their work and feel happy at the workplace (Lin et al., 2014). Second, skills match—the perceived match between job demands or requirements and an employee's skills and abilities. When there is a skill match, employees feel competent and engaged. They often show resourcefulness and confidence in performing work within the scope of their expertise and skills (Lin et al., 2014).

Organizational links refer to the ties an employee feels to other people in the organization (Mitchell et al., 2001). It represents cognitive and affective connections between an employee and others in the work environment that create a sense of community and belonging. These links can be formal or informal and can be in different forms. Social ties refer to strong and positive relationships with colleagues that can make work more efficient and enjoyable. Mentorship and support from mentors or colleagues can increase job performance and satisfaction and make employees feel valued. Finally, formal ties through committee memberships, participation in projects, or involvement in professional organizations can create a sense of being embedded into the company's people (Mitchell et al., 2001; William Lee et al., 2014).

The extant literature shows that job fit and organizational links are associated with important work-related outcomes. For instance, prior studies (Le and Le, 2024; Zia et al., 2022) indicate that they impact employee in-role and extra-role behaviors (i.e., job performance and organizational citizenship behavior, respectively). Susomrith and Amankwaa (2019) find that job fit and organizational links positively affect employee innovation. Other studies show a positive relationship between job fit and job satisfaction (Peng and Mao, 2015; Lim et al., 2019) and a sense of well-being (Lin et al., 2014). Regarding their antecedents, prior studies suggest several factors that can leverage employee job fit and organizational links, such as job security, job flexibility (Rahimnia et al. 2019), work engagement (Arasli et al. 2017), organizational fit (Lim et al., 2019), training and development opportunities, career opportunities, supervisor relationships, and support (Van Dyk et al. 2013). In contrast, employees' negative psychology can hinder job fit and/or organizational links (Sun et al., 2012).

Hedonic Well-Being in the Workplace

The concept of human well-being is defined by Ryan and Deci (2001) as the optimal psychological experience and functioning. Literature shows that this concept has been approached from the hedonic or eudaimonic perspective (Waterman, 2008). These two approaches are interrelated because pursuing eudaimonic well-being would result in hedonic well-being (Diaz et al., 2015). This study is interested in hedonic well-being (e.g., happiness and life satisfaction) as an ultimate affective state every human strives to achieve (Diener et al., 1998; Le et al., 2023). Moreover, given that work is an important part of every employee's life, we focus on hedonic well-being in the workplace as a domain-specific construct contributing to an employee's general well-being (Pavot and Diener, 2008). Accordingly, hedonic workplace well-being refers to an employee's cognitive and affective evaluation of his/her work life (Diener, 2000). This subjective approach is widely adopted in the literature on employees' well-being in the workplace (Bartels et al., 2019). Specifically, most studies in this stream, including the current study, argue that hedonic workplace well-being is best represented by job satisfaction (Bowling et al., 2010; Diener and Biswas-Diener, 2002). This is because job satisfaction also reflects the pleasurable emotional state resulting from the cognitive appraisal of one's job or job experience (Locke, 1969; Luthans et al., 2005). In other words, job satisfaction is described as an affective response and cognitive assessment of one's job (Erdogan et al., 2012).

In management research, several studies have shown that job satisfaction is (positively or negatively) associated with work-related outcomes such as job performance, job commitment, job engagement, turnover intention, and organizational citizenship behaviors (Ng et al., 2021; Erdogan et al., 2012), and life-related outcomes such as happiness, self-esteem, and life satisfaction (Karabati et al., 2019; Rothausen and Henderson, 2019). Literature also identifies antecedents of job satisfaction, such as organization-related factors (organization or supervisor support, communication, co-workers, supportive environment, rewards, job security, learning, career development opportunities), job-related factors (job demands, person-job fit, role ambiguity, workload, job autonomy, job flexibility, job variety, job meaningfulness, work time), and person-related factors (stress, work-family conflict, family support, psychological capital) (Sousa-Poza and Sousa-Poza, 2000; Erdogan et al., 2012).

Proposed Research Model and Hypotheses

To address the stated research questions, a structural model together with research hypotheses is proposed, as illustrated in Fig. 6.1. This model depicts the direct impact of job stress on an employee's hedonic workplace well-being. It also has indirect effects via job fit and organization links. The justifications for the proposed

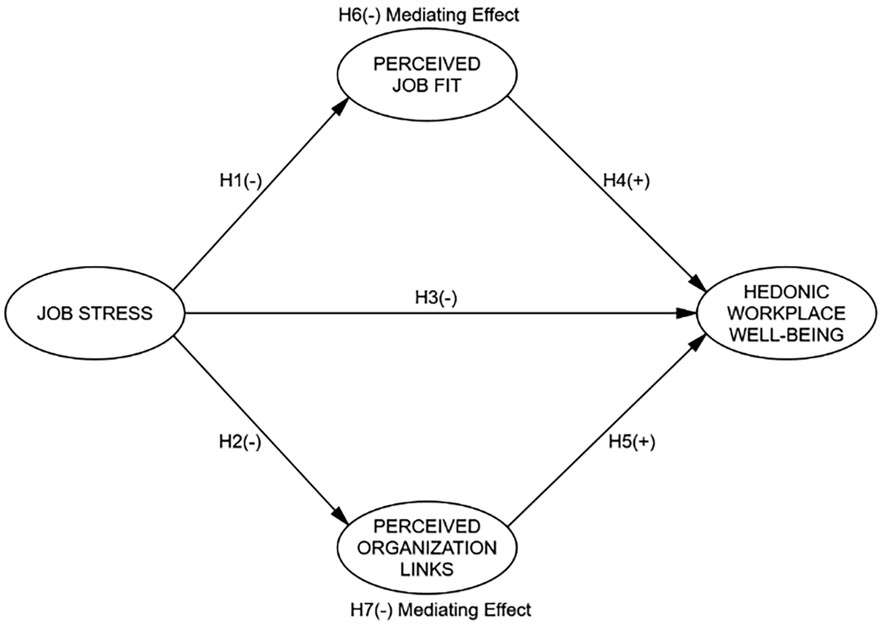

Fig. 6.1 The proposed research model (Source: Created by the authors)

hypotheses are based on the Job Demands-Resources theory mentioned above (Demerouti et al., 2001), the theory of Person-Organization fit (Kristof, 1996; Kristof-Brown et al., 2005), and the Self-Determination theory (Ryan and Deci, 2001). Studies have shown that organization fit, organizational links, and job fit are operationally related but conceptually different (Huang, 2022; William Lee et al., 2014). The following sections will justify each of the hypotheses.

Job Stress and Job Fit

Drawing on the Job Demands-Resources theory (Demerouti et al. 2001), it is argued that when stress increases due to a higher level of job-related demands such as professional skills, excessive workload, or lower levels of resource-related factors such as employee psychological or physical states, employees are likely to perceive a mismatch between job demands and personal resources. When stress is caused by role conflict, role ambiguity, or ethical ambiguity, employees will see a value misalignment. In both situations, when job stress increases, the feeling of employees about their job fit is decreased. This is because the perception of employees on their job fit is assessed by two aspects: (1) the alignment between job characteristics and personal values and (2) the match between job demands and personal resources and abilities (Mitchell et al., 2001). Therefore, it is proposed that:

H1: *There is a negative relationship between job stress and perceived job fit.*

Job Stress and Organizational Links

The affective state of job stress can result from relationship-based or organization-based stressors such as interpersonal conflict, role conflict, and unethical leadership (e.g., Dodanwala et al., 2023; Zang et al., 2022; Schwepker Jr. & Dimitriou, 2021). In these situations, employees may experience negative or irritable moods at work, depression, lack of concentration, or exhaustion (Babapour et al., 2022; Bakker and Demerouti, 2017). These, in turn, negatively affect their formal collaborations and/or informal relations with supervisors and colleagues, resulting in frequent occurrence of conflicts and weaker connections with other people in their work environment. These eventually lead to a decreased sense of being linked with the company and its people (Mitchell et al., 2001; William Lee et al., 2014).

H2: *There is a negative relationship between job stress and perceived organizational links.*

Job Stress Directly Affects Hedonic Workplace Well-Being

Several studies have relied on the allostatic load model (Goldstein and McEwen, 2002) to explain the relationship between job stress and employee well-being through physiological health, mental health, and cognitive ability (e.g., Juster et al., 2010; Guidi et al., 2020). As mentioned, job stress represents a negative affective state that manifests in different signs, from anxiety, fear, fatigue, reduced concentration, depression, and sleep disorder to cardiovascular disease or diabetes (Lazarus, 2013; Ganster and Rosen, 2013). These psychological states of negativity eventually affect job performance and hedonic workplace well-being (Hirschle and Gondim, 2020; Holman et al., 2018). Thus, we propose the following:

H3: *There is a negative direct relationship between job stress and employee's hedonic workplace well-being.*

Job Fit and Hedonic Workplace Well-Being

Based on the Person-Organization Fit theory, perceived job fit has been shown to have significant positive impacts on job satisfaction, self-efficacy, co-worker satisfaction, and supervisor satisfaction (Kristof-Brown et al., 2005; Peng and Mao, 2015). This relationship can also be explained by the self-determination theory (Ryan and Deci, 2001). Accordingly, when employees perceive a match between job demands or characteristics and their capacities, they are more confident at work (Lim et al., 2019). Their needs for self-esteem and competence are thus fulfilled, leading to a higher level of (extrinsic and intrinsic) working motivation (Ryan and Deci, 2008). Enhanced motivation, in turn, is an important antecedent of employees' workplace well-being (Manganelli et al., 2018). Therefore, it is proposed that:

H4: *There is a positive relationship between perceived job fit and hedonic workplace well-being.*

Organizational Links and Hedonic Workplace Well-Being

The positive effect of perceived organizational links on hedonic workplace well-being (represented by job satisfaction in this specific study) is shown in previous studies (Kristof-Brown et al., 2005). For example, Wheeler et al. (2007) provide evidence of the positive relationship between employee perception of person-organization links and job satisfaction. Other factors of organizational links, such as positive interpersonal relationships among coworkers/supervisors or a supportive organizational environment, have been found to affect employee hedonic workplace well-being (Bagheri et al., 2019; Westerman and Cyr, 2004). This relationship between perceived organization links and hedonic workplace well-being (i.e., job satisfaction) is also reinforced by Lim et al. (2019) based on the motivation theory. Therefore, this hypothesis is proposed:

H5: *There is a positive relationship between perceived organizational links and hedonic workplace well-being.*

The Mediating Effect of Job Fit and Organizational Links

As proposed, job stress has a significant negative impact on perceived job fit (H1), which, in turn, positively affects hedonic workplace well-being (H4). A similar causal flow is proposed on job stress, perceived organizational links, and hedonic workplace well-being (H2 and H5). These give rise to examining the mediating effects of job fit and organization links on the relationships between job stress and hedonic workplace well-being, besides its direct effects.

H6: *Job fit mediates the relationship between job stress and hedonic workplace well-being.*

H7: *Organizational links mediate the relationship between job stress and hedonic workplace well-being.*

Method

As mentioned previously, the hypotheses were tested on professional employees in the IT consulting services in Vietnam. Respondents were recruited using a convenience sampling method. Data were collected through an online survey of IT consulting professionals in four companies via the courtesy of their HR managers. These companies were privately owned and sized from 60 to 190 employees. They were chosen conveniently based on the network connections of the researchers. Consequently, a total of 204 responses were obtained. After checking the data quality, 11 cases were eliminated due to patterned answers to consecutive questions. Therefore, the sample comprised 193 usable cases.

Scales to measure the four constructs in the model were adopted from previous studies. Job stress was measured by four items reflecting workload, time pressure, role conflict, and role ambiguity (Antwi et al., 2019). The scale measuring perceived job fit was borrowed from Saks and Ashforth (2002) including four items reflecting the extent of match between the respondent's knowledge, skills, and abilities with the job requirements; job and respondent's needs; job and the respondent's values and/or personalities; and the extent that the job enables the respondent to do the kind of work he/she wants to do. The scale to measure perceived organizational links was adapted from Mitchell et al. (2001). Items reflect the extent of respondents' perception of their ties with other people in the company, such as colleagues, team members, supervisors, and company leaders. Finally, hedonic workplace well-being was measured via the proxy of the job satisfaction scale (Brayfield and Rothe, 1951), in which four items read "I really enjoy my current job," "I feel satisfied with my job," "rarely do I get bored with my job," and "I work enthusiastically most of the time." All items were presented in the Likert-type form, anchoring from 1 (minimum) to 7 (maximum). The questionnaire went through the process of collaborative translation into Vietnamese and a pilot test (Douglas and Craig, 2007). After minor amendments to item wording, the final Vietnamese version was used.

Findings

Sample Description

The sample includes 193 respondents, including 47.2% females and 52.8% males. The majority of them were university graduates (80.8%) or postgraduates (19.2%). Their age group ranged from less than 25 years old (5.7%), 25–35 (57%), and over 35 (37.3%). Regarding marital status, 47.2% of them were single, while 52.8% were married. In terms of working duration, the majority of the sample (87%) showed that they had been working for the current company for less than 5 years, which was relatively short. They hold different job positions, with the majority being supervisors or below (68.4%), followed by lower or middle managers (21.8%), and finally, upper managers (9.8%). Besides, the number of respondents with an average monthly income bracket of 18–35 million VND (# 700–1400 USD) accounted for 47.7%, nearly equal to the proportion of respondents with higher income brackets combined. These statistics indicate that the sample is diverse enough to ensure appropriate variances for testing hypotheses.

Scale Assessment and Refinement

Initially, the dimensionality of each scale was assessed using exploratory factor analysis, which resulted in all scales being unidimensional. Next, confirmatory factor analysis (CFA) was applied using the AMOS software to estimate the full measurement model connecting four constructs and their associated measurement items. To achieve a satisfactory fit between the model and data (chi-square/df = 1.44, Comparative Fit Index (CFI) = 0.98, Tucker Lewis Index (TLI) = 0.97, Root Mean Square Error of Approximation (RMSEA) = 0.05), the measurement model was refined by eliminating three items, each from job stress, organization links, and hedonic well-being. Accordingly, all four scales achieved reliability with composite reliability (CR) ranging from 0.80 to 0.90, above the threshold of 0.70. The standardized factor loadings of scale items varied from 0.67 to 0.91 (>0.50), and the average variance extracted (AVE) of scales ranged from 0.58 to 0.76, all above 0.50, indicating convergent validity. Moreover, the squared correlations between pairs of scales were smaller than the corresponding AVEs, except that the squared correlation between job fit and well-being (0.68) was slightly higher than the AVE of well-being (0.65). However, additional analysis showed that at a 95% confidence level, their standardized correlation was 0.90, still significantly lower than 1.0, indicating that the discriminant validity of all scales was satisfactory (Anderson and Gerbing, 1988). In short, the measurement scales were all qualified for proceeding to the next steps.

The data were also subjected to the common method variance (CMV) test using the single-factor method (MacKenzie and **Podsakoff,** 2012**). The result showed far-from-fit indices with chi-square/df = 10.0, CFI = 0.61, TLI = 0.53, and RMSEA = 0.216. Therefore, common method bias was not a problem in this study.**

Structural Model Estimation and Hypothesis Test

The estimation of the structural model was conducted using the Covariance-based structural equation modeling (CB-SEM) approach, yielding satisfactory indices: chi-square/df = 1.95, CFI = 0.96, TLI = 0.95, and RMSEA = 0.07. In particular, the statistics in Table 6.1 indicated a significant negative coefficient from job stress to job fit ($\beta = -0.23$, $p = 0.006$), thus supporting H1. Hypothesis H2 on the path from job stress to organizational links was not supported because the coefficient was insignificant ($\beta = 0.02$, $p = 0.922$). The direct negative effect of job stress on hedonic

Table 6.1 Hypothesis testing results

Path				Std. coeff.	*p*-value	Test result
Direct effect:						
H1	Job stress	→	Job fit	−0.23	0.006	Supported
H2	Job stress	→	Organizational links	0.02	0.922	Unsupported
H3	Job stress	→	Hedonic well-being	−0.22	0.002	Supported
H4	Job fit	→	Hedonic well-being	0.73	0.003	Supported
H5	Organizational links	→	Hedonic well-being	0.26	0.002	Supported
Indirect effect:						
H6	Job stress → Job fit → Hedonic well-being			−0.16	0.025	Supported
H7	Job stress → Org. links → Hedonic well-being			0.00	N/A	Unsupported
Total effect:						
	Job stress → Hedonic well-being			−0.38	0.001	

well-being (H3) was supported with $\beta = -0.22$, $p = 0.002$. Next, H4 on the positive effect of job fit on hedonic well-being was strongly supported with $\beta = 0.73$, $p = 0.003$. Hypothesis H5 also received the supporting result with $\beta = 0.26$, $p = 0.002$. In addition, the mediating effect of job fit on the relationship between job stress and hedonic well-being—H6 was supported with $\beta = -0.16$, $p = 0.025$. In contrast, the empirical result did not support H7 on the mediating role of organizational links (β # 0.00). This is understandable because H2 was not supported. The results also indicated that the standardized total negative effect of job stress on employees' hedonic workplace well-being was $\beta = -0.38$, $p = 0.001$. These results facilitate the discussion presented in the next section.

Discussion and Conclusion

Discussion

This study addresses the issue of job stress that commonly occurs in the modern working environment and threatens the sustainability of the workforce worldwide. It responds to calls from scholars (Perrewé & McAllister, 2024; Trougakos et al., 2020) for research to provide a fuller understanding of the various ways stress exerts its impacts on employees' well-being. In so doing, this study focuses on two important aspects of employees relating to the job itself (i.e., job fit) and the people they interact with within the workplace (i.e., organizational links). Besides elucidating the effects of job stress on workplace well-being through different routes, it is expected that the relative strength of these nuanced relationships is subject to the empirical context and salient stressors that cause employee stress.

Within the context of IT consulting services in the collectivistic country of Vietnam, the findings indicate that job-related stress as a negative emotional state directly affects employees' hedonic workplace well-being. In addition, job-related stress indirectly impacts hedonic workplace well-being through the partial mediation of employees' perceived job fit but not through perceived organizational links. This finding implies that nowadays in the modern working environment, job-related stress is mainly caused by the perceived gaps between increasing job demands or requirements and employees' resources and abilities (i.e., job fit), rather than by the formal and informal relationships with others at work that are harmful to their perceived organizational links. This is reasonable given that the empirical setting in this study was the IT consulting service. In this industry, the professionals' knowledge-intensive job is characterized by the continuing advancement of technology. Employees who do not learn and update continuously would easily find themselves left behind, mentally stuck, severely stressed, and eventually lead poor quality of life (Fehrer and Bove 2022).

This study also shows the positive impacts of both perceived job fit and organizational links, the two major components of job embeddedness, on employees' workplace well-being. By this finding, we enrich the theory of job embeddedness by reinforcing the notion that job embeddedness can be expanded beyond the prediction of employee retention, organizational engagement, or citizenship behavior (e.g., Le and Le, 2024). It has been shown to explain workplace well-being as well.

Managerial Implications

Given that job-related stress caused by job demands and resource gaps is common in knowledge-intensive services or the like, the findings of this study suggest some ideas for managers to reduce it and restrain its effects on employee well-being in the workplace. First, managers should provide opportunities and resources for employees to learn and update their knowledge and skills frequently. They should also arrange other factors such as time, incentives, or motivations for employees to undertake that learning. Second, they should develop a leadership style and nurture an organizational culture that highly values the engagement and formal and social relationships among people in the organization. Although this recommendation is not for reducing job-related stress, it increases hedonic workplace well-being by fostering organizational links, thereby compensating for the decrease in workplace well-being caused by job-related stress.

Limitations and Further Research

Despite our efforts, there remain certain limitations in this study. First, we acknowledge that job stress resulting from different sources (e.g., relationship-related vs. job-related sources) may lead to different outcomes relating to well-being. However, this study only focuses on job-related sources, thus limiting the chance to investigate and compare their different impacting routes on well-being. Second, the interplay between job fit and job stress may be in two-way directions. In this study, job stress (a psychological state) is argued to influence job fit (a feeling of strong ties). However, the reverse direction also seems reasonable if job fit is understood as a result of a cognitive appraisal process. Finally, there may be other unexplored mediators (e.g., job performance or organizational support) on the relationships between job stress and workplace well-being that call for further studies.

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Chapter 7
Emergence of Dual Missions in Early-Stage Social Ventures: A Model for Social and Economic Sustainability

Irina Popova and Mahmoud Al-Kilani

Abstract The emergence of dual missions, social and economic, in early-stage social ventures (SVs) is critical for their sustainability, yet it remains underexplored in the literature. This conceptual paper applies the model of dual mission management, originally developed for growth-stage SVs, to examine how dual missions emerge in nascent SVs. Drawing on longitudinal ethnographic data from an SV incubator in the United Kingdom, we present two illustrative vignettes to demonstrate the challenges and processes involved in achieving social and economic sustainability. Our findings highlight the importance of external support networks and learning in enabling nascent social entrepreneurs to identify and connect their economic mission with their social mission. We propose that the emergence of an economic mission is a prerequisite for mission spillover effects (MSEs) and sustainable outcomes. This chapter contributes to the literature by offering a model for understanding dual mission emergence in early-stage SVs and suggests avenues for future empirical research.

Keywords Social venture · Sustainability · Dual mission · Social entrepreneurship · Early-stage social ventures

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Introduction

Social ventures (SVs) and social enterprises are often used interchangeably in the literature on social entrepreneurship (Ruvio & Shoham, 2011). However, SVs encompass a broader range of business types, with social enterprises being one subset. The defining characteristic of SVs is their dual commitment to both a social and an economic mission. Achieving these dual missions, however, presents significant challenges, particularly in the early stages of venture development. While reaching economic sustainability is often a prerequisite for survival, fulfilling the social mission typically requires more time and resources, creating tension in strategic management (Smith et al., 2013; Smith & Lewis, 2011). Despite the growing interest in social entrepreneurship, empirical studies on the creation and early development of SVs remain scarce (Gras et al., 2011). Notable exceptions include Renko (2013), who explores the early challenges faced by nascent social entrepreneurs (NSEs), and Popova et al. (2025), who examine the practices nascent SEs engage in at an SV incubator (SVI).

One reason for the limited research on NSEs is the high failure rate of early-stage ventures. As Renko (2013, p. 1045) notes, "many individuals who intend to start a new business never proceed to actual operations." Furthermore, 6 years after starting the firm creation process, approximately one-third of new entrepreneurs have exited, another third have an active business, and the remaining third are still developing their start-up (Reynolds, 2007). Gasca (2017) highlights this issue, reporting that 38.3% of SVs survive less than 1 year, while only 5.2% last more than a decade. These statistics underscore the precarious nature of early-stage SVs and the need for a deeper understanding of how dual missions emerge and are managed during this critical phase.

This conceptual chapter aims to contribute to the literature by applying Siebold et al.'s (2019) model of dual mission management, originally developed for growth-stage SVs, to explore the emergence of dual missions in early-stage SVs. By doing so, we propose a framework for understanding how NSEs navigate the challenges of aligning social and economic objectives to achieve sustainability. We also identify avenues for future empirical research on dual mission emergence in early-stage SVs.

The chapter is structured as follows. First, we review the literature on social entrepreneurship and SVs, highlighting the key characteristics and challenges of dual mission management. Next, we discuss the concept of sustainability in the context of SVs, emphasizing the interplay between social and economic objectives. We then introduce Siebold et al.'s (2019) model of dual mission management and argue for its relevance to early-stage SVs. Finally, we present two illustrative vignettes from a longitudinal ethnographic study conducted in an SVI to demonstrate how dual missions emerge and the factors that influence their success or failure.

By bridging the gap between theory and practice, this chapter seeks to provide insights into the early-stage dynamics of SVs and offer practical guidance for NSEs striving to achieve social and economic sustainability.

Literature Review

Social Entrepreneurship and SVs

There are multiple definitions of social entrepreneurship and SVs. Lumpkin et al. (2013, p. 762) define social entrepreneurship as a "social value creation process in which resources are combined in new ways to meet social needs, stimulate social change, or create new organisations." The study indicates that the business processes of commercial enterprises and social enterprises are largely similar. The distinguishing feature of a social enterprise is its commitment to a social mission. In addition, social entrepreneurship is defined by three key characteristics: social innovation, accountability, and sustainability (Kamaludin et al., 2024). Others go as far as to define social entrepreneurship as the marketization of the non-profit sector (Dempsey & Sanders, 2010). However, that view is limiting and does not include most born social companies in all their forms.

A broader perspective of social entrepreneurship encompasses for-profit businesses that prioritize social issues and generate profits through their operations (Light, 2008). While these organizations may operate like traditional businesses, their primary focus is on addressing social concerns rather than solely maximizing profits for shareholders. This inclusive view challenges the earlier, limited understanding of social entrepreneurship that mainly focused on the non-profit sector (Zhang & Swanson, 2014). Similarly, Al-Kilani et al. (2021a) describe the concept of social innovation hubs, which create and capture economic and social benefits for wider society. In practical terms, an organization can be considered a social entrepreneurial enterprise (or an SV) if its mission statement integrates both social and business goals, regardless of whether it is legally structured as a for-profit or non-profit organization.

Different authors highlight different perspectives when defining SVs, but they all converge on the core idea of combining social impact with business operations. Haugh (2007) and Hockerts (2006) emphasize the problem-solving aspect of SVs. They see these ventures as innovative businesses that actively address social issues while creating social value. This perspective underscores the entrepreneurial nature of SVs and their proactive role in tackling societal challenges. Gregory and Anderson (2003) focus on the legal and financial structure of SVs. Their definition highlights that these ventures can operate as for-profit corporations while explicitly aiming to address social concerns and generate revenue. This perspective acknowledges that SVs can utilize traditional business models for sustainability while prioritizing their social mission. Alter (2007) introduces the concept of a "hybrid spectrum" to categorize SVs. This spectrum recognizes the diverse range of organizational models, highlighting that ventures can blend social and economic objectives to varying degrees. The hybrid spectrum includes traditional for-profit corporations on one end, primarily driven by profit maximization for shareholders. On the other end are non-profit organizations that engage in commercial activities to fund programs aimed at solving social problems and creating social value. Nesta's definition of an SV considers that its primary purpose is social impact while seeking financial viability. An SV is any organization that, "regardless of legal form:

(a) intends, as its primary objective, to tackle a social need and then...
(b) seeks to deliver a financial return to investors" (NESTA, 2015).

Thus far, we have established that SVs are businesses that address social problems and generate social value. As pointed out by Al-Kilani et al. (2021a), the "social landscape" of business model innovation and social innovation evolves and changes over time. Technology, for example, has become a key enabler, and virtual contact has evolved from an intrusive medium to a socially acceptable norm. Social and economic objectives are not mutually exclusive. SVs prioritize societal benefit over profit maximization (when compared to traditional for-profit businesses). They achieve this by addressing social issues, reducing unemployment, and promoting economic, social, or environmental well-being (Alter, 2007). Instead of focusing on shareholder profits, SVs reinvest their earnings to advance their social mission. This might include investments in research and development, organizational growth, or direct support to communities (Haugh, 2007). They employ entrepreneurial strategies to achieve social progress with the aim of creating a sustainable and inclusive economy, using business as a tool for positive change (Zhu & Sun, 2020). While sharing similarities with non-profits in their social orientation, SVs differ in their approaches. They utilize market-based solutions and innovative business models to achieve both financial and commercial sustainability (Bae & Fiet, 2021). This distinguishes them from many traditional non-profits that rely primarily on donations. In addition, studies on early-stage SVs (Katre & Slipante's, 2012) show that social entrepreneurs combine behaviors from conventional business ventures and nonprofits. Heterogeneous knowledge and networks are important because social entrepreneurs need to manage diverse business and mission logic (De Carolis & Saparito, 2006; King, 2004). Social innovation hubs, described by Al-Kilani et al. (2021b), form a backbone to the SV landscape. These hubs bring together expertise, experience, resources, support, training, and networking. No longer confined to physical places, many are now partly or completely online, making them readily accessible to all. The value of such hubs is recognized in developed countries, and they are often given special legal status that supports early engagement and accessibility for the start-up community. In less well-developed countries or those with fractured infrastructure such as those in the middle east, these types of support entities struggle despite there being a theoretical infrastructure available (e.g., in terms of internet access) and a will to succeed.

Sustainability in the Context of SVs

The concept of sustainability is interpreted in one of two ways. For some, it means having a dedicated commitment to environmentally friendly practices, requiring a complete overhaul of the business model (Smith & Lewis, 2011). This perspective aligns with our earlier discussion about social enterprises prioritizing social and environmental goals alongside financial ones. For others, a sustainable business simply means one that can survive. This emphasizes the long-term viability of a business, ensuring it can continue to operate and generate value. This echoes our previous point about SVs needing to achieve financial stability to pursue and sustain their social missions. Following this, Zhang and Swanson (2014, p. 179) suggest that when we consider their social mission and purpose, SVs are "sustainable by design." They also emphasize that when organizations are truly social entrepreneurial, they are economically viable while at the same time addressing social problems through innovative approaches, "whereby making them truly economically and socially – and possibly also environmentally – sustainable" (Zhang & Swanson, 2014, p. 176). Graikioti et al. (2020) also defined *social entrepreneurial sustainability* as both achieving their social mission and maintaining financial stability.

Given the dual missions that SVs need to achieve to become sustainable, we need to delve into how they do that. A recent study by Siebold et al. (2019) explains the process model for managing SVs' dual missions for growth. We review that model next and argue that a similar model is needed for SV startups, who can use it to design their business models for social and economic sustainability. This model is also useful to understand why a lot of SVs fail within the first year of existence, and even more follow their faith by the third year (Fig. 7.1).

Siebold et al.'s (2019) process model focuses on SVs in their growth stage and the processes identified as well as the outcomes relate to that stage of development. The first part of the model consists of the individual-level factors that facilitate dual

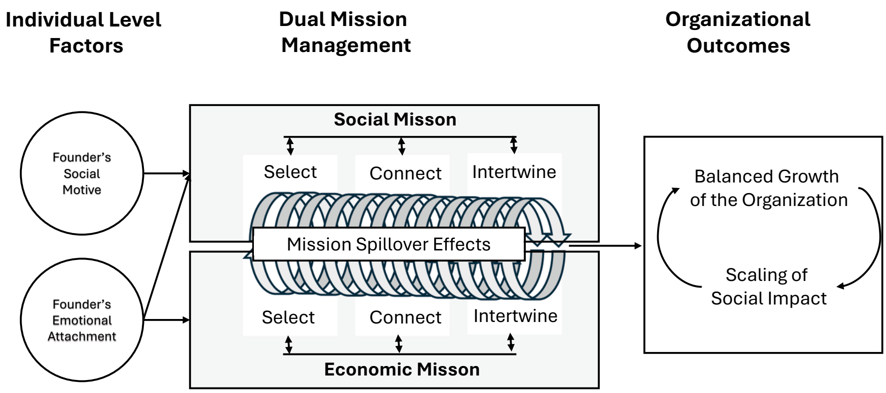

Fig. 7.1 Foundations and processes of dual mission management in SVs (Source: Siebold et al. (2019))

mission management. This stage is related to the founder's background and how this enabled the selection of a social and an economic mission. The two imprinting sources that determined how the two missions were selected were the founder's social motive and their emotional attachment to *both* missions. An interesting finding from their study is the fact that ventures that blended the two missions sustainably had founders who had a strong attachment to both their customers and their beneficiaries. Hence, the founder's emotional attachment to both missions is key for the ventures to select, connect, and intertwine their social and economic missions, that is, for dual mission management. The imprinting sources are the foundation for the selection of social and economic missions. Hence, we argue that those sources are key for NSEs at the start-up stage. Once selected, the dual missions need to be connected and associated with mission spillover effects (MSEs): "MSEs are the intended or partly unintended benefits that help a venture to realize its social mission because of pursuing an economic mission, and vice versa. In the management of dual missions, MSEs are achieved through the processes of (i) selecting dual missions, (ii) connecting dual missions, and (iii) intertwining dual missions" (Siebold et al., 2019, p.722). Their results showed that different degrees of MSEs (either one-sided or two-sided) led to different outcomes in terms of growth and social impact. The three types of outcomes were balanced growth (portrayed as an ideal case scenario in the model), growth with mission drift, and no growth. The two-sided MSEs are the key mechanism for dual mission management that leads to growth, achieves social impact, and avoids mission drift. SVs managed their dual missions, engaging in all three processes to achieve balanced growth as follows: "selecting dual missions based on common values, connecting and intertwining them over time through two-sided MSEs that strengthened and reinforced the interdependence of both missions" (Siebold et al., 2019). On the other hand, one-sided MSEs favored one mission, resulting in growth with mission drift or no growth and minimal increase in social impact, if any.

Mission drift is a process of organizational change that is particularly relevant to SVs, as with growth, some divert away from their social mission to their economic mission (Cornforth, 2014; Kwong et al., 2017). This is more likely for SVs with B1G1 (buy-one-give-one) business models (Marquis & Park, 2014), where the social activities are separate from the economic ones (Santos et al., 2015). Those types of SVs use some of the profits from their commercial activities to fund social activities (Ebrahim et al., 2014). As they grow, these ventures must avoid straying from their social mission, which could harm their beneficiaries and undermine their purpose. Mission drift can damage their reputation and credibility, making it hard to secure resources like funding and support, ultimately threatening their survival.

After discussing the dual mission management process model, we now turn to a brief description of the methods and research setting, where the data vignettes originate from.

Methodology

We used data from a longitudinal ethnographic study the first author conducted over a period of 18 months between May 2014 and July 2015 in an SVI in the United Kingdom (Popova, 2017; Popova et al., 2025). The data was used to construct two

SV case vignettes. While this is not attempted as a multiple case study research strategy (Eisenhardt, 1989; Yin, 1994) in a way that Siebold et al. (2019) have done, we use the case vignettes to illustrate how their model is relevant to NSEs and early-stage SVs. Siebold et al. (2019) show the ways SVs manage dual missions in the pursuit of growth, while we propose and illustrate how NSVs the dual missions emerge in the first place in the pursuit of social and economic sustainability. We purposefully selected the case vignettes to illustrate the possible outcomes for NSVs—*social and economic sustainability or unsustainability.*

The SVI is a particularly suitable place to study NSVs. The initial study was based on a cohort of 11 social entrepreneurs who applied to the incubator and were selected through a competitive process. Some of them were very early stage, where they just had an idea, whereas others had been working on their idea for a while, with one that had already received some initial funding from a previous incubator. What they had in common was the strive to become investment ready and sustainable within 12 months (by the end of the incubation program). They all had a social mission, as that was part of the admission criteria. This research setting thus provided rich data on NSEs and their ventures, which we now use to underpin and develop a model of dual mission emergence for early-stage SVs.

Vignette Presentation

Here, we present two illustrative vignettes of two SEs and their nascent ventures.

Social and Economic Sustainability

Lucy, an experienced occupational therapist, founded Avalon Performance to address the rising mental health issues among students. With over a decade of experience in the NHS Mental Health Services, Lucy identified a significant gap in the market for academic coaching while working with students in a psychosis team. Her innovative approach blends coaching, supervision, mentoring, and therapy, offering a tailored and confidential service that removes the stigma associated with traditional counseling.

Lucy's journey began when she noticed that students, much like business professionals, needed performance coaching without the fear of stigmatization. The turning point came when she presented her idea at an event where she learned about the support available from the SVI. Joining the first cohort was crucial in helping her develop a sustainable business model that includes partnerships with businesses and academic institutions. By offering coaching services to businesses, Lucy can offset the costs of providing free or subsidized coaching to students in need, which is an example of a variation of the B1G1 business model. However, the scale of the start-up and the way it is organized uses the same people who coach the businesses (the customers) to coach the students (the beneficiaries), which demonstrates a good level of connection between the economic and social mission.

When Lucy first applied to the program, her connection to the social mission was really obvious, but she did not have an idea of her economic mission. Lucy clearly had the right background to deliver her social mission, and it provided her with the opportunity to identify the gap in the market. Working on her own, she struggled with making the business sustainable before joining the incubator because she did not have a business background. Once she joined the program, she had meetings with a few of the business advisors. She did not know much about business models when she had a chat with one of the business advisors at the SV weekend. That is when the idea of offering her services to businesses came about in order to subsidize her work with students. Later on, after a talk to the program director and one of the advisors on the program, she also realized that she needed to put her prices up and spend time on her business development (the economic mission): “I’m probably going to have to spend three days a week running the business, and only maybe two days a week doing clinical work” (interview 1). She did not have much confidence with money and did not envision seeking investment. However, through confidence building and networking, and the business support too, at the end, Lucy felt like a successful entrepreneur. She managed to select an economic mission and identified a suitable business model (B1G1). She was making more money than expected, and she also hired another occupational therapist for her practice while in the incubator. By the end of the year, Lucy had a healthy revenue stream and was planning to implement an impact-measuring system that was funded by the SVI. She had taken two colleagues on and became financially sustainable: “here’s a definite shift in the sense that I do realise that I can be an entrepreneur, I am an entrepreneur. I have a company … I do feel like an entrepreneur and I have the confidence now that I can run a business … I have certainly learnt, and my confidence has grown, and I’m looking ahead now and I can see that there can be quick, big shifts quickly and I need to be prepared for them … And I know I have a viable product or a viable business” (interview 3).

Unsustainability

Nate had 20 years of senior management experience in education, health, and social care as director of client services at YMCA (12 years), national director of a charity that works with schools and prisons (6 years), and then just before joining the incubator, he was the CEO of a disability charity (8 years). The charity had to close down, and he was trying to find a business model in order to continue the social mission of the charity and develop the services into a package that he could sell in search for financial sustainability. DEVPEPA aimed to provide support packages and resources to disabled, elderly, and vulnerable people to enable them to employ PAs or care staff, and also to organizations that support vulnerable people to live independently. A few months into the program, he made his first sale of £2000, but “that didn’t really develop into further sales with other charities” (interview 3). Another couple of months later, Nate made a reverse transition back to employment. He also did not engage with his business advisor much and stopped seeing him after that. However, he did not feel he personally failed as he was "going back into the charitable sector and applying the learning that I've got from social enterprise and taking it back into the charitable sector" (interview 3). He went through a personal learning journey, but the venture journey was not successful in terms of generating the income he needed to live on, and thus, he decided to have a well-paid job, taking the entrepreneurial learning back to being an employee. However, similarly to another entrepreneur on the program, he did not want to give up his venture completely:

"and I think that that was—I don't think any of us would have been selected on the programme by Beth and you, and the rest of the team if that passion and expectation, and aspiration wasn't there. So I just think it's all been tempered by the reality of putting bread on the table. If your business is not earning that money to do that, you've either got to do it, do something different in terms of the social enterprise, or supplement it with other income. And so I haven't totally stopped DEVPEPA, I do it one day a week and that, in a sense, I'd like to think that I can keep it ticking over until such time as I retire, possibly, when I'm getting on a bit. So maybe in six, seven years' time I can return to it when I'm retired, and I've got a pension and I can just carry on doing DEVPEPA, and without the pressure on me for it to have to earn me money and put bread on the table."

This entrepreneur failed to find an economic mission to help him achieve social and economic sustainability. The lack of a good economic mission that can support the social one was damaging. He could not find a way to monetize the product, although his motivation and attachment to the social mission were strong; his inability to commercialize the product led to an unsustainable outcome for the venture and him returning to employment.

Discussion and Conclusion

What is common for early-stage SV is their strong social motivation and attachment to the social mission, as evident in the two vignettes presented above. The journey to reaching social and economic sustainability is therefore primarily focused on finding an economic mission and developing a robust business model. Most social entrepreneurs do not have a strong background related to their economic mission; however, this does not lead to a negative outcome as described by Siebold et al. (2019). Venture founders like Lucy, who have no background related to an economic mission, are still able to find and select one. In those early stages, the external support and networks she received helped her find an economic mission that is congruent with her social activities and enabled the connection of the social and economic missions in a sustainable business model. In turn, in 12 months, she had reached both economic and social sustainability. The information exchange process with others who supported her learning and development was enabled by the incubator. Those who manage to discover the right economic mission and begin commercial activities reach social and economic sustainability.

By connecting Siebold et al.'s (2019) model to the sustainability literature, we show how it is relevant to early-stage SVs that strive for sustainability. Here, we also see that the first individual-level factor, social motive, influences the selection of the social mission. We observe that both individual-level factors in the model are important for the choice of social mission. However, most nascent entrepreneurs have a strong emotional attachment to the social mission only and do not yet have an economic one, whereas with more developed ventures, Siebold et al. (2019) found that the emotional attachment was strong to both the social and economic missions (the ones that exhibited balanced growth). The reasons for that were strong attachment to previous education, work experience, or private life events.

MSEs are also not key at the emergence stage due to a lack of an economic mission in the first place. The emergence of the economic mission is therefore a prerequisite for MSEs to occur. However, entrepreneurs lacking background or experience related to the economic mission are still able to reach sustainability due to engagement with external support networks that enabled the learning related to business models and financial activities. Therefore, those are key elements in the emergence of an economic mission. Thereafter, ventures are able to monetize and commercialize their products or services and reach social and economic sustainability. However, more research is needed to determine the antecedents that lead to dual mission emergence in nascent SVs in order to further develop the model for social and economic sustainability.

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Chapter 8
A Study of Homestay Startups for Senior Women Entrepreneurs in India: Sustainability, Equity, and Empowerment

Minu Mehta and Boishampayan Chatterjee

Abstract This chapter builds a model for homestay businesses for senior women entrepreneurs and seeks to understand the possibility and challenges of commercialization of existing endowments at one's disposal for a possible profitable venture. The chapter focuses on women homeowners in the age bracket of 60 years or more. In India, most people retire from active employment around 60 years of age, and it becomes increasingly difficult for most of them to find avenues of income generation that accommodate their age-related physical and mental challenges. This is all the more true for senior women. The authors argue that homestay businesses can fill this gap. A homestay business model falls in the category of sustainable innovation as it offers the woman the opportunity to monetize both her experience as a homemaker and the home itself. Thus, it paves the way for social and economic empowerment for women in their advanced age. An exploratory model is built to understand the intention of senior women homeowners to translate their functionality into capability and the underlying challenges thereof. Since homestay businesses offer an opportunity to utilize their existing skill sets and resources, the newly created entrepreneurs can become agents of change. This could, therefore, become a sustainable business venture for senior women, utilizing their pre-existing facility and functional ability for their socio-economic well-being. The chapter develops a conceptual framework to explore the idea that the functional knowledge that women homemakers possess is an expertise that can enhance the capability of becoming a successful entrepreneur. Furthermore, the chapter explores the possible challenges and policy interventions that can encourage more elderly women to optimize the commercial opportunity of converting their existing residences to homestay businesses.

Keywords Homestay · Startup · Women entrepreneurs · Sustainable innovation

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Homestay Business and Senior Women

As per the Government of India statistics,[1] in 2024, 12% of India's population comprised senior citizens (citizens above the age of 60 years), and women formed 58% of this category. It is estimated that although population growth will fall from 12.4% between 2011 and 2021 to 8.4% between 2021 and 2031, the elderly population growth is projected to increase from 35.8% to 40.5% during the same time periods.[2] Further estimates show that the old age dependency ratio for females is expected to increase from 16.7% to 21.5% from 2021 to 2031.[3] This accords an urgency to evolve models of social and economic engagement suitable for a growing population of citizens who are past their active professional phase. The authors feel that while a lot of attention is generated for the well-being of senior citizens through the provision of mental and physical care, there is a need to develop dignified avenues that offer opportunities to be socially active and economically productive.

This chapter builds a model for senior women who are homeowners and thus have the potential of turning into homestay entrepreneurs. The homestay business works more favorably for women homeowners than men, as they have spent more time and thus gained more expertise for homemaking, thanks to the skewed division of labor popularized by patriarchy. As they step into their 60s, most women find themselves less occupied with professional duties, having already retired. Those who were never part of the active workforce and had dedicated all their time to homemaking, also find themselves to be more free with children having grown up. Homestay business provides a suitable platform for senior women, with or without prior work experience, to set up a profitable business, as the two critical requirements, the existence of a home to set up the homestay and homemaking experience, are taken care of. What is required is the ability to convert an existing property one is living in into a commercial establishment that can be rented to guests for short stays.

Most existing research on third-age entrepreneurship focuses on the likelihood of senior citizens becoming successful entrepreneurs. However, no conclusive evidence can be found on senior citizens' willingness and ability to become successful entrepreneurs after the age of 60 years. The existing literature has identified several predictors that impact the intention of senior citizens to consider entrepreneurship post-retirement. In their research, Hart et al. (2004) studied the 2003 Global Entrepreneurship Monitor (GEM) UK survey data and found that prime-age people are twice as likely as senior citizens to pursue entrepreneurial activity. Similarly, Kautonen (2008) estimated that in Finland between 2000 and 2006, the rate of starting a business was 50% higher for ages 20–49 years than 50–64 years. Similar observations were made by Curran and Blackburn (2001), as they found that a very

[1] https://www.niti.gov.in/sites/default/files/2024-02/Senior%20Care%20Reforms%20in%20India%20FINAL%20FOR%20WEBSITE_compressed.pdf.

[2] https://www.statista.com/statistics/1302844/india-ageing-population-growth-rate/.

[3] https://www.statista.com/statistics/1303304/india-old-age-dependency-ratio/.

insignificant proportion of individuals in the age group of 50–75 years were willing to take up entrepreneurial activity. This lack of willingness of senior citizens toward entrepreneurship is explained by the fact that elderly people prefer to employ themselves in relatively less risky ventures that can give instantaneous returns (Lévesque & Minniti, 2006).

In sharp contrast, several studies claim that older people are more likely to engage in entrepreneurial activity than younger ones (Singh & DeNoble, 2003; Weber & Schaper, 2004). The authors argue that the rich networks of the senior citizens may facilitate in garnering resources needed for any business (Lechner & Dowling, 2003). Also, the expertise that the senior citizens acquire from their work experience in terms of technical and managerial skills makes them better suited to running a start-up (Kibler et al., 2012). Along similar lines, Hinz and Jungbauer-Gans (1999) have documented that the success of a business is strongly dependent on the entrepreneur's industry knowledge and that older people are more likely to innovate and implement transformative business practices.

Various studies have identified push and pull factors that support the entrepreneurial intention of senior citizens. Pull factors are the positive aspects that attract a senior citizen toward entrepreneurship, while push factors are some negative aspects of the current environment that compel a senior citizen to consider entrepreneurship. Kibler et al. (2012) state that entrepreneurship offers attractive pull opportunities for older people to generate additional revenue in their retirement years, allowing them to maintain their preferred standard of living. The push factors can be the individuals' aversion to their current occupation or way of life, family dynamics, age, level of education, and network of support (S. Mueller & A. Thomas, 2000). Muhammad Nizam Zainuddin (2011) uses the Ajzen's theory of planned behaviour to evaluate the push and pull factors of entrepreneurial intention. The study finds entrepreneurship education as a significant pulling factor for students majoring in entrepreneurship towards entrepreneurial intention. According to R. Brockhaus (1980), push factors like losing one's job or being completely dissatisfied with one's current employment can often lead to the commencement of an entrepreneurial journey. Prior experience like overstressed professional lives that did not allow work–life balance might push older individuals with sufficient experience, financial means, and knowledge to pursue entrepreneurship as a more flexible and preferred option than regular employment (Teemu Kautonen, 2013). However, other factors more positively viewed in most societies, such as the prospect of using one's training and exposure to the business world, may "pull" some people to launch a new business by motivating them to look for and take advantage of new opportunities (N. Krueger & D. Brazeal, 1994).

During the last decade, the homestay model has drawn significant research attention with its growing popularity as an alternative to traditional forms of accommodation for travelers, such as hotels, hostels, and lodges. An initial study by Frochot and Morrison (2001) explores how homestays can play an important role in promoting local customs, food, and hospitality and facilitate cultural exchange. Further research along these lines was done by Gursoy et al. (2010), Hall (2019), and Li et al. (2024), who also stated that idle residential properties, when transformed into homestays, can be a steady income stream for homeowners. Swarbrooke and Horner, S. (2004), Gursoy et al. (2010), and Font and McCabe (2017) highlighted the sustainability aspect of homestays. These studies argued that homestays can be beneficial for environmental conservation as they support local businesses and propagate eco-friendly tourism.

Another line of research studied the customer perspective on homestays, focusing on understanding the important factors that tourists consider for accommodation. These studies have found factors such as guest satisfaction, service quality, quality assurance, feedback mechanisms, host communication skills, housekeeping, and cultural sensitivity impact the choice of accommodation for tourists (Nunkoo & Ramkissoon, 2012; Wang & Nicolau, 2017; Lim & Kim, 2016). In particular, Xiang and Gretzel (2010) find that tourists choose to stay in homestays on account of cultural authenticity and personalization services that they offer, which traditional forms of accommodations cannot manage. Further to this, Muhar et al. (2018), Rana and Bisht (2023), and Takaendengan et al. (2022) added that customers prefer homestays with a safe and tranquil environment, preserving cultural and natural values. There is a dearth of literature from the service provider's perspective on homestay businesses in the context of India (Sood et al., 2017; Thakur et al., 2023). In particular, there are limited studies on women-run homestays (Acharya & Halpenny, 2013; Gu & Wong, 2006; Yaja et al., 2023) and no specific research on senior citizen women managing homestays.

In 2002, the Ministry of Tourism, Government of India, launched an international tourism campaign with the title "Incredible India" to promote tourism in India. In 2018, the Government of India rebranded homestays as Incredible India Homestay Establishments and linked them with the Incredible India tourism campaign. Under this scheme, a homestay is defined as a residential establishment where the owner/promoter and his family physically reside and have one to six rooms for letting out. The government has come up with general guidelines regarding the infrastructure, set up and logistics of homestay establishments.[4] State-specific fiscal and non-fiscal incentives such as reimbursement of registration fee, reimbursement of expenditure on furniture and furnishings, subsidized hardware setup for provision of internet, provision of free/subsidized software for operation of homestays, and so on are provided by the state government's tourism department.[5] In 2022, the Government of India, as an initiative toward Atmanirbhar Bharat has launched a national strategy for the promotion of rural homestays. Many incentives are provided by the government such as exemption of rural homestays from licensing, benefits under schemes for self-employment and enterprise development, and dedicated state schemes for financial support to rural homestays.

[4] https://nidhi.tourism.gov.in/uploads/gallery/1659456723.pdf.

[5] https://goatourism.gov.in/homestay-tourism-policy/.

Factors Influencing Entrepreneurial Intention

This study intends to test the factors that majorly influence the readiness of women who are 60 years or more in age, to start a homestay business. While developing the general framework of the study, the authors conducted in-depth interviews with 25 senior women who were homeowners. Fifteen of these women had recently retired or were on the verge of retiring from full-time jobs, while 10 women had always been homemakers. The insights gained from the conversations helped the authors to understand the critical importance of four factors: Financial Need (FN), Social Engagement (SE), Ability Endowment (AE), and User Behavior (UB), which influence the Behavior Intention (BI) of the women to start a homestay business. FN, as the term clearly implies, is the monetary motivation behind the intention of the senior woman to start her homestay business. SE as a factor refers to the opportunities to remain socially active long after their prime years that motivate senior women to consider becoming entrepreneurs. AE is the existing capabilities of homemaking and home ownership that give women the confidence to start a homestay business. UB refers to the technology engagement of the women that can be gainfully deployed for running their homestay business. It is their ability to use the internet for online transactions, e-commerce, and social platforms. BI is the entrepreneurial intention of the senior women to monetize their residential properties by converting them into homestays.

Of these four factors, the conversations with the respondents suggested that the two factors AE and UB had foundational importance, while the other two factors FN and SE were the motivators that goaded the senior women to become entrepreneurs. Accordingly, the authors categorized AE and UB as “Enablers” and FN and SE as “Inducers.” The enablers thus refer to the preconditions in the absence of which it is very difficult for a woman in her 60s to set up a homestay business. For instance, a senior woman, however motivated, cannot set up a homestay if she does not have a rentable property. She has to first acquire a property and then start her business, which delays the process given the challenges of searching, negotiating, and buying a property, in addition to arranging the required capital. The longer the delay, the lesser the chances of beginning a new venture, as health indices decline rapidly as old age sets in. One of the respondents, Renuka, shared with us, “Immediately after her retirement from the government job, my sister was toying with the idea of setting up a coaching class but did not have the required infrastructure of a large enough spare room that could be converted into a classroom. In the absence of any option to rent a place nearby, the idea had a slow death, and when an opportunity actually arose to construct an additional room, my sister dismissed the proposal as she had lost all motivation. Learning from this, I decided to have a business that I could immediately start. What I have is an apartment that needs very little modification to become a homestay. So by the next three months, when I retire, I will be ready to start my homestay business.”

The qualitative study also offered insights on the primary importance of inducers, as the mere existence of enablers does not automatically get translated into a strong entrepreneurial intention. The authors came across a few cases like that of Rachna, a homemaker with a spacious villa who reported no interest in the homestay business. “My home is for me. I am not interested in allowing strangers into my private space. I don’t think it is worth the effort,” she said. Thus, as the authors understood, the enablers are the necessary conditions for the senior women venturing into the homestay business while the inducers play the role of sufficient conditions when enablers are present. A comprehensive questionnaire based on these factors was administered to 517 respondents who were women in the age bracket of 60 years and above and were single or joint owners of their residential properties.

As Fig. 8.1 shows, for most of the respondents, AE is the most important factor that allows them to consider becoming a homestay entrepreneur. As Malti, a retired school teacher from Prayagraj, confided, “I never thought I can run a business as I have no prior experience or training. However in the recently concluded Kumbh[6] festival, I found a great opportunity. I live near the Arail Ghat, close to the main pilgrimage site, the meeting of the three rivers of Ganga, Yamuna, and Saraswati. As thousands and thousands of pilgrims came to Prayagraj to take a holy dip in the rivers, there was a huge shortage of accommodation for travellers. I l offered as homestay option, two bedrooms of my humble home as a tiny contribution from my side to make the Kumbh festival a great success. I intended to help the pilgrims and the business aspect was not even in my mind. However, people were willing to pay anything ranging from Rs 2000–3000 for a night’s stay. I discovered I could be a homestay owner. I have managed a large family for the last 30 years, so I have the required experience and skills.” Another respondent, Aparna, from Alibaug, a tiny coastal town approximately 100 km away from Mumbai, shared how she has witnessed Alibaug’s growing popularity as a weekend getaway and is seriously considering converting her farmhouse into a homestay. She said, “I have a house in the middle of my farm. All I need to do is construct a washroom attached to the spare

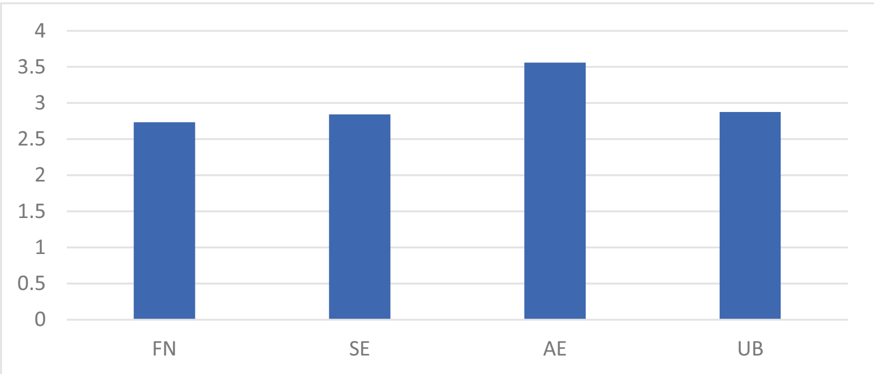

Fig. 8.1 Median scores of FN, SE, AE, and UB

[6] https://kumbh.gov.in/.

three bedrooms, and I will be ready to host the guests. Freshly plucked vegetables from my farm and fresh catch from the sea will be an added attraction. I am a great cook. I know I can pull it off." Thus, AE, that is, the existence of both skills and the infrastructure, has emerged as the most important enabler for senior women.

UB is another critical enabler that supports the prospective entrepreneur since it gives the woman the proficiency to use technology for business purposes. Since the woman is adept with internet-based operations ranging from online payments to engaging with friends and family, it is reasonable to expect that she will be able to handle homestay bookings, queries, and feedback. We attempted to understand if the prior experience of the respondent influenced the relative importance of AE and UB. As shown in Fig. 8.2, across the different categories of prior experience, all the respondents rated both AE and UB as important and, among the two enablers, gave higher scores to AE. This shows the critical importance of AE, as it offers the primary infrastructure for a homestay business.

Similar results were found when we examined the educational background of the 517 respondents. Across all categories, the women rated AE as more important than UB, as seen in Fig. 8.3. One reason could be the possibility of outsourcing work related to business operations, in case the woman was not adept at internet usage for business work. The authors came across a few examples where the respondents mentioned their lack of ease with social media platforms. However, it was not viewed as a debilitating factor, as they could always ask someone else to perform the task. Nethravathy, a prospective homestay owner, confided, "I don't know how to make reels and upload on Instagram which other homestays do. I have asked my grandson to look after this aspect. He is always on his phone so it shouldn't be a big issue for him."

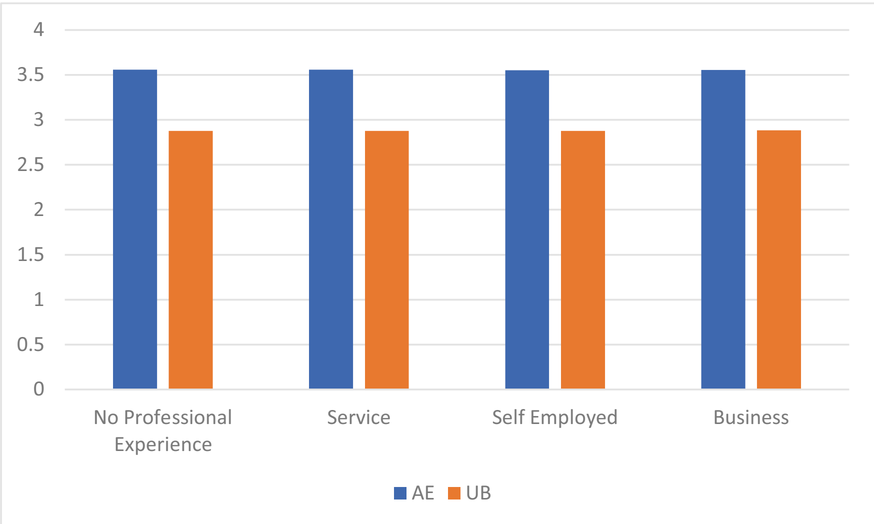

Fig. 8.2 AE and UB across professional background

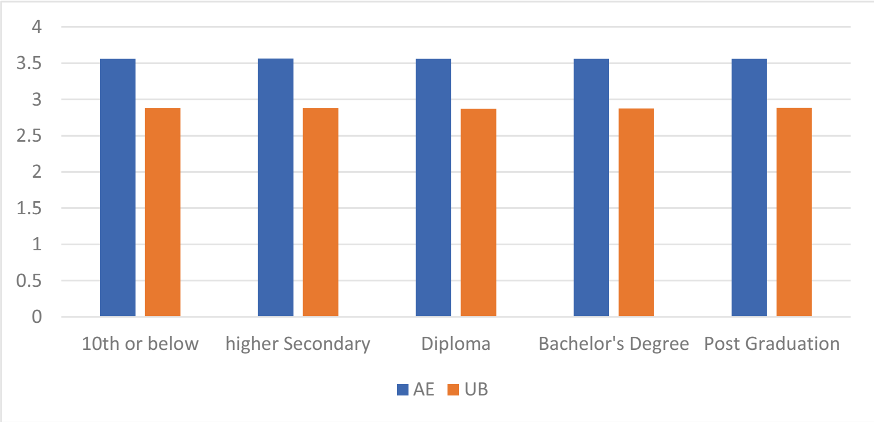

Fig. 8.3 AE and UB across educational background

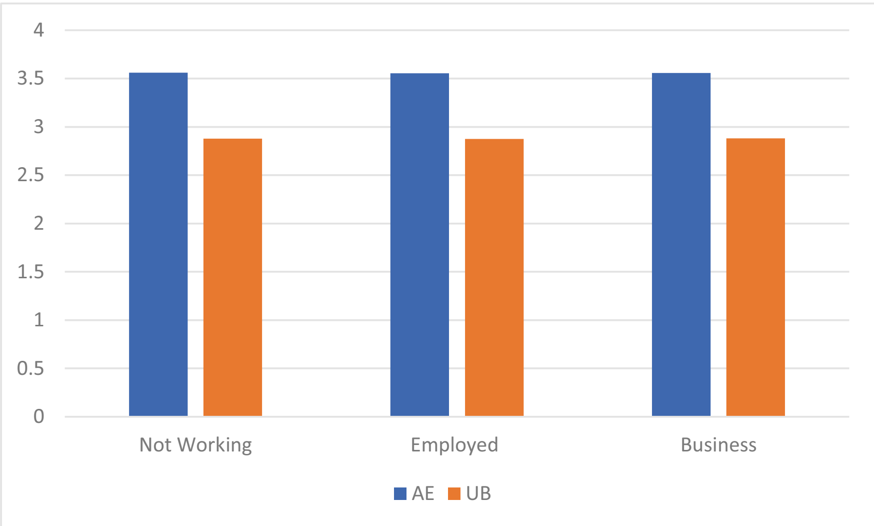

Fig. 8.4 AE and UB across current work status

AE continued to be given more importance than UB irrespective of the current work status of the respondents (Fig. 8.4). Whether the women were currently unemployed, working, or in business, they felt that property ownership was more important for them to consider a homestay business, compared to their ability to use technology for running the business. Sumana, who was planning to retire from her existing garment business and start a homestay, felt that technical skills can be learnt and so are easier to manage if one does not already have them: "I have handled a traditional readymade garment business with hardly much need for online skills. However, if needed, I am willing to join a class or a short-term training program to understand how the hospitality industry works."

Coming to the inducers, that is, FN and SE, the authors were surprised by the results. It was expected that FN would be a stronger inducer than SE. However, as the graphs in Figs. 8.5, 8.6, and 8.7 show, across the categories of education, prior experience, and current work status, the respondents rated SE higher than FN. The educational background did not significantly impact women's need to stay socially engaged. Most women reported having more time on their hands with diminishing demands of family responsibilities. "Now is my time to enjoy life. Homestay gives me the ability to earn money and also stay socially connected. I get to welcome guests home, interact with them, make friends, and spend my time usefully," said Manjushree, who seemed to be very happy with the prospect of homestay business.

Prior experience had little impact on the choice between FN and SE as the inducers for entrepreneurial intention. As per Fig. 8.6, women respondents who have always been homemakers, those who worked in the service sector, were self-employed, or had some prior business experience, accorded more importance to SE than FN. Thus, women, irrespective of their work histories, felt more motivated by the opportunity for SE than the pecuniary benefit of income generation. It was found that homestays are perceived as more upmarket than renting one's property to tenants for yearly contracts. As alternatives to hotels, they need to cater to demanding customers who come for short-term stays. Curiously, women found this arrangement interesting as it offered them a sense of pride and accomplishment to have guest-friendly apartments and customized services for amenities like food. "It is not the money that I find most exciting. It is my ability to make the guest happy. I have spent my entire life trying to make my extended family comfortable and happy. All

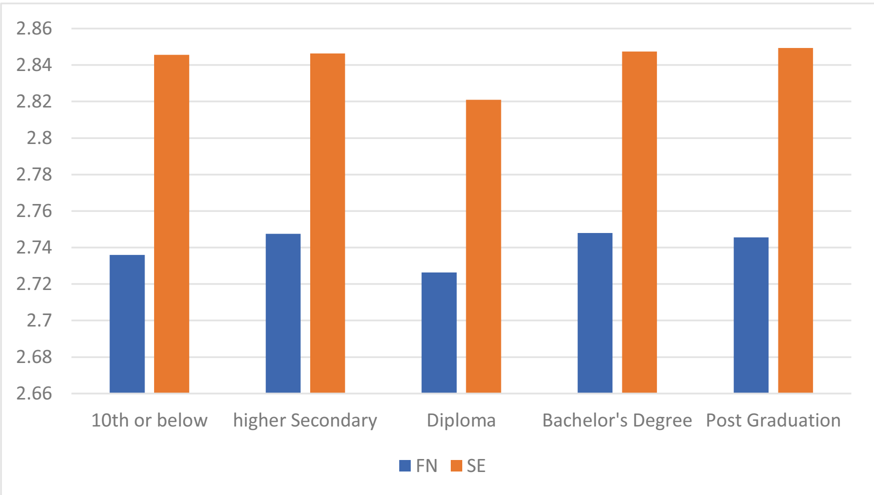

Fig. 8.5 FN and SE across educational background

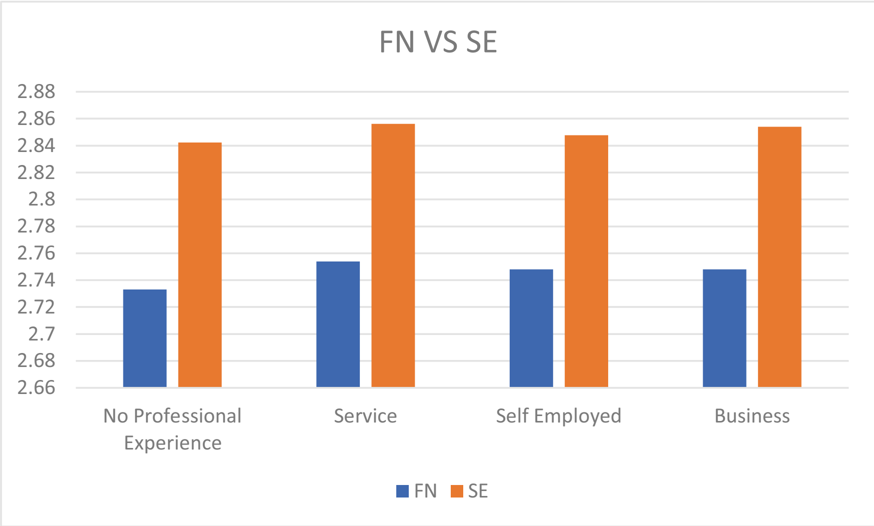

Fig. 8.6 FN and SE across professional background

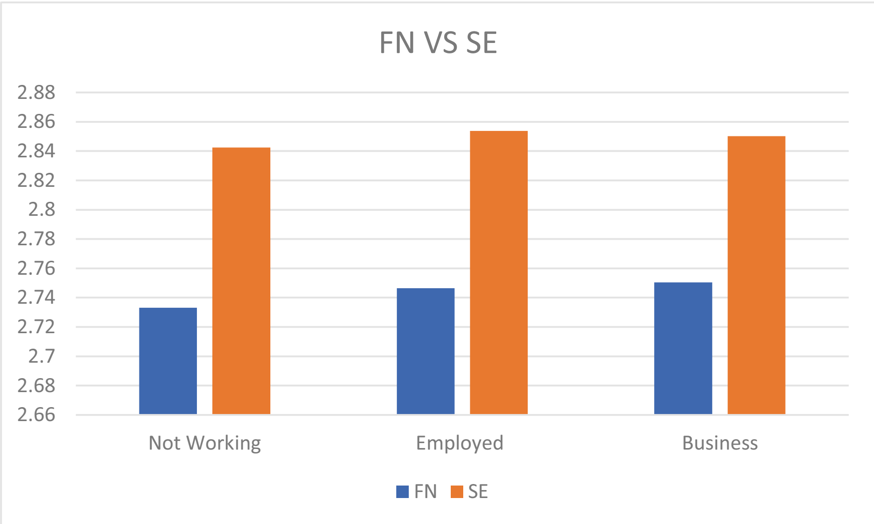

Fig. 8.7 FN and SE across current work status

that experience I can use now," said Madhumita from Darjeeling, a bustling hill station in West Bengal.

Similarly, it was seen that (Fig. 8.7), whether currently working or not, women respondents acutely felt the need to stay socially engaged. As Swarnalata, a homemaker, confided, "My only interest in homestay business stems from the prospects of meeting guests and interacting with them. As an empty nester, I feel lonely. With children settled in distant places, there are very few opportunities for SEs. Hardly anyone visits us now. I actually don't need the money. I need a reason to decorate my house and cook my signature dishes. Homestay gives me that opportunity."

BI is the expression of the readiness of the respondent to start her business. The purpose of Fig. 8.8 is to establish a correlation between education and entrepreneurial intention. As per Fig. 8.8, BI was reported to be the highest among postgraduate respondents and the lowest among diploma holders. Diploma holders usually obtain vocational training and are trained to obtain some specific skill required to do a particular type of job, like tailoring, nursing, and so on, thereby having a lesser inclination toward starting a homestay.

As far as prior experience is concerned, as Fig. 8.9 shows, women with a service background indicated a higher BI compared to those who were self-employed or in business. This is reasonable as self-employed or business women find it more rewarding to continue their current work than start something afresh. Women who had always been homemakers were hesitant to venture into business and thus showed the lowest BI. Thus, any policy intervention by the government in the form of training or support, like subsidies, should aim to catch women on the verge of retirement, as they are most likely to consider entrepreneurship. Also, loss of a steady stream of income as well as opportunities of SE is experienced most acutely by women who retire from active employment after putting in long years of service. Self-employed women and businesswomen are more likely to continue with their existing income and social activities for longer periods.

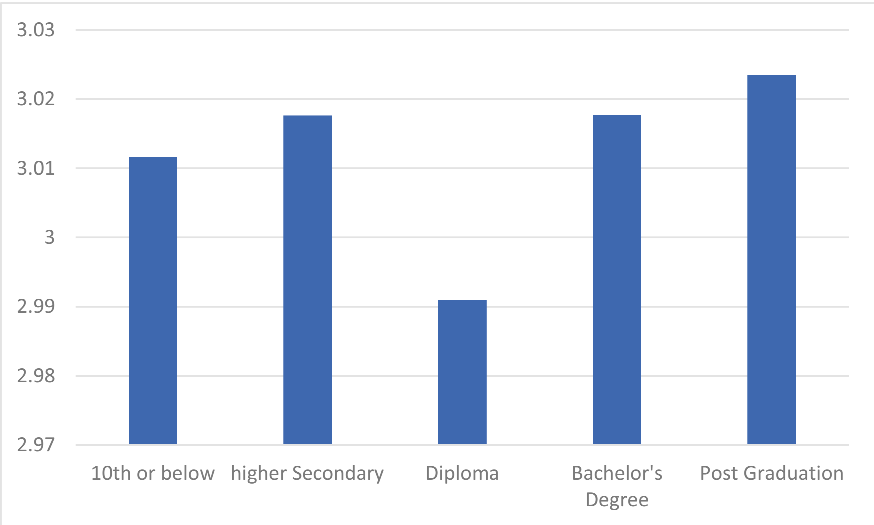

Fig. 8.8 Median BI scores across educational background

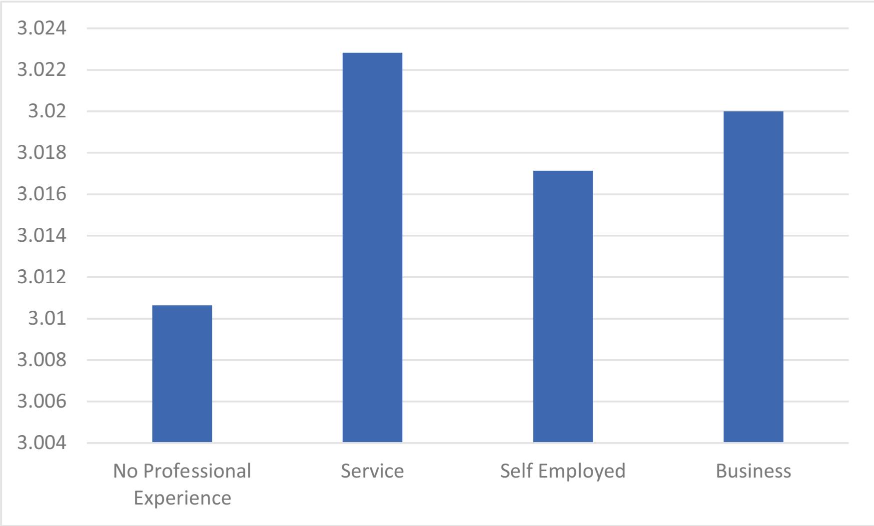

Fig. 8.9 Median BI scores across professional background

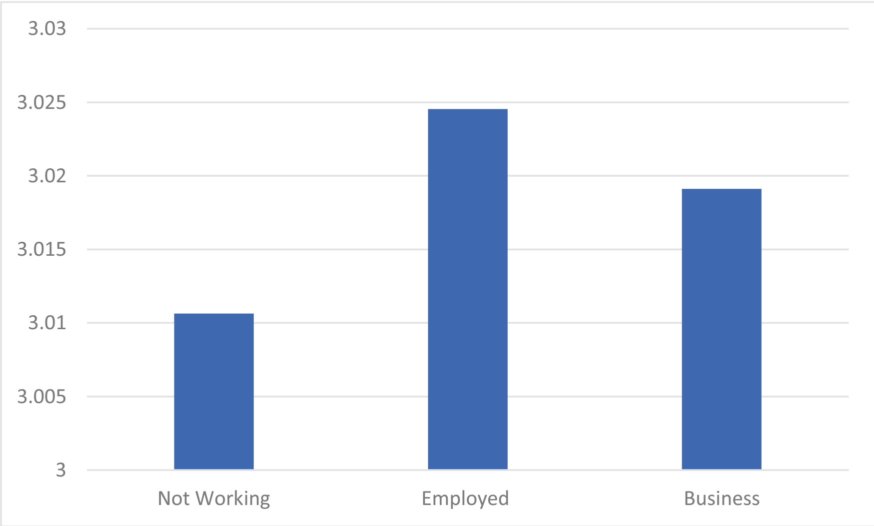

Fig. 8.10 Median BI scores across current work status

This observation is reinforced through the graph of Fig. 8.10, where currently employed women report the highest BI compared to those not working or in business. As Purnima from Mumbai said, "I honestly feel lost and depressed as I think about my impending retirement next month. I am considering starting a homestay business as it will keep me occupied and also put to good use my housekeeping skills as well as my pretty house."

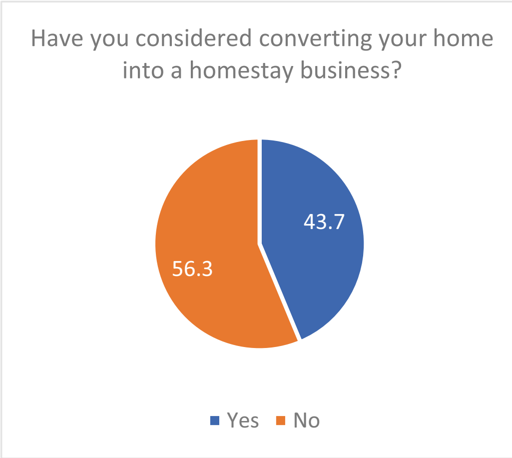

Fig. 8.11 Percentage of women willing to convert their home into home-stay business

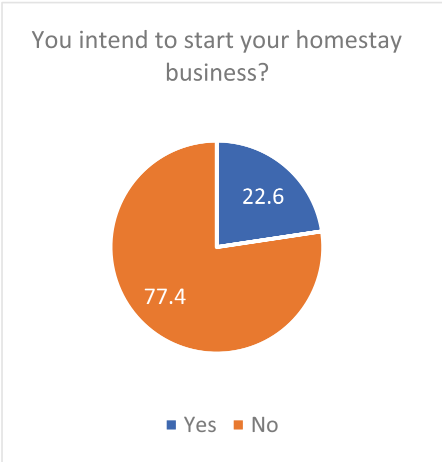

Fig. 8.12 Percentage of women intending to start home-stay business

When pertinently asked if they had considered converting their existing apartment into a homestay business, more than 40% of the respondents replied affirmatively (Fig. 8.11), showing a high potential of entrepreneurial possibilities for senior women. However, when asked if they actually intended to start their homestay business (Fig. 8.12), less than one-fourth of the sample said yes.

Table 8.1 represents the correlation values of FN, SE, UB, and BI. Both FN and SE as inducers have a significantly strong association with BI. SE again appears as a more prominent factor than FN affecting BI. At the same time, it is also observed that there exists a significant correlation between the inducers (FN and SE) and the enabling variables AE and UB. Finally, AE and UB also significantly affect BI. Thus, the correlation figures not only exhibit a simultaneity in the impact of FN, SE, AE, and UB on BI, but also that AE and UB may act as mediating factors in the influence of FN and SE on BI.

Table 8.1 Correlation matrix

	FN	SE	Ability Enhancement	UB
Ability enhancement	0.139 (0.0015)	0.180 (0.0000)		
UB	0.249 (0.0000)	0.283 (0.0000)		
BI	0.472 (0.0000)	0.541 (0.0000)	0.390 (0.0000)	0.505 (0.0000)

Figures in parentheses indicate p-values. All p-values are less than 0.01, indicating that the correlations are significant at a 1% percent level

Table 8.2 Regression analysis

Variables	Coefficients	
Intercept	0.611	0.497
Ability enhancement	0.226***	0.209***
UB	0.272***	0.254***
FN	0.297***	
SE		0.365***
R^2	0.433	0.47
F-stat	130.51	151.64
N	517	517

*** $p < 0.01$

Table 8.2 summarizes the results from the following regression models:

$$BI = \beta_0 + \beta_1 AE + \beta_2 UB + \beta_3 FN \tag{8.1}$$

$$BI = \alpha_0 + \alpha_1 AE + \alpha_2 UB + \alpha_3 SE \tag{8.2}$$

The results confirm that SE emerges to be a relatively stronger predictor of BI than FN. AE and UB also have a significant influence on BI. Given that all the factors are significantly related to BI, it remains to be tested whether AE and UB act more of mediating factors in the influence of FN and SE on BI. These results led the author to hypothesize if the Enablers mediate the influence of the Inducers. Thus, even if BI is directly influenced by FN and SE, its impact gets mediated through AE and UB. The authors further categorized FN and SE into Push and Pull categories. FN compels the respondent to consider entrepreneurship as a viable means to ensure steady finances, and so was classified as a push factor. The opportunity of SE and meeting new people, making more friends emerged as the major attraction for senior women to start a homestay business. So, it was classified as a pull factor. Based on the qualitative responses and the quantitative analyses, the authors propose the following conceptual framework (Fig. 8.13) to test the relationship of entrepreneurial intention of senior women who are homeowners with factors such as FN, SE, AE, and UB. The regression results in this study hint that the pull model turns out to be

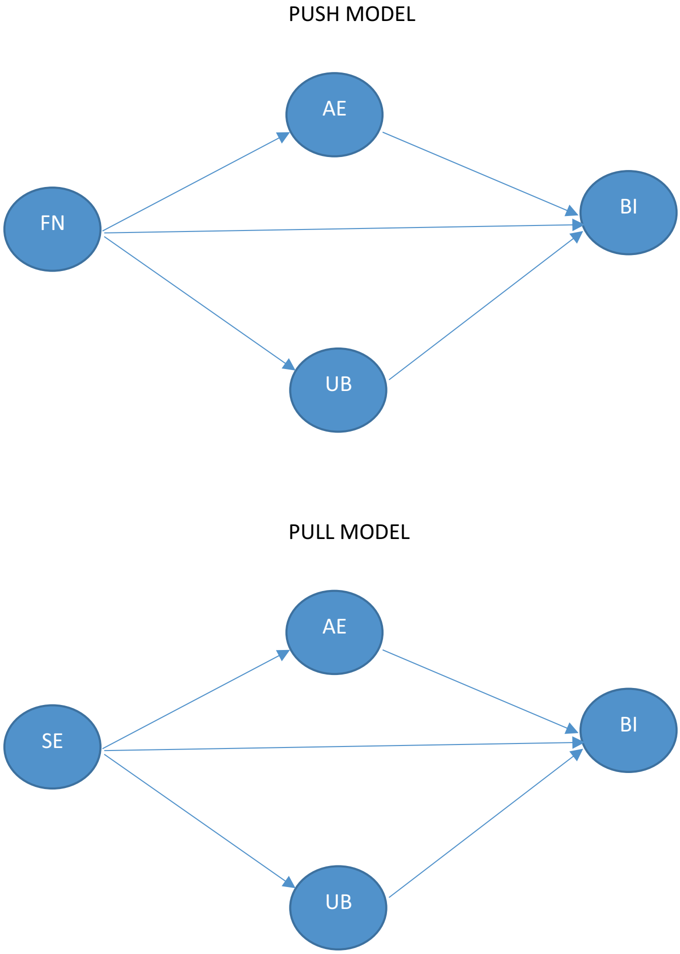

Fig. 8.13 Conceptual framework

better than the push model, as per the R^2. However, further confirmatory analyses of the framework are required in order to test as to what extent AE and UB emerge as mediating factors and also the relative efficacy of the Push and the Pull models.

Conclusion

The authors propose to test the framework developed in a future study to investigate the relative influence of AE and UB on FN and SE. However, even in the absence of further analysis, what emerges is the need to alter the existing perception and narrative centering around senior citizens, especially women. The authors found a gap in the current avenues that support senior citizens. Apart from the health-focused services covering the gamut of physical and mental wellness, there seems to be hardly any other offer besides luxury and affordable old-age homes. The senior citizens are primarily viewed as recipients of a care economy and not as contributors to the economic progress of India. Homestay offers a viable entrepreneurial option to senior women as it builds on the woman's existing assets and skills and has a much lower financial risk than most other businesses. As India experiences a rapidly growing segment of the older population, the authors argue for the need to explore pro-senior interventions such as short-term training programs, subsidized loans, tax exemptions, and a concerted push for popularizing homestays owned and managed by senior women. Local women should be encouraged to form self-help groups to encourage their members to take up rural homestays to supplement their incomes. Self-help groups can be provided with financial and institutional support by the government for promoting homestays. Industries in the field of travel, hospitality, and tourism, in collaboration with the Ministry of Tourism and State Governments, may identify clusters of prospective homestays and undertake their development, capacity building, and marketing.

Homestays offer senior women various advantages. They can work from the security and safety of their homes and experience the sense of achievement and social connectivity that rapidly diminishes with age. The flexibility of choosing to rent their apartments as per their convenience allows the women the ability to accommodate visits of family and friends and take a break from active business as required. They can time the bookings and restrict the number of guests per their choice, thus protecting themselves from unnecessary stress typically associated with the hospitality industry. Besides, homestays, as conveyed by many respondents, add a purpose to the life of the senior women and give them an opportunity and a reason to keep their homes attractive and guest-ready. What prevents many women from exercising this option is a feeling of inadequacy, which could be related to the current condition of their homes or their finances or their business ability. Here, private and government-led initiatives can add value and offer the senior women the chance to live with dignity and independence well into their mature years.

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Part III
Sustainable Marketing and Sales in International Markets

Chapter 9
The Sustainability Marketing Canvas: From Conceptual Chaos to Coherence

Nikolina Fuduric

Abstract Historically, marketing has made a questionable impact on environmental and social sustainability due to a conceptual and level-of-analysis fragmentation. This disjointedness not only impedes theoretical advancement but also hinders the implementation of coherent and sustainable actions. The challenges facing our planet—such as climate change, resource scarcity, biodiversity loss, and social degradation—necessitate a paradigm shift in production and consumption patterns. Marketing, as a discipline with a broad interdisciplinary reach, is uniquely positioned to contribute to meaningful solutions to these sustainability challenges.

This chapter introduces the need for and the logic of the Sustainability Marketing Canvas (SMC), a decision-making framework. It integrates the traditional 7Ps of marketing with the dimensions of Planet and People from the Triple Bottom Line. The logic of the SMC is further elucidated through an industrial taxonomy developed during a pilot study conducted at Hilti AG. The study, implemented across two of Hilti's business units, aimed to facilitate measurability, comparability, and strategic planning.

Keywords Sustainability marketing · Marketing strategy · Sustainability marketing canvas

> …what else is modernization than a process of rational differentiation of society in autonomous, mutually isolated sub-spheres to the point where no one any longer knows what the unity of it all is? We differentiate, we specialize, we hyperspecialize, and then we get puzzled over the fragmentation we have produced around us, between ourselves and even within ourselves.
>
> (Jeurissen, 1997)

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Introduction

Sustainability Marketing, as a concept and as a discipline, still has conceptual problems due to fragmentation in academia and in practice. Ten years ago, McDonagh and Prothero (2014) implored future research to engage with the question "what is sustainability marketing." The fact that, still today, many sustainability marketing definitions exist demonstrates the contested nature of the concept. We cannot seem to agree on what sustainability marketing is, and there are no generally accepted theoretical frameworks that the academic community can agree on. Why is this a problem? If we view sustainability marketing as a phenomenon with siloed terms, models, and frameworks, then we are limiting our understanding of the larger phenomenon set in a complex, interconnected system and, most importantly, the opportunities inherent in it.

At the practitioner level, a key barrier to understanding sustainability marketing is the dominance of compliance-driven strategies (Bhattacharya, 2022). While compliance ensures a level economic playing field and supports ecological and societal goals, it fosters a reactionary mindset that overlooks sustainability's potential for Schumpeterian "creative destruction" (Schumpeter, 2012). The prevailing narrative—"We must complete reports"—contrasts with a proactive, opportunity-driven perspective—"We seek business innovation." A systems-oriented approach reframes sustainability as a catalyst for innovation, optimization, and strategic partnerships, leveraging disruption to create competitive advantages. When commercial enterprises lack straightforward, efficient, and scalable solutions for conducting business in a more ethical and sustainable manner, the environmental and social challenges exacerbated by economic activity will persist and, in many cases, intensify. Without strategic interventions that align profitability with sustainability, commerce will continue to drive systemic issues rather than contribute to their resolution.

The absence of a strong theoretical foundation, coupled with compliance-driven business strategies, has created a fragmented landscape of digital ESG reporting tools and consultancies. This environment resembles a "Wild West" of competing solutions, characterized by information asymmetry—a classic principal–agent problem. ESG tool developers and consultants (principals) sell their expertise to businesses (agents) that lack the resources and knowledge to grasp sustainability's broader implications. This restricted flow of information hinders both corporate progress and academic advancement, resulting in suboptimal sustainability solutions, particularly for resource-constrained SMEs facing increasing reporting demands.

This chapter addresses the conceptual and practical fragmentation in sustainability marketing through the Sustainability Marketing Canvas (SMC). The SMC provides a simple, structured framework to define, conceptualize, and operationalize sustainability marketing for academics, managers, and students. It answers the academic question—What is sustainability marketing?—while offering practitioners guidance on how to implement it effectively.

This study introduces the foundational elements of the SMC: the Marketing 7Ps (Booms & Bitner, 1981) and sustainability's Triple Bottom Line (3BL) (Elkington, 1997). It then examines the current state of sustainability marketing knowledge, highlighting conceptual gaps. Three key findings emerge from the literature:

- A lack of definitional and conceptual synthesis impedes the development of a unified, accessible sustainability marketing framework.
- Planetary and social dimensions of sustainability marketing are often treated separately.
- The 4Ps and 7Ps of marketing are typically analyzed in isolation. In other words, only the product level is analyzed or the placement (supply chain). When considered holistically, the Ps are rarely integrated with *both* planetary and social dimensions.

To address these gaps, the SMC is proposed as a unifying framework. It was tested in two pilot studies. The first at VAUDE GmbH in Germany and then at Hilti AG's headquarters in Liechtenstein, demonstrating its value in providing a coherent structure with a standardized taxonomy for comparative sustainability assessments with the company itself, competitors, and customers.

Method

The first step in developing a holistic sustainability marketing framework is to assess the existing knowledge and conceptual foundations. A literature review was conducted to identify seminal papers defining sustainability marketing. The search focused on academic studies explicitly addressing the conceptualization, definition, or bibliographic analysis of sustainability marketing. Studies on micro-level consumer behavior and macro-level economic or political perspectives were excluded, as they fell outside the scope of this work.

The primary search terms were "sustainability marketing" and "sustainable marketing." The search was later refined by combining marketing's 7Ps with sustainability (e.g., "Product and Sustainability" or "Pricing and Sustainability") to uncover relevant conceptualizations. The SCOPUS database, the largest repository of academic research, was selected for its extensive coverage of journals and conference proceedings.

No timeframe restrictions were applied. Articles were selected based on relevance and, partly, citation count. Whilst citations are higher for older articles, to avoid this bias, newer articles were included, which built upon previous research. This yielded 150 sources. Titles were screened for relevance, followed by abstract reviews and, where applicable, full-text analysis. Additional studies were identified through cross-referencing key sources. After filtering, 15 articles were deemed relevant for analyzing the conceptual landscape of sustainability marketing.

This methodology prioritized studies explicitly using the terms "sustainability marketing" and "sustainable marketing," potentially overlooking relevant discussions in related fields such as channel management or architecture/construction for the "physical evidence" P. However, broadening the scope would have exceeded the study's objectives. The chosen search strategy and exclusion criteria are deemed appropriate for capturing the current academic discourse on sustainability marketing.

Following the identification of literature gaps, the SMC was developed as a holistic framework. To evaluate its conceptual and practical relevance, a pilot study was conducted in 2020 at VAUDE GmbH, a German sports equipment company with approximately 1600 employees. The study assessed the SMC's coherence and applicability to business strategy by mapping VAUDE's sustainability initiatives using internal and publicly available documents. The findings confirmed that the SMC served as a comprehensive conceptual tool, enabling managers to understand their sustainability initiatives in a systems-focused way (Fuduric, 2020). However, the study also highlighted a key limitation, particularly the lack of a standardized taxonomy for categorizing sustainability data within the SMC. This absence hindered comparability across departments, competitors, and customers and would restrict the assessment of sustainability maturity through standardized metrics or KPIs in the medium to long term. We still had the problem of comparing apples to oranges, so to speak.

The next research phase aimed to remedy this weakness. The goal was to refine the SMC from a conceptual sustainability marketing framework into a practical, complexity-reducing decision-making tool. A second pilot study was conducted at Hilti AG, a multinational construction solutions company headquartered in Liechtenstein with approximately 34,000 employees (Fuduric et al., 2022). This study had three key objectives: first, to establish an industry-specific taxonomy using the SMC structure to enable comparability across Hilti's nine business units. We conducted qualitative, secondary research using Hilti's internal and external sustainability reports to code statements and categorize them within the SMC rubrics. Focusing on publicly available reports and data, the same was done for one of Hilti's competitors and for one of their key B2B customers. A total of 1200 statements were coded and cross-analyzed using ATLAS.ti to establish the industry taxonomy. Second, two business units' adoption of the SMC was guided, and its potential application across the remaining seven was evaluated. Third, sustainability maturity was evaluated by comparing the SMC maps of Hilti, their key competitor, and their customer.

This study also identified future research needs, including assigning standardized KPIs to each taxonomy and digitalizing the SMC for simpler and faster usability. Ultimately, these advancements would facilitate rapid sustainability maturity assessments and the scaling of sustainability strategies. We examined the SMC's logic and analytical application at Hilti AG, using two business units: Anchors and Fire Protection for our data sets. To demonstrate the SMC's capabilities, only Fire Protection is presented in this chapter for the sake of brevity.

Literature Background: Conceptualizing Sustainability Marketing

The Marketing Mix

The traditional marketing mix or the 4Ps, namely, product, promotion, placement, and price, has been an enduring marketing management framework since its origin in the 1960s. Academics and practitioners embraced the marketing mix as the indispensable element of marketing theory and marketing strategy development (Constantinides, 2006). The 4Ps are controllable parameters for organizations to drive their marketing strategy and influence the target audience's buying habits and decisions (Brassington & Pettitt, 2007).

In the 1970s and 80s, when global economies were transitioning into services, the 4Ps needed to be updated to include three more service-supporting components: Processes, Physical Evidence (buildings, offices, and stores), and People. At this time, marketing moved from a transaction (sales) to a relationship (service) based activity (Booms & Bitner, 1981; Wilson, 1974). The 7P framework has maintained widespread acceptance and practical utility for over three decades, demonstrating its value through its simplicity and adaptability. Presently, it is the most holistic way to delineate the field of marketing.

Sustainability

A modern version of understanding sustainability stems from the United Nations' Brundtland Report, which divides the concept into three Es—Environment, Equity, and Economics (United Nations, 1987). Later, the three Es were adapted into the three Ps (People, Planet, Profit or Prosperity) or what is called the 3BL (Elkington, 1997). Since then, it has been widely used as a framework to understand sustainability's reach and context. The 3BL then morphed into the environment, social, and governance aspects of the ESGs, often embedded on the corporate analytical level or in the field of finance.

The 3BL invites marketing strategy to see the social, ecological, and long-term economic motives as factors equally important and in interaction with one another.

- The **"People"** variables refer to the positive and negative impact an organization has on its most important stakeholders and the social dimensions of a community or region. They could include: measurements of education, equity and access to social resources, health and well-being, quality of life, and social capital.
- The **"Planet"** factors represent the positive and negative impact an organization has on its natural environment. This includes reducing its carbon footprint, usage of natural resources, toxic materials, effects upon biodiversity, but also the active removal of waste, reforestation, and restoration of the natural harm done.

- Finally, the **"Profit"** aspect focuses on the positive and negative impact an organization has on the local, national, and international economy. This includes creating employment, generating innovation, paying taxes, wealth creation, and any other economic impact an organization has (Elkington, 1997). Elkington viewed "Profit" on the macroeconomic level. Today, sustainable profit is often conceptualized on the meso, firm level, supporting the notion that sustainability activities also need to remain profitable.

Despite the 3BL's popularity, Elkington has criticized the misuse of the economic dimension as an accounting and reporting tool whilst keeping profit-making at the center stage (Elkington, 2018). As Elkington explains: "The 3BL wasn't designed to be just an accounting tool. It was supposed to provoke deeper thinking … Its goal was system change—pushing toward the transformation of capitalism" (Elkington, 2018).

Sustainability Marketing

There is no clear definition of sustainability marketing. Some researchers define it as an environmental concept, others define it more holistically, with definitions from the Brundtland Commission (United Nations, 1987) and the 3BL (Elkington, 2018). Today, it is still an evolving concept (Lunde, 2018). Peter Drucker was one of the first researchers in marketing and management to explore notions of sustainability. He concluded that management "has to consider the action that is likely to promote the public good, to advance the basic belief of our society, to contribute to stability, strength and harmony" (Drucker, 1955). He later argued that firms should produce a benefit for society (Drucker, 1974).

During the 1970s and 1980s, sustainability was viewed through the lens of an environmental focus (Kassarjian, 1971; Kotler & Zaltman, 1971). Products were assessed mainly for the destruction they were causing to our environment. This decade had an ecological and product focus. The 1990s saw these ideas diverge into related concepts such as societal marketing (El-Ansary, 1974), green marketing (Kumar Kar & Harichandan, 2022), green products (Dangelico & Vocalelli, 2017; van Dam & Apeldoorn, 1996), and consumer-focused sustainability (Peattie & Belz, 2010; Peattie & Crane, 2005). In the 2000s, researchers sought to systematize sustainability marketing through comprehensive frameworks, yet the field remained fragmented due to diverse research streams lacking integration (Thomas, 2018).

This fragmentation is particularly evident in the way studies handle the 4Ps and 7Ps of marketing. The Ps are often examined in isolation rather than as interconnected components (Kemper & Ballantine, 2019; McDonagh & Prothero, 2014; Oates et al., 2016; Peattie & Belz, 2010; Thomas, 2018). Research still today disproportionately focuses on planetary sustainability, with social dimensions underdeveloped both conceptually and in terms of measurement.

The absence of a unifying structure hinders the seamless flow of data and knowledge from operational levels to corporate decision-making. This limitation creates a knowledge gap, hindering potential process optimizations and opportunities for sustainability-driven innovation (Thomas, 2018).

Conceptual Gaps

This chapter does not aim to provide a systematic literature review but rather to illustrate the conceptual gaps identified in the preceding section regarding the definition of sustainability marketing. Table 9.1 presents seminal articles that have shaped the field's conceptual development. Additionally, these articles were evaluated based on their emphasis on planetary and social sustainability and their primary focus within the 7Ps of marketing.

This analysis highlights key inconsistencies: First, the absence of definitional and conceptual synthesis among scholars adds to thematic and conceptual fragmentation. This impedes the development of a unified and accessible framework. Table 9.1 on the next page shows that there is little dialogue among scholars to either refute or support conceptualization suggestions. Second, the 4Ps and 7Ps of marketing are often examined in isolation, with studies focusing on individual elements—such as products or supply chains—rather than considering them as an integrated whole. Even when addressed holistically, these marketing models are rarely aligned with both planetary and social sustainability constructs (Pomering, 2017). Third, the focus of a large amount of research is on planetary versus social boundaries. Therefore, the social component of sustainability lags in conceptualization and measurement in the marketing discipline.

Introducing the SMC: A Roadmap

Given these gaps, a holistic sustainability marketing approach must integrate both planetary and social dimensions. As a comprehensive marketing strategy traditionally encompasses the 7Ps, a coherent *sustainability* marketing framework should do likewise. The SMC, presented below, addresses these needs by offering a structured framework that both defines sustainability marketing and guides its implementation (Table 9.2 on page 166).

The SMC provides the most comprehensive current definition of sustainability marketing by integrating widely accepted yet straightforward constructs from marketing (7Ps) and sustainability (Planet & People). It serves as a strategic tool for mapping a firm's existing sustainability initiatives, identifying gaps, and ensuring coherence with operations. When sustainability marketing is viewed from a systems perspective, suddenly overlooked connections turn into opportunities for

Table 9.1 Sustainability marketing literature assessment and gap analysis

Authors	Year	Journal	Citations	Title	Research focus	Planet and people/7P categories
Van Dam Apeldoorn	(1996)	Journal of Macromarketing	606	Sustainable Marketing	A critical assessment of marketing theory: Economic and cognitive approaches	Planet People _______ Products
Peattie and Belz	(2010)	Marketing Review St Gallen	320	SM: An Innovative Conception of Marketing	A new consumer-oriented marketing mix with socio-environmental priorities: • Customer solutions (reminiscent of Products/ Services) • Customer cost (reminiscent of Price). • Convenience (reminiscent of Place or distribution) • Communication (reminiscent of Promotion)	Planet People Product Price Place Promotion
Gordon et al.	(2011)	Marketing Theory	568	A Framework for Sustainable Marketing	• Green marketing • Social marketing (marketing social change) • Regulation and control	Planet People _______ Product

Rettie et al.	(2012)	Journal of Marketing Management	340	Normalizing green behaviors: A new approach to SM	Consumer behavior assessing: • Normal vs. green marketing Sustainability marketing strategies based on consumer perceptions	Planet ______ Product
Leonidou et al.	(2013)	Journal of the Academy of Marketing	744	"Greening" the marketing mix: do firms, do it and does it pay off?	4Ps focus on environmental "green' themes	Planet ______ 4Ps
McDonagh and Prothero	(2014)	Journal of Marketing Managment	535	SM Research: Past Present Future	Bibliometric assessment of articles defining sustainability marketing and critique of the field	Planet ______
Lim	(2015)	Marketing Theory	261	A blueprint for sustainability marketing: Defining its conceptual boundaries for progress	Views SM from the dimensions: Economic, environmental, social, ethical, and technological. Macro level perspective	Planet People ______

(continued)

Table 9.1 (continued)

Authors	Year	Journal	Citations	Title	Research focus	Planet and people/7P categories
Lunde	(2018)	AMS Review	140	Sustainability in Marketing: a systematic review unifying 20 years of theoretical & substantive contributions	Theory-level literature assessment from 1997 to 2016. Proposes a GREEN Framework as a conceptualization. Combines business and consumer theories. Focus on academia and not practitioners	Planet People
Thomas	(2018)	Journal of Marketing Management	55	Sustainability marketing: The need for a realistic whole systems approach	Acknowledgment of theoretical fragmentation. Positions critical realism as a metatheoretical framework. Meta-level discussion	Not applicable
Kemper and Ballentine	(2019)	Journal of Marketing	344	What do we mean by SM?	Levels of SM: • Auxiliary: 4Ps • Affirmative: Consumption Transformative: Institutional change	Planet People ——— Product

Tollin and Christensen	(2019)	Journal of Business Ethics	92	Sustainability Marketing Commitment: Empirical Insights About Its Drivers at the Corporate and Functional Level of Marketing	Understanding corporate sustainability through the lens of the functional level of marketing	Corporate level of analysis
Sheth and Parvatiyar	(2021)	Journal of Macromarketing	282	Sustainable Marketing: Market-Driving, Not Market-Driven	A framework for driving sustainable consumption through corporate marketing strategy and government interventions	Planet People ——— Product
Bhattachary-ya	(2022)	Asia-Pacific Journal of Business	31	The structure of SM research: a bibliometric review and directions for future research	Article categorization into 11 thematic categories. Verifies fragmentation of the field	Not applicable
Fuxman et al.	(2022)	Sustainable Production & Consumption	67	The new 3Ps of sustainability marketing: The case of fashion	Examines the role of three new Ps—Public, Process & Preservation—within the traditional 4Ps perspective.	Planet People ——— 4Ps
Kumar et al.	(2022)	Journal of Cleaner Production		Green marketing innovation and sustainable consumption: A bibliometric analysis	Analysis of 1121 research and review articles published in 462 journals listed in the Scopus and Web of Science databases during 1990–2021. Points to research focus on consumption and environmental factors	Planet ———

Table 9.2 The SMC

	Product	Place	Price	Promotion	Physical Evidence	Processes	Employees
Planet							
People							

Source: (N. Fuduric, 2020; Fuduric et al., 2022)

optimization and innovation. The SMC enables firms to refine their sustainability strategies through this structured evaluation process:

- **Define** relevant business activities within a standardized taxonomy.
- **Map** existing sustainability strategies at the product, project, or business unit level.
- **Assess** coherence with industry standards and corporate strategy—identifying misalignment or conflicts.
- **Check** for inconsistencies in strategic and tactical approaches.
- **Measure** performance using KPIs, impact valuation coefficients, or third-party certifications.
- **Evaluate** potential new sustainability strategies that enhance value propositions and competitive differentiation.
- **Decide** which sustainability initiatives serve as flagship activities for stakeholder communication and brand positioning.
- **Maintain** honesty and transparency, avoiding greenwashing.
- **Control** and periodically reassess to ensure continuous improvement.

This structured approach helps organizations systematically implement and refine sustainability marketing practices.

The Hilti Pilot Study: The SMC in Action

The Hilti Group provides products, systems, software, and services to the global construction and energy industries. With approximately 34,000 employees across 120+ countries, the company is recognized for its direct customer relationships, quality, and innovation, generating CHF 6.5 billion in revenue in 2023 (Hilti: Sustainability Report, 2023). Since 2021, Hilti has expanded its sustainability efforts through a global strategy centered on three pillars: environment, people (health and safety of construction workers), and society.

Hilti's Customer Sustainability Team supports clients in achieving their sustainability goals. The company engages in extensive reporting initiatives, including the Science Based Targets Initiative, UN Global Compact, EcoVadis, the World Business Council for Sustainable Development, and the Net Zero Standard. These commitments require substantial internal expertise and resources. Acknowledging that many customers and partners lack the financial and human resources necessary to align with Hilti in its sustainability transformation, the company sought to develop a more comprehensive framework and saw potential in the SMC.

Hilti's aim was to support partners in adopting a more systemic perspective on their own sustainability efforts. As a result, Hilti identified new service opportunities, providing consulting and support to key customers who were lagging in critical sustainability areas. To this end, we tested the SMC on two business units—Anchors and Fire Protection. To maintain conciseness, this chapter presents findings from the Fire Protection unit as a representative example of the SMC's potential as a practical framework for practitioners.

The Requirements

The Hilti team identified the need for a sustainability planning framework that could:

1. Ensure coherence in sustainability reporting across business units by enabling comparability of strategies and operations.
2. Facilitate benchmarking of Hilti's sustainability strategies against competitors.
3. Assess customers' sustainability progress and anticipate their needs, potentially uncovering new service opportunities.

The first step involved developing a precise industry-specific taxonomy for the SMC rubrics to establish a structured framework. This taxonomy enhances comparability across Hilti's business units, competitors, and customers. Data for rubric classification was sourced from Hilti's internal and external sustainability reports, as well as publicly available reports from key competitors and customers. Table 9.3 presents the finalized taxonomy for the construction industry.

Interpreting the Results through the SMC Framework

The Fire Protection business unit at Hilti specializes in passive fire protection, preventing the spread of fire, smoke, and toxic gases through pipe, cable, or line penetrations. Hilti provides software that helps customers identify optimal fire protection products and streamline data preparation for fire authority approvals. Given the extensive use of products, materials, and chemicals in fire protection, sustainability has become increasingly relevant for this business unit.

Using the SMC taxonomy, we mapped Hilti's sustainability activities alongside those of a key competitor and a key customer. The comparison across all rubrics (Table 9.4) revealed that the competitor was more active in physical evidence/planet

Table 9.3 Construction industry SMC taxonomy based on Hilti AG

	PLANET – Plants, insects, animals, biodiversity, natural resources -	**PEOPLE** -Human health, safety, education, well-being -
PRODUCT	Product considerations impacting the environment incorporating all circular product elements: Design Sourcing Production Waste management Recycling, regeneration, reuse	Product considerations impacting humans: Product usage: Safety & no damage to health Product donations
PLACEMENT	All upstream & downstream channel impact on the environment. Logistics Supplier themes: governance & code of conduct Lowering channel GHG emissions protocols	All upstream & downstream channel impact on humankind or social justice. EHS requirements for channel members Code of conduct with partners Partnership transparency
PRICE	True cost transparency for the usage of common pool resources.	True human cost transparency: Cost of health & safety effects on the population.
PROMOTION	All planet-related communication where environmental promises are made & kept: Environmental focused SDG's CO2 compensation projects Environmental projects unrelated to business Providing tools & communications for customers & suppliers Sustainable promotional materials. Creation of foundations	All human-related communication where social promises are made & kept: Humanitarian projects Business values/ethics Socially focused SDG's Supporting customer certification Charity investment
PHYSICAL EVIDENCE	The effect a firm's physical conditions have on the environment: CO2 neutrality Energy efficiency Renewable energy sources Water usage – reduced, recycled Machine heat recovery Building materials- nontoxic, reusable, recyclable Office interiors-nontoxic, reusable, recyclable	The effect a firm's physical conditions have on a population: Buildings Materials Chemicals Land usage Noise effects on health Pollution effects on health
PROCESS	The effect of interdisciplinary firm processes on the environment: Third party certifications Industry standards: ISO Environmental compliance strategies Processes reducing energy, water & production waste Developing holistic sustainability strategies Prioritizing strategies Specialized staffing for sustainability projects	The effect of interdisciplinary firm processes on humankind & society: Third party certifications Industry standards: ISO Social/workplace compliance strategies. Employee health & safety strategic level HR processes: Diversity Training
PEOPLE (Employees)	Employee environmental engagement: Training for increased environmental awareness at work & at home Reduced business travel Mobility solutions to & from work Volunteering Donating	Employee engagement for social causes: Volunteering Donations. Employee Health & Safety functional level Culture of engagement Diversity on the functional level Mentoring

(Source: Fuduric et al., 2022)

Table 9.4 Hilti fire protection, a key competitor and a key customer

	Sustaianbility marketing canvas elements	Hilti n = Statements	%	Key competitor n = Statements	%	Key customer n = Statements	%
Planet	Product	44	13	48	18	55	22
	Price	12	4	11	4	5	2
	Placement	25	7	13	5	31	12
	Promotion	8	2	7	3	44	17
	Processes	30	9	29	11	7	3
	Physical evidence	21	6	31	11	3	1
	Personnel	6	2	3	1	0	0
Social	Product	18	5	4	1	6	2
	Price	2	1	17	6	2	1
	Placement	13	4	6	2	14	5
	Promotion	17	5	12	4	35	14
	Processes	69	20	22	8	8	3
	Physical evidence	28	8	45	17	10	4
	Personnel	48	14	23	8	35	14
	Total	**341**	**100%**	**271**	**100%**	**255**	**100%**

Source: N. Fuduric et al. (2022)

and people sustainability initiatives than Hilti, while the key customer demonstrated significantly greater engagement in sustainability promotions at both the planetary and social levels.

Hilti's sustainability strengths lie in product/planet, processes/people, and people/people(employees) rubrics. While Hilti and the competitor showed similar activity levels in product/planet initiatives, Hilti demonstrated a stronger presence in the product/people category.

The SMC provided Hilti with a structured approach to assessing Fire Protection's sustainability maturity, addressing key strategic questions:

Strategy Congruence: To what extent are business unit strategies aligned with corporate sustainability goals?

Impact Valuation: Which activities have the greatest planetary and social impact, and how are these impacts measured through metrics or certifications?

Sustainability Maturity: What is the maturity level of each sustainability initiative—emerging, maturing, or expert? Compared to competitors? Compared to customers?

Strategy Gaps: What gaps exist in sustainability strategy, and how can they be addressed in the short, medium, and long term?

Market Differentiation: Which sustainability initiatives enhance competitive positioning?

Sustainability Value Propositions: How do sustainability activities create value for customers and stakeholders?

Transparent Communication: Which mature strategies should be promoted, and which ongoing initiatives require transparent communication to avoid greenwashing?

By systematically addressing these dimensions, the SMC offered Hilti the ability to evaluate, refine, and align its sustainability efforts with both corporate strategy and market expectations. Once the taxonomy was established, Hilti was able to assess its position as an industry leader in sustainability and identify opportunities to extend services to customers requiring additional support.

Conclusion

The SMC addresses key conceptual gaps in sustainability marketing. Its strength lies in integrating planetary and social considerations within the 7Ps framework, which provides a unified conceptualization of sustainability marketing. In practice, it aids businesses in strategizing, measuring, and planning sustainability initiatives.

Hilti's application of the SMC offers valuable insights for firms seeking to enhance their sustainability strategies:

- **Comprehensive Strategy Mapping:** The SMC serves as an effective tool for systematically mapping sustainability strategies at the business unit level, as well as those of key competitors and customers, enabling a broader industry perspective.
- **Comparability Through Standardized Taxonomy**: By adhering to a defined taxonomy, the SMC facilitates comparability across business units, allowing firms to benchmark sustainability performance and identify best practices.
- **Encouraging Systems Thinking:** The structured process of mapping sustainability marketing activities fosters a systems-thinking approach, ensuring that sustainability efforts are proactive and strategic rather than reactive and short term.

The SMC empowers firms to develop coherent, competitive, and forward-thinking sustainability strategies that align with both corporate objectives and broader industry trends. However, to drive meaningful change, our questions and expectations of marketing must expand—becoming more ambitious, inclusive, and transformative.

While sustainability marketing has advanced the conversation, its impact has yet to scale. True transformation requires a systematic and comprehensive framework that embeds sustainability marketing into a unified strategic and operational approach. As McDonagh and Prothero (2014) challenge, "Can marketing be trusted to support the sustainability transition?" The answer is a resounding yes.

If marketing has contributed to the system's problem, it must also be part of the system's solution. By embracing integration, innovation, and accountability, marketing can drive the sustainability transition—not as a peripheral concern, but as a core business imperative shaping the future of commerce, society, and the planet.

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Chapter 10
Marketing Strategies of Chinese Online Platforms in Switzerland

Dominik Reust

Abstract Chinese online platforms, particularly Temu, have rapidly expanded in Switzerland, leveraging innovative marketing strategies and operational efficiencies. Despite being a relatively new entrant, Temu has positioned itself as a formidable competitor to established Swiss and global players such as Digitec Galaxus, Interdiscount, Brack, Amazon, and Zalando, capitalizing on Switzerland's affluent consumer base. This success is primarily attributed to its focus on ultra-low pricing, dynamic supply chain management, and advanced digital engagement tactics.

Temu utilizes a consumer-to-manufacturer (C2M) and a direct-to-consumer (D2C) model, bypassing traditional intermediaries to streamline its supply chain and reduce costs. Its marketing strategies are tailored to local market conditions, emphasizing high visibility on social media platforms such as Instagram and TikTok. By targeting younger, digitally literate audiences, Temu effectively aligns its offerings with consumer expectations, particularly through mobile-first experiences and personalized product recommendations.

However, Temu's aggressive market penetration has not been without controversy. The company faces allegations of unethical practices, including the use of manipulative web designs, misleading discount policies, and inadequate adherence to legal standards. Actions by European regulatory bodies, including the European Commission and national consumer protection agencies, highlight ongoing scrutiny over its compliance with local laws and guidelines, particularly in relation to the Digital Services Act (DSA).

Sustainability remains a critical area of concern for Temu. While the company promotes initiatives such as recycled product lines and carbon offset programs, these efforts are often criticized for lacking transparency and failing to address broader issues such as overproduction and environmental impact. Enhanced trans-

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parency and independent audits could significantly improve Temu's credibility in this domain.

Temu's adaptability in addressing regulatory challenges suggests its potential to maintain a competitive edge. Should Temu align its operations with European and Swiss regulations, it is likely to maintain its competitive edge while reshaping consumer expectations in the Swiss e-commerce market. Its success underscores the need for local retailers to reassess their marketing and pricing strategies and operational efficiencies in response to this growing competition.

Keywords Digital marketing strategies · Chinese online platforms · Supply chain optimization · Mobile-first commerce · Sustainability in e-commerce

Background

Since 2022, Chinese online platforms like Temu have made considerable strides in expanding their reach on the global stage. Switzerland, with its high purchasing power, offers both attractive opportunities and distinct challenges. This chapter examines the key marketing strategies of Chinese online platforms in Switzerland. It is based on a comprehensive analysis of market reports, scientific studies, and current practical examples.

Overview of the Swiss E-Commerce Landscape

Switzerland is the 24th largest market for e-commerce with an estimated revenue of around CHF 18 billion in 2024 with a population of approximately 8.8 million (EDA, 2023), placing it ahead of Iran with a population of nearly 92 million people (Rudolph et al., 2024, p. 49). This highlights how a small, wealthy population can generate a much higher volume of e-commerce transactions than a far larger, less affluent population. The median gross salary, adjusted for purchasing power, is nearly 50% higher than in the European Union, and Switzerland has the second-lowest Gini coefficient for income before redistribution among Organisation for Economic Co-operation and Development (OECD) countries (Bericht des Bundesrats, 2024, p. 42). Estimates of the revenue generated by e-commerce in Switzerland vary widely. However, there is agreement that the e-commerce market will continue to grow strongly (ECDB, 2025; Rudolph et al., 2024).

Swiss consumers are accustomed to local e-commerce players such as Digitec Galaxus (owned by Migros-Industrie AG), Interdiscount (owned by Coop Genossenschaft), Brack, and retailer-backed online stores (e.g., Coop@home, migros.ch). Additionally, international giants such as Zalando and Amazon play a significant role in shaping the e-commerce landscape, although Amazon has no warehouse in Switzerland, and the products that can be delivered to Swiss addresses are limited. Zalando, with its strong focus on fashion, and Amazon, known for its vast product range and efficient logistics, are highly popular among Swiss consumers, contributing to the country's active participation in cross-border e-commerce (Comparis, 2025; IPC, 2025, pp. 9, 18; IRM-HSG, 2024). Around 50–60% of Swiss online shoppers have made at least one purchase from an overseas retailer, indicating a well-established habit of international online shopping (vgl. Rudolph et al., 2024, p. 70; Morant, 2024b; Comparis, 2025). Chinese providers achieve more than a billion in revenue and continuously increase their market share in the Swiss market (Morant, 2024a; Rudolph et al., 2024, p. 111). According to studies by the University of St. Gallen and Comparis, the key factor for shopping on a Chinese platform is the low price (Rudolph et al., 2024, p. 120; cf. Comparis, 2025).

The Swiss market is small but highly attractive for platforms and sellers due to its high purchasing power, but it also presents a significant challenge due to its linguistic and cultural diversity.

Temu: A Fast-Growing Chinese Player in Switzerland

By leveraging China's robust manufacturing capabilities, competitive pricing strategies, and tech-savvy user engagement models, companies such as Temu, SHEIN, and Alibaba have surged in popularity across the world. Their expansions not only intensify competition with established global players such as Amazon, Zalando, and eBay but also reshape consumer expectations around price, convenience, and user experience.

In this chapter, the author focuses on the fastest-growing Chinese platform in Switzerland, Temu. Since 2022, Temu has been among the most-downloaded apps worldwide (Juozas, 2022; Statista, 2024; Wright, 2024).

Temu is owned by PDD Holdings (PDD Holdings, 2025), a multinational commerce group established by Chinese entrepreneur and former Google engineer Colin Huang (Liang & Dean, 2024). The company's ownership structure and operational details highlight its global reach and strategic positioning in the e-commerce market. PDD Holdings is registered in the Cayman Islands with its principal office in Dublin, Ireland (Kharpal, 2023). Temu itself is officially incorporated in Delaware, United States, and operates with its headquarters in Boston, Massachusetts (Faithfull, 2024). Within the United States, Temu functions under Whaleco, Inc., a subsidiary of PDD Holdings (Del Rey, 2024). In addition to Temu, PDD Holdings owns Pinduoduo, one of China's leading e-commerce platforms (Pinduoduo, 2025). This connection allows PDD Holdings to leverage its extensive manufacturing network and supply chain expertise, contributing to Temu's success in international markets. Despite being a relatively new entrant in the global e-commerce landscape, Temu's aggressive expansion strategy and ultra-low pricing model have enabled it to emerge as a major competitor in multiple countries. Through its innovative approach and strong corporate backing, Temu continues to reshape the dynamics of the international e-commerce market (Rudolph & Gerlach, 2024; Sommer, 2024).

As of August 2024, Colin Huang has briefly held the title of China's richest individual, with an estimated net worth of $48.6 billion, driven largely by the rapid growth of Temu (Faithfull, 2024).

PDD Holdings launched Temu in Europe and Switzerland in late 2022 and early 2023 as a value-oriented marketplace offering a broad range of products, including apparel, electronics, and home goods (Weder, 2024). The term "value-oriented" reflects its focus on affordability and perceived cost-effectiveness, which are key aspects of its marketing and competitive positioning. Temu's business model is built on minimizing costs by facilitating direct connections between consumers and suppliers, with the platform solely managing shipping to the customer (Del Rey, 2024; Faithfull, 2024).

In December 2024, Temu released its first transparency report, which also included new user statistics for Europe (without Switzerland). On average, 97.3 million people use Temu each month. Six months earlier, it was 75 million monthly users, highlighting significant growth. Germany ranks first with 16.3 million monthly users, followed by France with 12 million and Italy with 10 million (Krisch, 2024).

In Switzerland, the consulting firm Carpathia estimated Temu's sales in the first 9 months of 2023 at CHF 350 million, which roughly corresponds to the sales performance of Migros' online shop (www.migros.ch) (Morant, 2024a).

The market value of Temu is rapidly growing, even though experts assume that Temu is still operating at a deficit. Hochman (2024) has calculated that Temu lost up to USD 40 per order in the United States in 2023, while Liu (2023) speaks of USD 30 per order. Koutsou-Wehling (2024) is questioning both numbers. Even without knowing exact figures on the amount of loss per package, it can be assumed that Temu is accepting losses in order to grow quickly and gain market share in saturated markets (cf. Porter, 1997).

Supply Chain Management: Key to Success

Temu has achieved rapid growth, driven by its extensive product range and ability to offer exceptionally low prices while continually introducing new items (Deighton, 2023; ECDB, 2024). The company's supply chain efficiencies, technological innovations, and organizational strategies allow it, along with other Chinese competitors, to outperform many Western and Swiss counterparts (Deng, 2024).

As of early 2024, Temu has relied solely on a consignment model, where suppliers retained ownership of goods until they were sold or consumed by customers. Leveraging a D2C strategy, Temu bypasses intermediaries such as wholesalers and conventional retailers, thereby optimizing its supply chain. By directly connecting suppliers with end consumers worldwide, the company creates a leaner and more efficient distribution system (Del Rey, 2024; Faithfull, 2024). Controlling the entire supply chain—from design to delivery—not only reduces overhead but also enables

Temu to capitalize on economies of scale (cf. Stigler, 1958), securing more favorable terms from suppliers (Deighton, 2023).

Temu's advanced supply chain techniques rely on real-time data analytics, beginning with small production runs to test consumer interest. Temu calls it the "C2M" model (Temu, 2025a)—a concept in which production is triggered by specific customer requests and demands, enabled by data innovations at various points along the value chain. In this form of "Reverse Manufacturing," consumer preferences are captured with exceptional precision and speed through data analysis (cf. White et al., 2003). Trends on social media platforms are identified and evaluated using social listening tools, while proprietary customer and platform data provide additional insights into consumer desires. The collected data is interpreted in such a way that both manufacturers and retailers can develop and offer a product assortment that is precisely aligned with consumer demand and preferences. In some cases, production only takes place once a sufficient number of customers have added a specific product to their shopping cart. To successfully implement this type of "Reverse Manufacturing," companies require a high level of data management and data analytics capabilities. This enables Temu to operate a highly dynamic and efficient marketplace where production is optimized based on consumer data. This approach benefits both retailers and manufacturers, as it helps prevent the production of excess inventory and reduces reliance on discount-driven sales (Richartz & Hosang, 2024). Successful products are rapidly scaled up, sometimes within days (Deighton, 2023; Thomas et al., 2024). This approach is enabled by close collaboration among designers, manufacturers, and logistics partners, often located within the same industrial clusters. When a product proves successful, large-scale production further reduces per-unit costs (cf. Stigler, 1958, p. 54 ff.). Such a system minimizes inventory risks and avoids overproduction, issues that have historically challenged Western retailers with slower design-to-shelf cycles (Turker & Altuntas, 2024).

Temu invests heavily in logistics and information technology infrastructures (Qu, 2024; Wall Street Journal, 2023). Automated inventory control and sophisticated forecasting models reduce supply chain bottlenecks, enabling production schedules to align closely with consumer demand (Rajvanshi, 2024). Western retailers, meanwhile, often rely on seasonal forecasts and may lack the agility to react immediately to emerging market trends (cf. Oberholzer-Gee, 2009).

Like other international traders, Temu benefited from the Universal Postal Convention of 1875, which regulated international postal traffic. Its aim was to create a standardized framework for international postal traffic (International Bureau of the Universal Postal Union, 1985). Previously, each country had separate treaties with other countries, which made international postal traffic complicated and inefficient. Since 2016, Chinese merchants have been paying the same postal rates as other industrialized countries in the same country class (e.g., Canada, Japan, and Australia) (Bornhauser, 2024; Zimmermann, 2024). Temu has contracts with Swiss Post and DPD for distribution in Switzerland. The contracts are private, and the rates are competitive. This means that parliamentarians and lobbyists who represent the interests of the Swiss Retail Federation industry association cannot prohibit Swiss Post from concluding the contract with Temu (Valda, 2024b).

Deliveries to Switzerland typically take between 5 and 11 business days, with over 80% of orders arriving within 8 days. If a delivery exceeds 12 days, customers automatically receive a CHF 5 credit, while delays beyond 15 days result in a full refund (Temu, 2025c). These policies have established delivery within 11 days as the standard expectation (Rudolph & Gerlach, 2024). The ultra-low prices offered by Temu make the longer delivery times compared to local dealers acceptable for many customers. Temu ensures this efficiency by leveraging China's vast network of specialized manufacturers and suppliers. Decades of export-oriented policies have fostered a highly efficient industrial ecosystem, where individual firms focus on specific tasks, such as textile dyeing or garment stitching, leading to lower per-unit costs (Ellram, 1991; Mizgier et al., 2013). Western retailers, by contrast, often outsource to multiple countries, resulting in higher coordination costs and extended lead times due to geographically dispersed supply chains (cf. Oberholzer-Gee, 2009).

Industry representatives and consumers claim that Temu splits orders into many small packages with low merchandise value or does not declare the merchandise value correctly (Bornhauser, 2024; Ehrbar, 2024; Michel, 2024). For such small shipments, the Federal Office for Customs and Border Security waives the collection of value-added tax (VAT). This regulation applies to packages with a merchandise value of up to CHF 62 at the standard VAT rate of 8.1%. In these cases, the tax amount would be less than CHF 5 (Eidgenössische Steuerverwaltung, 2024). Since January 1, 2025, online platforms are though required to register for VAT in Switzerland and Liechtenstein if, within 1 year, small shipments with a total value of at least CHF 100,000 are sold to domestic customers via their platform. This registration requirement applies even if the platform does not act as a seller itself but merely connects buyers and sellers. The platforms must therefore include the VAT directly during the ordering process—regardless of the order value—and remit it to the Swiss tax authorities. The aim of this tax obligation is to ensure that sales to domestic customers are correctly taxed and do not remain untaxed (Eidgenössische Steuerverwaltung, 2024; KMU-Portal, 2024; Rehfisch, 2025).

Despite rising wages, China's relatively favorable labor costs and workforce flexibility remain critical advantages (Fang & Yang, 2024; McKinsey & Company, 2023, p. 106; Yang et al., 2010). Factories often operate continuous shifts, ensuring rapid order fulfillment. Although this raises concerns about labor conditions, the ability to adjust staffing to meet fluctuating demand is a significant advantage. Western companies, constrained by stricter labor regulations and higher overhead costs, struggle to achieve similar flexibility (Kuddo, 2018).

In March 2024, Temu introduced a marketplace model alongside the consignment model in the United States, enabling significantly faster delivery times. Over time, this model also provides local businesses with the opportunity to sell their products through Temu's platform. The marketplace model has since been expanded to Germany, France, Italy, and Spain, with plans for further expansion into additional countries, including Switzerland (Güntert, 2025; IRM-HSG, 2024). Unlike competitors such as Amazon or AliExpress, Temu manages all shipping logistics in-house and does not permit direct shipping from manufacturers. Amazon has already responded and launched a model similar to Temu with Amazon Haul (Amazon, 2025; Schwarz, 2024; Weidemann, 2024).

The convergence of China's specialized manufacturing ecosystem, D2C distribution, real-time supply chain management, competitive labor frameworks, and channels underlies the ability of Temu to deliver both lower prices and faster turnaround times compared to many Western and Swiss rivals. As global e-commerce continues to expand, the operational efficiencies pioneered by Chinese platforms like Temu will likely intensify competitive pressures on conventional retail models—potentially prompting a reevaluation of established supply chain and marketing practices (Qu, 2024).

Key Marketing Strategies in Switzerland

Temu and other Chinese platform providers have distinguished themselves through a combination of aggressive and adaptive marketing strategies tailored to local markets. Leveraging Switzerland's high internet penetration and digital literacy (Rudolph et al., 2024, p. 16), Temu has effectively harnessed digital media to establish a foothold in the market. The company employs robust online marketing techniques, including search engine optimization, search engine advertising, and targeted social media advertisements. Controversially, Temu has been accused of targeting competitors' keywords to increase visibility (Reid, 2024; Wojtczak, 2024). While this tactic increases exposure and facilitates direct engagement with its audience, it also carries the risk of harming the company's reputation and fostering distrust if customers view it as manipulative or unethical.

A significant component of Temu's approach is maintaining high visibility on social media platforms such as Instagram and TikTok (Temu, 2025b). This strategy effectively captures the attention of younger, digitally savvy consumers, who form a substantial portion of the target demographic. With 52.4% of all online purchases in Switzerland made via smartphones (Rudolph et al., 2024, p. 6), Temu focuses on appealing to mobile-first shoppers who are increasingly comfortable purchasing directly from foreign platforms (Correira & Cunningham, 2024; McKinsey & Company, 2023, p. 66). To cater to this audience, Temu's online shopping experience mimics the exploratory nature of physical retail stores, utilizing "Marketing Discovery Commerce" to continuously present new products and inspire engagement (Gollnhofer, 2023).

Temu also capitalizes on consumer psychology by offering flash sales, gamified discounts, and free shipping promotions, which appeal to price-conscious shoppers. These time-sensitive offers create urgency and drive conversions, even in a relatively price-insensitive market like Switzerland (IRM-HSG, 2024). Advanced artificial intelligence and analytics are used to identify and respond to trends in Swiss consumer preferences, enabling Temu to adjust product listings dynamically to match demand (Trisolvena et al., 2024). Customer reviews and ratings are prominently displayed to build trust and transparency, even as consumers remain aware that ultra-low prices may compromise quality (Kawaf & Istanbulluoglu, 2019). Temu's accommodating return and refund policy—which allows returns within 90 days (Temu, 2025c) and often does not require customers to return defective items—further mitigates purchase anxiety (Schelbert, 2024; Temu, 2025d).

Recognizing Switzerland's linguistic diversity, Temu has localized its website and mobile applications to support German, French, and Italian, fostering trust and accessibility. Marketing content is adapted to reflect local traditions, festivals, and consumer behaviors, reinforcing connections with Swiss shoppers.

Fast and often free international shipping enhances Temu's appeal, with subsidized delivery costs and efficient air freight operations meeting the expectations of convenience-driven consumers (IRM-HSG, 2024).

Temu has also introduced product lines marketed as sustainable, highlighting the use of recycled materials, organic products, and minimal packaging (Temu, 2025d). While these efforts signal environmental awareness, they are undermined by the waste associated with fast fashion and disposable goods (Niinimäki et al., 2020). Claims of carbon offsetting for shipping and operations lack transparency, further complicating evaluations of Temu's sustainability initiatives (Otis, 2023). Despite these challenges, Temu's comprehensive marketing strategies position it as a formidable competitor in the Swiss market.

Sustainability

Governance, environmental, and social sustainability are a prerequisite and have become a key expectation from investors, consumers, and regulators (IRM-HSG, 2024). This section tries to analyze how sustainably Temu operates.

On its website, Temu identifies "empowerment," "integrity," "inclusion and diversity," and "social responsibility" as core values, describing itself to improve as being "honest," "ethical," and "trustworthy" (Temu, 2025a). The company claims to have a code of conduct requiring compliance with various local laws. However, there is a notable absence of independent audits or compliance reviews, which are crucial for ensuring adherence to ethical standards and regulatory requirements (IRM-HSG, 2024).

As mentioned in the Supply Chain Management section, there are serious concerns about working conditions. In the United States, multiple entities, ranging from U.S. Senators to the House Select Committee on the Chinese Communist Party, states' Attorneys General, and countless others, have raised alarm over the practices of Temu and PDD—ranging from possible trade, slave labor, and national security concerns (M. R. Turner et al., personal communication, 2024). So far, there is no publicly available information on how Temu responded to the letter. However, in similar instances, Temu has emphasized that it takes its obligations seriously and continually invests to strengthen its internal systems and protect the interests of consumers on its platform.

A significant portion of the product range consists of fast fashion items, predominantly manufactured from synthetic fibers such as acrylic and polyester, which substantially contribute to environmental pollution. Projections by SPER Market Research estimate that the Chinese market for synthetic fibers will reach USD 39.8 billion by 2033, growing at a compound annual growth rate (CAGR) of 6.27%. The Asia-Pacific region is anticipated to dominate this market share (Rudolph & Gerlach, 2024).

There is a lack of transparency in the statements on the partnership with the organization "Trees for The Future," which aims to help offset the CO_2 emissions caused by business activities by planting trees in Africa (IRM-HSG, 2024; Temu, 2025f).

Temu also lacks transparency regarding data center energy consumption and provides no detailed information on waste management, including the handling of returns, recycling, or damaged goods (Temu, 2025e; IRM-HSG, 2024).

Although China published a 5-year plan to develop its circular economy by promoting recycling, remanufacturing, and renewable resources in July 2021 (McKinsey & Company, 2023, p. 74), there are still many shortcomings. A study by the Swiss consumer magazine K-Tipp examined Temu's return processes using eight packages equipped with electronic trackers. These packages, containing electronics, household items, and clothing, were sent to Temu's return address in Eglisau, Switzerland, and monitored between August and November 2024. Clevy Links, managing Temu's returns in Eglisau, sent two packages to Shenzhen and Guangzhou, while three trackers lost their signals near Zurich, and three packages remained in Eglisau for months. Observations showed employees sorting and unpacking returns, with overflowing packaging waste containers. Returns are reportedly shipped to China periodically, while local waste, amounting to 44 tons annually, is handled by a Swiss waste company. However, returns or electronic waste are not included. Temu stated that all returns are sent to China, where non-recyclable items are disposed of, and suggested that some trackers may have been discarded with waste. This shifts disposal to Switzerland (Schelbert, 2024).

Unlike Swiss electronics retailers, Chinese sellers do not pay recycling fees. To ensure fair competition, the Swiss parliament adopted the initiative 20.433, "Strengthening Switzerland's Circular Economy," on March 15, 2024. Revisions to the Environmental Protection Act, the Energy Act, and the Federal Procurement Act establish a legal framework to reduce environmental impact and resource consumption while enhancing the competitiveness and security of Switzerland's economy (BAFU, 2024).

Recently, the company has faced criticism for unethical business practices, including misleading discount rates, manipulative interface designs employing so-called "dark patterns," lack of accessible contact information on its website, and unfair competition related to price disclosure (Valda, 2024a; Weder, 2024).

The network of European consumer protection authorities (CPC), under the co-leadership of the German Federal Environment Agency (UBA), has initiated legal action against Temu in Germany. In a joint letter, the CPC authorities have called on Temu to promptly cease its violations of European law. The CPC alleges that Temu unnecessarily complicates the exercise of withdrawal rights for customers and employs manipulative website designs. Furthermore, the action addresses suspected fake consumer reviews, aggressive marketing tactics involving gambling elements, and misleading information regarding minimum order values and discounts (Todtmann, 2024). The European Commission has also launched a formal procedure to assess whether Temu has violated the DSA. The investigation focuses on areas related to the sale of illegal products, the potentially addictive design of the platform, its systems for recommending purchases to users, and access to data for researchers (Europäische Kommission, 2024).

Resistance to Temu is also growing in Southeast Asia. After Indonesia banned the Temu app in October 2024, Vietnam followed suit in December 2024. Both countries have stated that Temu violates copyright regulations and that its products exhibit quality deficiencies (Babst, 2024).

Temu's willingness to address these concerns through cease-and-desist commitments and statements from its press office indicates a readiness to adapt its practices. Greater transparency and external oversight could play a pivotal role in ensuring compliance with both its stated ethical standards and broader regulatory requirements (IRM-HSG, 2024).

Conclusion

Temu and other Chinese platforms are often condemned as unsustainable, especially by competitors, and governments aiming to protect their industries have also expressed opposition to Temu's business practices. There is certainly a lot of potential for sustainability, and it would be highly desirable if Temu (and other platforms, manufacturers, sellers, retailers, and buyers) were to act more sustainably. But it is a fact that these platforms stimulate competition. Manufacturers and local (online) retailers are compelled to reassess whether their profit margins are too high. Swiss households should have the same opportunity to source products directly from China as European manufacturers do.

Should Temu officially establish a presence in Switzerland, adjust its business practices to comply with European and Swiss laws and regulations, and incorporate the advanced recycling fees like competitors such as Digitec Galaxus, Interdiscount, and Brack, it will become increasingly difficult for these to challenge its position. As long as Temu complies with all legal requirements, its attractive offerings are unlikely to change significantly. The platform excels at delivering Chinese products directly and affordably to Swiss households. Temu's disruptive nature parallels that of Uber and Airbnb. Both platforms have revolutionized the matching of supply and demand. Initially, US-based platforms encountered conflicts with Swiss regulations. However, they have adjusted their practices over time: Uber now complies with social security contribution requirements and rest period regulations for its drivers; Airbnb collects tourist taxes. It is expected that Temu will adopt a similar approach, aligning its operations with Swiss legal standards. Consequently, competitors such as Digitec Galaxus and others may be compelled to reassess and adapt their business strategies. When it comes to sustainability, it is not just up to Temu to rethink. It is up to each individual consumer to act more sustainably and not just pretend to want to act sustainably.

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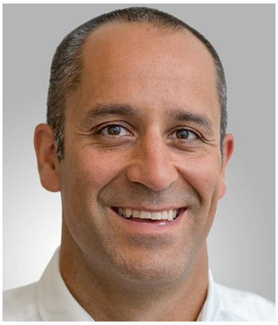

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Chapter 11
An Investigation into How Data Privacy and Data Security Concerns Affect Consumer Trust Within Sharing Economy Platforms in South Africa: A Case of E-Hailing Platforms

Marié Hattingh and Koketso Motiang

Abstract The sharing economy platform (SEP) has evolved significantly since the 1990s, driven by advancements in digital technologies such as the Internet, cloud computing, and big data. Its rapid growth has introduced significant economic benefits and new business models. However, it has also raised critical concerns regarding data privacy and data security. These concerns are critical in the SEP, where large amounts of consumer data are collected, raising fears of misuse and cyber-related incidents. Such issues can deter consumers from using platform services. This study investigated how data privacy and data security concerns influence consumer trust within the SEP, focusing on Uber and Bolt within the transportation sector in South Africa. A survey research strategy was used to collect data through semi-structured interviews with 14 Uber or Bolt users. The data was analysed using thematic analysis using the constructs of the privacy calculus theory to classify the themes that emerged from the data. The study reveals significant data privacy concerns, including unauthorised use of personal information and unwanted communications, and data security concerns such as cyber incidents and policy and security deficiencies. These concerns have an impact on consumer trust and continued use of the platforms. The findings of this study will provide insights for platform providers on how to address consumer concerns and improve service offerings.

Keywords Data privacy · Data security · Consumer trust · Sharing economy platforms · South Africa

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Introduction

The sharing economy platform (SEP) contributes significantly to the economy since the era of the Internet (Song & Chee, 2022). The SEP business model has a positive impact on sustainable innovation; it enhances value creation and customer interfaces and creates new value networks and financial models (Li et al., 2023). SEPs address some of the social, economic and environmental challenges (Li et al., 2023). The SEP emerged from the sharing economy and has since developed significantly, enabling the digital exchange of goods and services (Morales-Pérez et al., 2022). The drive for the SEP was a result of the changing preferences of millennial consumers and the availability of microentrepreneurial prospects and has thus brought about a range of new and successful business models (Dann et al., 2022; Morales-Pérez et al., 2022).

The sharing economy's objective is to create platforms that are appealing and build strong connections between providers and users, facilitating transactions and interactions between buyers and sellers digitally (Acs et al., 2021; Geissinger et al., 2020). SEPs have introduced many benefits to their consumers, such as enhancing the speed and efficiency of the servicing offerings (Song & Chee, 2022). Furthermore, consumers are becoming more reliant on these platforms due to benefits such as convenience, reduced transactional costs and ease of transacting (Morales-Pérez et al., 2022).

There are challenges associated with using SEPs. The platforms collect consumer data through digital technology infrastructure, a process that is challenging to govern (Acs et al., 2021). Data is not only collected and stored but also analysed and then transformed into important business insights, leveraging technologies like artificial intelligence, which serves as a competitive advantage (Acs et al., 2021). The major concern is that the collection and processing of consumer data may result in data privacy and data security violations (Frenken et al., 2020).

This study aims to evaluate data privacy and data security concerns and how they affect user trust, using Uber and Bolt as examples to achieve the research objectives. Specifically, the research aims to answer the following main research question: To what extent do data privacy and data security concerns affect consumer trust within SEPs?

Studies have been conducted on the sharing economy and factors that influence user trust and adoption (Akhmedova et al., 2021; Ert et al., 2016; Katarzyna et al., 2018; Najjar & Dahabiyeh, 2021). However, there are limited studies conducted on the SEP in South Africa. This study aims to contribute to the body of knowledge by providing a rich understanding of the data privacy and data security concerns and the consequent impact on the trust consumers of the SEP have, in the South African context.

Section 11.2 provides a short literature background on the important concepts related to SEP. Section 11.3 describes the methodology followed. Section 11.4 presents a discussion of the analysed data. Section 11.5 concludes the study.

Literature Background

The Sharing Economy Platform

The SEP facilitates direct transactions with diverse users who would be unable to engage in transactions globally (Acs et al., 2021). Online trading offers opportunities for consumers to access goods and services in convenient ways (Geissinger et al., 2020), opening access to more sellers and giving buyers options to choose from a wide range of options (Acs et al., 2021). There are millions of users and agents connected through the SEP, allowing consumers to discover new products and services worldwide (Acs et al., 2021; Geissinger et al., 2020).

The SEP creates new markets with faster growth compared to other businesses, disrupting industries (Bamberger & Lobel, 2017; Dufva et al., 2017). The platforms expand the market by reaching a larger audience, thus promoting products effectively, adapting business models rapidly, and fostering flexibility and innovation while reducing transactional costs (Acs et al., 2021; Tshabalala & Beharry-Ramraj, 2021; Xue et al., 2020). Furthermore, they introduce competition, disrupt stagnant industries, challenge existing business models, and leverage technology and data analytics for efficient and scalable markets (Bamberger & Lobel, 2017).

The platforms foster and promote innovation and entrepreneurship, create closed-loop ecosystems for value circulation, enhance competitiveness in the international market, and facilitate job development to contribute towards economic growth (Bisultanova, 2023; Song & Chee, 2022). Kenney and Zysman (2016) concur by mentioning that the SEP is seen as a source of entrepreneurial opportunities and potential productivity growth.

State of the Sharing Economy Platform in South Africa

In South Africa, the SEP creates employment and entrepreneurial opportunities (Dogru et al., 2020). Around 1% of the South African population works for platform organisations, representing approximately 135,000 people (Fairwork, 2023). Whilst this assists with household income generation, platform workers are experiencing issues such as challenges related to basic labour rights and a lack of basic safety and security (Fairwork, 2023).

Although the SEP is present and active in South Africa, it is lagging due to challenges it experiences. Consumers are concerned about the privacy and security of SEPs; they are concerned about sharing their personal information and banking information on the platforms (Mara, 2020). Furthermore, the introduction of the oldest and largest e-hailing platform, Uber, caused major disruptions in South Africa; taxi owners responded with violence towards Uber drivers (Adenigbo et al., 2023; Mara, 2020). The SEP has also experienced lawsuits from other industry competitors, claiming unfair competition practices (Fairwork, 2023); nonetheless, the sharing economy continues to grow while negatively impacting the revenue of traditional businesses (Mara, 2020).

Data Privacy Concerns

SEPs often necessitate users to exchange highly personal and private information (Lambillotte & Bart, 2023). This raises privacy concerns such as unauthorised use and improper access (Lambillotte & Bart, 2023). Some platforms, like Uber, require users to disclose their exact location; while this facilitates service provision, it also raises privacy concerns (Lambillotte & Bart, 2023).

Platform services tend to use personalised pricing strategies through the collection and utilisation of vast amounts of consumer data (Mou et al., 2023). This occurs when prices for the same product vary depending on the consumer group, constituting price discrimination (Bamberger & Lobel, 2017; Wang et al., 2021), named by Mou et al. (2023, p. 1) as "Big Data-Based Discriminatory Pricing (BDDP)". Big data technology and algorithms are used to analyse customer purchasing behaviour and escalate prices for regular customers (Mou et al., 2023), and this raises concerns about consumer data and privacy violations (Bamberger & Lobel, 2017).

Online platforms collect personal data and use it for targeted advertisements, raising privacy concerns (Duan et al., 2022). Personalised advertisements may be deemed beneficial; however, they raise anxiety for consumers (Duan et al., 2022). Additionally, some online platforms sell consumer data to third parties without consumers' consent, and this poses ethical questions (Duan et al., 2022; Frenken et al., 2020; Hardaker, 2021); this data can be used for fraudulent activities (Padilla et al., 2022). Economides and Lianos (2021) provide a case on data privacy issues where advertiser-driven platforms like Google and Facebook offer free search services in return for user data.

Data Security Concerns

Security concerns are based on the users' beliefs that adequate security measures are in place to secure sensitive information (Zamani et al., 2019). The collection of extensive amounts of consumer data raises data security concerns, as consumers fear that their personal information may be misused or fall into the wrong hands (Padilla et al., 2022). These concerns can lead to consumers discontinue using platforms, thereby, affecting market behaviour (Padilla et al., 2022).

Digital technologies increase the likelihood of undiscovered risks (Galoyan et al., 2022). Some of these risks relate to the issue of cybersecurity (Howells, 2019), one of the biggest impediments to implementing the platform ecosystem strategy (Pooya et al., 2021). Currently, data is transferred globally using digital technology, and this poses a risk of data being attacked (Dufva et al., 2017).

The gaps in the regulatory environment raise questions about who owns the platform data (Dufva et al., 2017). Additionally, collaboration between employees from different organisations may result in data security being compromised, should they engage in untrustworthy or unethical actions (Chatterjee et al., 2023). Identity theft is another issue that affects the use and trust of online platforms (Ngoepe & Ngwenya, 2021).

Consumer Trust in Sharing Economy Platforms

Customers who trust a brand will assist the company in achieving higher profitability (Martínez-Navalón et al., 2019). Trust and security are important aspects to provide to the consumers of digital platforms, as this helps them feel "safe" (Mitchell et al., 2019). SEPs are accessed through cloud computing which is known to be prone to data security and privacy concerns and can result in issues of trust for consumers (Tabassum et al., 2023). There is a direct link between data privacy and trust (Martínez-Navalón et al., 2021; van Dijck, 2021).

Tabassum et al. (2023) outline the various measures and techniques that can help improve the trustworthiness of the technologies that operate on the cloud, these are end-to-end encryption, access control, data anonymity, and reliance on trusted third parties such as auditors. There is a need for a clear understanding of digital technologies, their implications on regulations, cybersecurity, and state administration, and how consumer data can be safeguarded (Galoyan et al., 2022). Platforms need to design data transfer mechanisms and enforce privacy protection rules to ensure data security and privacy for end-users (Wang et al., 2021).

Research Methodology

The study adopted an interpretive approach by collecting qualitative data by means of a survey, through semi-structured interviews with Uber and Bolt users and former users. The interviews were conducted on Microsoft Teams during December 2024 and January 2025. The participants for this study were over the age of 18 and residing in Gauteng province. Fourteen participants were involved in this study, selected using convenience sampling. The sample was adequate to provide the researcher with enough data to gather insights and answer the research questions. Based on a study by Hennink and Kaiser (2022), saturation for interviews is generally reached between 9 and 17 interviews. The sampling technique used for this study was convenience sampling (Oates et al., 2022).

Privacy calculus theory (Keith et al., 2014) was used deductively to analyse the collected data into themes. The privacy calculus theory is a commonly used theory that explains what contributes to people intending to disclose their information. Figure 11.1 demonstrates the constructs of the privacy calculus model. The theory

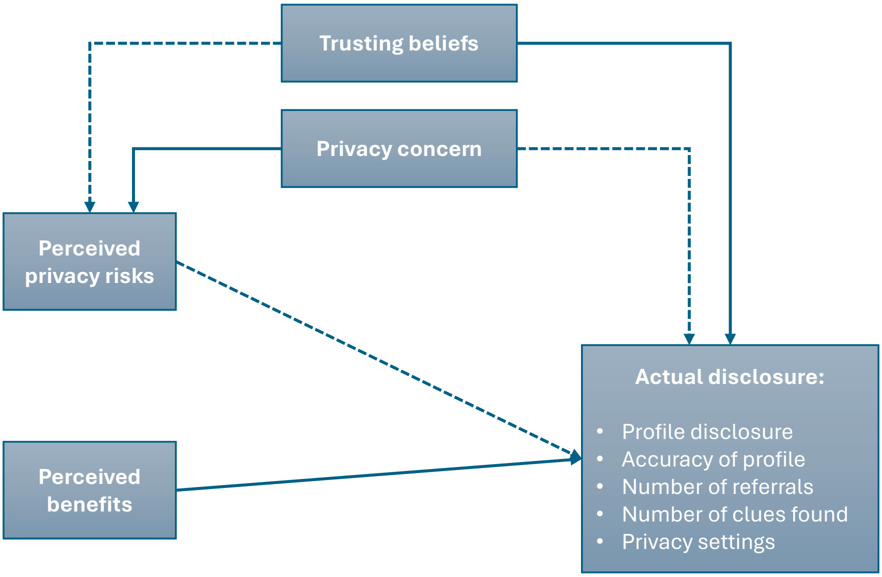

Fig. 11.1 Privacy calculus model (Keith et al., 2014:3150)

suggests that four attributes influence the disclosure of information—trust, perceived privacy risks, privacy concerns and perceived benefits (Keith et al., 2014).

Analysis and Discussion of Findings

Fourteen participants interviewed all reside in the Gauteng province. Of the participants, 43% are male and 57% are female. The average age of the participants is 35, ranging between the ages of 22 and 43. A combination of Uber and Bolt users were selected to participate in the study: three participants use Uber only, one uses Bolt only and nine use a combination of both Uber and Bolt. Usage of platforms ranges from daily to once every 2 months.

Data Privacy Concerns

Participants were asked what their data privacy concerns are when using Uber and Bolt applications. Two themes and sub-themes were generated from this question as shown in Table 11.1.

Table 11.1 Data privacy concerns themes

Theme	Sub-themes	Frequency
Unauthorised use of personal information	Misuse of information	4
	Non-transparent secondary use of personal information	3
	Sharing and selling of information to third parties	7
	Sharing information within an ecosystem	1
	Unauthorised use of location information	4
Unwanted third-party communications	Spam emails	1
	Telemarketers	4
	Using information for marketing	1

Unauthorised Secondary Use of Personal Information

Participants raised concerns about their personal information being used by Uber and Bolt for secondary reasons they have not consented to. Participants were asked: What data privacy concerns do you have with using Uber and Bolt online platforms? Seven participants mentioned platforms selling their personal information to third-party companies and four were concerned with information misuse.

Interviewee 10 "We really, really don't have control of what happens with the data."
Interviewee 13 "There is always, you know, an underlying concern that there might be data breaches or misuse of personal information"

One participant mentioned that the platforms share consumers' personal information within their ecosystem to expand on it. The participant mentioned Uber and Uber Eats as platforms that are within the same ecosystem, sharing consumers' information.

Interviewee 1 "Uber has sort of expanded their ecosystem to include Uber Eats. The problem I have is I am a registered Uber client but for some reason my information is now on that platform."

In an era where consumer data is used to create opportunities for organisations, there are concerns regarding the unauthorised use of consumers' personal information (Libaque-Saenz et al., 2016). There are possibilities of personal data misuse by e-hailing platforms (Salleh et al., 2024). This could result in privacy loss, inappropriate use, and other risks (Libaque-Saenz et al., 2016).

When riders request services on the e-hailing platforms, they must submit their locations, and this can lead to privacy leakages (Huang et al., 2021; Yu et al., 2021). Participants are concerned that their location information might be used outside their rides.

Interviewee 9 "Another concern is online tracking of your ride."
Interviewee 13 "I am concerned about misusing of my location data because they know exactly where I am."

Based on a study conducted by Kamais (2019), riders' location information can be tracked by Uber after the trip has ended. This information can be used to track riders' movements and collect sensitive information such as where they live, work, and socialise (Pham et al., 2017).

Unwanted Communications

Participants raised concerns about an influx of emails and calls they receive from third-party companies for promotion. Six participants believe that this is due to Uber and Bolt sharing their information.

Interviewee 9 "They are probably selling our data to marketers who are marketing out there."

Interviewee 13 "I'm not entirely sure about how transparent they are with the secondary uses of my data. I am worried about calls I receive from telemarketers."

In contrast, interviewee 4, a Bolt user, and interviewee 8, an Uber and Bolt user, mentioned that they are confident that the platforms do not use their personal information for unwanted communications.

Interviewee 4 "I'm way comfortable for the fact that I don't get any spams."

Interviewee 8 "I've never received a call from anybody saying that they got my data from Uber."

Interviewee 10 argues that although he receives marketing calls and emails, the platforms inform them, and they consent without paying attention to it.

Interviewee 10 "The fine print as well, you know, when we sign up to these platforms, we don't really read them, we just select yes."

Participants' direct marketing concerns coincide with studies conducted by Duan et al. (2022) and Pham et al. (2017), stating that e-hailing companies sell their customers' ride information to third parties for marketing purposes, raising significant privacy concerns.

Data Security Concerns

To understand Uber and Bolt data security concerns, participants were asked three questions: How comfortable they are with disclosing their personal information on the applications, how confident they are that Uber and Bolt keep their personal information safe and secure, and whether they had unsubscribed from Uber and/or Bolt due to the fear of their data not being secured. Two themes and sub-themes were generated from the responses as shown in Table 11.2.

Six participants indicated that they are comfortable with disclosing their information, four are somewhat comfortable, and four are uncomfortable.

Table 11.2 Data security concerns' themes

Theme	Sub-themes	Frequency
Cyber incidents	Cybersecurity attacks	2
	Data breaches	4
	Hacking	3
	Information theft	3
Policy and security deficiencies	Unclear policies or security measures	2

Most participants are comfortable with disclosing their personal information because they believe that Uber and Bolt do not ask for unnecessary information such as their identification number.

Interviewee 4 "It's one of those where we provide them with minimal information."
Interviewee 11 "I don't stress about it because they don't have my ID number."

Participants also raised a concern about disclosing their bank card details and home addresses. Incidents of data breaches have heightened concerns around the potential for unauthorised access to sensitive information (Libaque-Saenz et al., 2016).

Interviewee 3 "They will know where you stay. They will do anything that they can do with the data"
Interviewee 9 "Identification and banking details I am not comfortable sharing."

Cyber Incidents

Although participants have not personally encountered any data security issues with Uber and Bolt, they are aware of the incidents that have occurred in the past and this has affected their level of comfort with using the applications. Data breaches were the biggest concern mentioned by participants. Interviewee 9 mentioned three incidents experienced by Uber in the last few years, and Interviewee 6 mentioned the general concern with data breaches.

Interviewee 6 "There is always, you know, an underlying concern that there might be data breaches"

A security incident was reported by Uber in 2022, where the account of an Uber external contractor was compromised after a malware attack on their personal device. This attack resulted in the attacker accessing several Uber tools (Uber, 2022). A technology security firm, Appthority, indicated that newer versions of the Uber app did not enforce encrypted connections, making data vulnerable to third-party prying (Kamais, 2019). This supports the cybersecurity attacks and hacking concerns raised by participants.

Interviewee 10 "These platforms can get hacked, they can get hit, you know, there are cybersecurity attacks, and your information is out there"

In 2016, Uber experienced a massive data breach that affected approximately 57 million users worldwide. The breach included consumers' personal information such as names and contact details (Kamais, 2019).

Policy and Security Deficiencies

Participants raised concerns regarding the South African policies that protect consumers of online platforms. Participants mentioned that South Africa is still lagging and that there is a need for strict policies focused on protecting personal information on e-commerce, with harsh non-compliance consequences.

Interviewee 10 "I don't think we have well defined policies or security measures in place with harsh penalties if the platforms do not comply."

Participants' concerns are valid, based on numerous studies establishing that updating the regulations is essential to adapt to emerging technologies such as the SEPs (Dahmani & Youssef, 2023; Hardaker, 2021; Ngoepe & Ngwenya, 2021; Obioha & Masumbe, 2023; Ostanina & Titova, 2020). Additionally, the current regulations in the transport and security sectors are not aligned with the growing and emerging technologies, such as the e-hailing services and the overall sharing economy (Kamais, 2019).

Effects of Data Privacy and Data Security Concerns

Two themes and sub-themes were generated when participants were asked questions relating to the effects of data privacy and data security, as shown in Table 11.3.

To determine the participants' overall confidence in online platform data privacy and data security, they were asked whether data privacy and data security concerns affect their decision to use online platforms. Thirteen participants responded with a yes. Interviewee 3 stated that he avoids online platforms requiring banking information. Interviewee 14 is concerned about sharing her identity number.

Table 11.3 Data privacy and data security effects' themes

Theme	Sub-themes	Frequency
Criminal and safety risks	Criminal activities	8
	Financial impact	3
Reduced trust in the platforms	Choosing alternative transport	1
	Lack of trust	2

Interviewee 3 "If it involves me putting in my banking details, I try by all means to avoid that one."

Interviewee 14 "As soon I'm trying to do something, and they ask for my ID number to be put in, I'd rather not."

Platform users' personal information can be used for malicious intent by service providers (Huang et al., 2021). This data can be misused for unethical purposes (Pham et al., 2017). In addition, some online platforms sell consumer data to third parties without consumers being aware, and this poses ethical questions (Duan et al., 2022; Frenken et al., 2020; Hardaker, 2021).

Criminal and Safety Risks

Participants are concerned that their personal information might land in the hands of criminals, compromising their safety. There have been cases of rape, kidnapping and murder against Uber (Kamais, 2019). This reinforces the fears raised by participants:

Interviewee 8 "I've heard issues around, you know, people getting abducted or harassed and things are stolen from them because their personal information was leaked"

Criminal activities such as sexual assault and aggression by drivers, inappropriate behaviour and attacks have been reported by e-hailing service consumers because of sharing location information (Nor et al., 2021). Furthermore, consumers' personal data can be used for fraudulent activities (Padilla et al., 2022).

Reduced Trust in the Platforms

To understand the impact of data privacy and data security issues on trust, participants were asked if they had ever unsubscribed from Uber and/or Bolt due to the fear of their data not being secured. Two participants have unsubscribed from Bolt due to suspicious bank transactions. Data security and data privacy concerns affect the trust of online platforms (Ngoepe & Ngwenya, 2021).

Interviewee 11 "People were saying bad things about Bolt, and that's when I decided I will stop using the app."

Interviewee 12, a former Bolt user opted to use Uber only because she is not confident that Bolt safeguards consumers' personal information. The participant further stated that irrespective of Uber's price compared to Bolt, she will still choose Uber. Customers are willing to pay higher prices for products and services from a reputable company (Burlea-Schiopoiu & Balan, 2021).

Interviewee 12 "I consciously choose to use Uber over Bolt because like I said, Uber just gives me a little bit more comfort."

This finding aligns with Mohd Idros et al. (2019)'s study, which deduced that data security and data privacy have an influence on consumer trust and satisfaction with e-hailing services. When people have trust in the SEPs, they are willing to share their personal information and transact on the platforms (Akhmedova et al., 2021).

Participants were further asked if they trust that Uber and Bolt only collect their data for purposes that they have consented to. Of the participants, 50% trust that their data is used as consented.

Interviewee 7 "I guess I do because I have no reason not to"

Interviewee 8 "I trust that because I've never experienced any other thing out of the ordinary."

Of the participants, 43% indicated that they do not trust that the platforms only collect their data for purposes that they have consented to. According to the participants, their information is used for secondary purposes outside of the rides.

Interviewee 9 "I don't trust them, even when they say, we are going to use your information just for the purpose of your rides, I don't trust that at all."

Of the participants, 7% are unsure of what their personal information is used for.

Interviewee 11 "I don't even remember consenting to anything when I signed up for this app. Because I've had this app forever"

Although the participants have not personally experienced security and data privacy issues, they are aware of incidents reported on Uber. Interviewee 9 believes that these incidents could damage Uber's reputation. Reputation has an impact on customer behaviour; it impacts customer loyalty (Burlea-Schiopoiu & Balan, 2021).

Interviewee 9 "I'm not that confident because I know at any time, any day there might be a data breach. Is Uber really reputable? Are people even aware of these incidents?"

Building Consumer Trust

Trust encourages consumers to continue using services (Akhmedova et al., 2021). To determine what the SEPs can do to improve consumers' level of trust, participants were asked: What can Uber and Bolt do to make you feel more secure about your data when using their applications and build your trust? The responses raised two themes and sub-themes, shown in Table 11.4.

Table 11.4 Building consumer trust themes

Theme	Sub-themes	Frequency
Enhanced security features	Strengthen security features	6
	Bank debit authorisation	3
	Encrypt rider details	2
	Rider authentication	2
Transparency and awareness of data security and privacy	Consent for data sharing activities	1
	Create data security awareness	5
	Consumer data usage transparency	3

Enhanced Security Features

The participants feel strongly that Uber and Bolt must continuously strengthen their security features to protect consumers' information. They believe this will help them feel more at ease with their information being stored on these platforms.

Interviewee 12 "I wish they can just tighten up on security, especially Bolt."
Interviewee 14 "They must just beef up on security and make sure our information is safe."

Participant's need for stringent security measures links to Dahmani and Youssef (2023)'s study, which reveals that platform operators must implement strict security measures to ensure their customers' information is kept safe and secure, thereby improving trust and overall customer experience. Digital platform customers feel at ease when they trust that their personal information is secured (Mitchell et al., 2019).

Participants also indicated that for Uber and Bolt to alleviate the concern they have with the platforms storing their bank card details, they must be asked to authorise payments for all rides.

Interviewee 2 "I think those additional things like instead of saving the card and just processing it every time a person uses it, but rather in like enabling additional authentication to ensure that actually it's still the same person using it."

Several studies emphasise the need for secure online payment processes and systems (Hassan et al., 2020; Hossain et al., 2024; Jafri et al., 2024). There are vulnerabilities in electronic payments (Hassan et al., 2020). Strong encryption and multi-factor authentication are important to protect sensitive data, mitigating the risks of fraudsters accessing systems and thus improving customer trust (Hossain et al., 2024).

Participants believe that Uber and Bolt must put security measures in place to protect their information. Participants advised on encryption and disabling the copying of riders' information from the applications.

Interviewee 3 "They should make an encryption between my details and the driver's details."

Interviewee 5 "If they can lock my information from the Uber driver or Bolt driver from copying the information."

E-hailing service providers must ensure that they have adequate safety and security measures to protect riders (Nor et al., 2021), even though risks cannot be completely eliminated (Mohd Idros et al., 2020). Online platform consumers are scared that their information may be compromised, and some use fake profiles to protect their personal data (Ngoepe & Ngwenya, 2021). Nine participants have implemented additional security measures to protect their data when using Uber and Bolt, such as avoiding public Wi-Fi, using virtual cards, and not using their real names on the platforms.

Interviewee 1 "I'm possibly gonna look at using virtual cards instead of my physical card details going forward."

Interviewee 7 "Most of the times I don't use my real name"

Tabassum et al. (2023) reported that end-to-end encryption, access control and data anonymity are amongst other techniques that can improve consumer trust and confidence.

Transparency and Awareness of Data Security and Privacy

Participants mentioned that Uber and Bolt need to be transparent with how they store and use their data. The platforms must make efforts to create awareness around their security protocols where consumer data is concerned.

Interviewee 6 "So, if they could inform me, the public, around the data security controls they have in place"

Consumers who buy products and services online are concerned about not being informed about how their data is collected, used, and shared, and they plead for more transparency and control over these processes (Culnan, 1993). Nor et al. (2021) asserted that there is a need for robust security policies and regulations to protect consumer data and ensure their safety; there is a direct relationship between safety and security and customer satisfaction.

A participant mentioned that Uber and Bolt must make consumers aware if they make any changes to their policies.

Interviewee 9 "When it comes to security, the number 1 important thing is awareness. Sometimes they just change their policies without anyone knowing"

These concerns highlight the need for online platforms to adopt fair information practices, including obtaining explicit consent from consumers before using their personal information (Culnan, 1993). Furthermore, organisations must be transparent as it helps build trust (Mohd Idros et al., 2020) and mitigate concerns about data privacy (Mou et al., 2023).

Conclusion

The aim of this study was to determine the impact of data privacy and data security concerns on influencing consumer trust in South Africa. To achieve this objective, data was collected from 14 participants through semi-structured interviews and analysed using the privacy calculus theory to generate themes. The findings revealed that there are significant data privacy and data security concerns when using the SEPs, such as misuse of personal data, possible cybersecurity attacks, data breaches and hacking, as mentioned by the participant. These concerns affect consumers' trust in using the platforms. Consumers fear that data privacy and data security issues may lead to their information being used for criminal activities, and the fear has led to some participants to opt for alternatives.

There are measures that can be put in place such as strict security features and policies and promoting transparency in their data handling practices to foster a sense of security and trust. In addition, there is a strong need for strict well-defined policies and regulations from the government with severe penalties for those who do not comply. It can therefore be concluded that data privacy and data security have a direct impact on consumer trust, influencing consumers' decision to use the SEPs.

This research offers the SEP providers with suggestions on how to improve their data handling practices and address consumer concerns, that is, implementing strict security measures, complying with the existing regulations, introducing custom regulations and creating awareness. This will help enhance consumer trust and improve the service offerings in the SEPs.

This research focused on consumer trust from a generic perspective and future research can investigate whether demographic factors affect perception of data privacy and data security in the SEP. Future research can also extend the study to other SEP businesses apart from e-hailing services.

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Chapter 12
Nearshoring in Central Eastern Europe: The Evolution of Shared Service Centers and Global Business Services

Marcel Hirsiger

Abstract This chapter examines the evolution of service and production nearshoring in Central Eastern Europe, with a particular focus on Poland. It explores the increasing tendency of companies to outsource their business processes to countries that are geographically and culturally closer to their own, with the aim of reducing costs and enhancing operational flexibility. The trend is further strengthened by global events, such as the COVID-19 pandemic and geopolitical tensions. Nearshoring offers numerous advantages, including the ability to respond more quickly and reduce CO_2 emissions. Poland has been successful in establishing itself as an attractive location for nearshoring, with a growing number of SSCs and a skilled workforce. Finally, the importance of sustainability and cultural proximity in nearshoring strategies is emphasized.

Keywords Shared service centers · Business process outsourcing · Nearshoring · Service offshoring · Central Eastern Europe

From Offshoring to Nearshoring: Recent Developments

While Western European companies have been moving their activities to remote areas such as China or India for several decades, it seems a rather recent phenomenon that they are looking at closer destinations. This trend gained momentum with the onset of the global pandemic, the ongoing geopolitical tensions, and the threats to global supply chains. Nearshoring—and its newer ally, friendshoring—has merged as a robust strategy, with a focus on areas in closer proximity.

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This geographical shift does not only reflect a change in the preferred countries. This development encompasses not only the pursuit of cost-effectiveness but also the consideration of criteria that render regions in closer proximity more appealing. The recent trend involves more than the mere pursuit of cost-cutting in distant regions; it also has implications for service chains and the establishment of sizable office centers in countries such as Poland and the Czech Republic.

A recent survey by the European Central Bank revealed that large European firms anticipate an increase in operational resilience through enhanced activity in reshoring and nearshoring over the next 5 years (Attinasi et al., 2023). This strategic shift entails not only the geographical proximity of production facilities (a phenomenon termed nearshoring) but also the relocation to countries with political and cultural affinities (a phenomenon referred to as friendshoring). This phenomenon is influenced by various factors, including supply-side dynamics such as the countries offering offshoring or nearshoring facilities. On the demand side, companies seek locations abroad, contributing to this trend (Piatanesi & Arauzo-Carod, 2019, pp. 810–811).

Nearshoring also has a positive impact on sustainability, which is a notable benefit. It is evident that proximity, as evidenced by the relocation of production plants and service centers from distant regions such as China or India to more proximate countries like Poland, will result in a substantial reduction in CO_2 emissions. However, it is imperative to recognize that the relocation of production facilities and service centers to more proximate locations will have far-reaching consequences that extend beyond the environmental dimension. These consequences will also encompass social aspects, including but not limited to gender equality and the quality of education (Di Stefano et al., 2024).

In this context, countries in Central Eastern Europe emerge as favorable and appealing destinations for Western European companies seeking to nearshoring their service (and manufacturing) activities (Gál, 2014, p. 69). In 2024, the business services sector in Poland employed over 450,000 individuals, exhibiting a growth rate of nearly 4% compared to the previous year (Association of Business Service Leaders (ABSL), 2024, p. 6). This sector is among the fastest growing in the sixth largest economy of the European Union, attracting an increasing number of international companies.

This chapter will provide an introduction to the various concepts of offshoring decisions, which are not only determined by geographical distance, but also cultural and, more recently, political proximity. This discussion will also involve an organizational dimension, as offshoring is very often conducted in the form of outsourcing. While the first move is about choosing a location, the latter involves the selection of an organizational form through the delegation of tasks to another company.

In the subsequent section, we explore the realm of services and their production. Broadly speaking, the provision of services necessitates the presence of customers; therefore, offshoring or nearshoring them should not be feasible. However, as recent years have demonstrated, certain processes can be distanciated and internationalized. The integration of nearshoring and service distanciation forms the basis of recent developments in internationalization strategies. This prompts a discussion of the predominant models of service organizations, including Business Process

Outsourcing (BPO), Shared Services Center (SSC), and Global Business Services (GBS), representing a recent evolutionary stage.

The subsequent section delves into the pivotal aspects of sustainability and corporate culture in nearshoring strategies. Given that nearshoring destinations are selected based on their cultural proximity, it might be inferred that cultural differences become less significant. However, proximity does not necessarily imply cultural similarity, thereby underscoring the persistent relevance of cultural gap bridging.

The chapter culminates in an overview of the pivotal factors that render Central and Eastern Europe an attractive destination within this business model, with a pronounced focus on Poland and its prominent nearshoring cities, such as Warsaw and Krakow.

Concepts of Distance and Organization

The opening of new markets in Far East Asia during the 1980s prompted an influx of companies seeking to establish a presence in these countries. These enterprises not only sought to capitalize on the opportunity to access new customers but also to reduce their production and administrative costs, thereby enhancing their financial performance (Akbari, 2024, p. 96). The practice of offshoring entails the transfer of specific operations within a value chain to less expensive, more isolated regions, enabling companies to take advantage of reduced labor costs and a vast workforce (Albertino et al., 2017, p. 57; Caniato et al., 2015, p. 7).

While expected cost reductions are frequently achieved within a short timeframe, companies often encounter significant challenges in other areas. These challenges may include cultural and language barriers, differences in legal and regulatory frameworks, and potential issues with quality control (Akbari, 2024, p. 97). A more comprehensive view of offshoring reveals the presence of additional, less visible costs that are difficult to manage and lead.

Moreover, companies are confronted with other disruptions, including pandemics, weather events, natural disasters, and increasing geopolitical risks. These disruptions, in combination with a broader backlash against globalization and raised concerns about global supply chains and their potential exposure to exogenous threats, have led companies to reconsider the localization of their main activities (Alfaro & Chor, 2023, p. 1; Oshri et al., 2022, p. 88). The decision to repatriate manufacturing processes to countries with closer proximity is further bolstered by shifts in cost structures within both the host and home countries. The former experiences significant cost escalations, while the latter becomes more cost-effective due to enhanced competitiveness. Additionally, enterprises gain substantial operational flexibility (Piatanesi & Arauzo-Carod, 2019, pp. 807–808).

The term “backshoring” signifies the reallocation of activities that were initially offshored to remote areas, and are now being relocated to the home country or its immediate vicinity. The term “reshoring,” which is often used interchangeably, refers to the reevaluation of a previously made decision regarding the localization of business components. Notwithstanding, it can also potentially result in another offshoring decision.

Conversely, “nearshoring” involves the location of activities in close proximity to the home country of the respective company. Despite the absence of a precise definition of this concept, it is reasonable to hypothesize that proximity encompasses several components. As noted by van Hassel et al. (2022, p. 3), “distance not only involves geographical distance, but also three other dimensions: cultural, administrative, and economic.” Nearshoring offers a multitude of potential advantages over offshoring, including the ability to respond more quickly to volatile consumer preferences and to react more rapidly to changes in the market (Piatanesi & Arauzo-Carod, 2019, p. 813). These factors may even outweigh the potentially higher labor costs in closer regions (Klimek, 2020, p. 34).

In the context of escalating political tensions, such as the tariff war between the U.S. and China or the Russian full-scale invasion of Ukraine, companies are confronted with a need to reevaluate not only their geographical and cultural location choices but also the reliability of their partners (Akbari, 2024, p. 106). This shift in perspective gives rise to a new dimension of values and trust in the concept of friendshoring (Klimek, 2020, p. 34). As Canosa (2024) asserts, this collaborative endeavor necessitates a congruence of values among participating nations (p. 144). This alignment of values has the potential to positively impact innovation and process enhancements, as evidenced by Akbari's (2024) findings (p. 106). A survey conducted by the European Central Bank further underscores the growing significance of geopolitical risks and uncertainty in decision-making processes concerning location choices by European companies (Attinasi et al., 2023).

While the “where” question focuses on the physical location, the “how” or “who” dimensions address the operational aspects of company activities. Historically, European companies have typically established subsidiaries in foreign countries while retaining comprehensive management control. However, it should be noted that offshoring frequently entailed an element of outsourcing. In such cases, processes are transferred to third-party providers who offer benefits through economies of scale, access to unique expertise and latest technology, variabilization of previously fixed costs, quality improvement, or the reduction of overhead costs (Kremic et al., 2006, p. 471; Oshri et al., 2022, pp. 7–8). Moreover, companies procure products (and services) only when there is a justified demand, and they do not need to adapt their own organization (Kopyciński & Mamica, 2021, p. 5).

The two dimensions—where and how (or who)—can be combined into various business and operating models, including traditional “offshoring/outsourcing” and “nearshoring/captive” (with the latter one run as a fully owned and controlled subsidiary) (Contractor et al., 2010, p. 7). As organizations evolve, other forms emerge, such as a purely captive model (fully integrated subsidiary) or the “build-operate-transfer” (BOT) model, where a third-party contractor establishes the model initially and subsequently transfers it to the primary company (Bryson et al., 2020, p. 192). Enterprises often opt for captive models to maintain comprehensive oversight of their rent-generating assets, which inherently encompasses core processes as opposed to support activities (Geodecki, 2021, p. 23).

The Distanciation and Outsourcing of Services

As nearshoring increasingly involves the distanciation of services (rather than manufacturing processes), a more detailed examination of their specifics is necessary. Services, by their nature, require the presence of the customer and are also referred to as "prosumption" because production and consumption coincide (Bryson et al., 2020, p. 27). Notably, advancements in ICT technologies and increasing commoditization are enabling the delivery of select service types in an impersonal manner, thereby contributing to the commodification of services. Consequently, services are becoming commoditized and increasingly reliant on predefined modules (Klimek, 2020, p. 9).

It is evident that the "harder" a service, the less prone it is to outsourcing or nearshoring. These services involve the use of ICT applications that facilitate communication between service providers and customers, thereby circumventing the need for physical interaction (Bryson et al., 2020, pp. 182–183). These processes can be codified and digitized, enabling their provision from any location, irrespective of geographical proximity (Contractor et al., 2010, p. 10).

In a similar fashion to the manufacturing sector, the outsourcing of services to external entities is a common practice, driven by the pursuit of cost reductions through economies of scale, the desire for specialization, and the aim of minimizing overhead expenses (Kremic et al., 2006, pp. 468–469). Initially, companies tend to outsource or offshore basic, cost-effective back-office functions to external entities. Subsequently, they transition to outsourcing or nearshoring customer-facing services, such as call centers or help desks. It is followed by the transfer of business functions, including Human Resources Management and Accounting. Ultimately, strategic, knowledge-intensive processes, such as market research and research and development, constitute the final phase of outsourcing (Oshri et al., 2022, p. 28).

The practice of outsourcing has evolved beyond a mere cost-cutting strategy. It facilitates rapid access to skilled and qualified professionals, enhances flexibility in developing new products or services for customers, and can stimulate digital transformation. Consequently, it should be regarded as an integral component of strategic management rather than operational (Schönenberg & von Wnuk-Lipinski, 2024, pp. 174–176). In contradistinction to the offshoring of manufacturing steps, the relocation of services incurs a lower cost: "It is much cheaper and faster to transfer the knowledge using the digital communication infrastructure" (Klimek, 2020, p. 22).

The decision regarding the potential relocation of services is influenced by a multitude of factors. These include general attributes such as the ability to standardize or formalize processes, thereby eliminating the involvement of tacit knowledge. Additional considerations include prior experience with outsourcing and the presence of a capable partner to facilitate the transition (Lacity et al., 2016, pp. 277–279). Typically, the provision of services is subsequently entrusted to an "external third party [which] is paid to provide a service that was previously the internal responsibility of the organization" (Doxey, 2021, p. 373). This practice is referred to as Business Process Outsourcing (BPO) (Lacity et al., 2016, p. 280).

Alternatively, Shared Services Centers (SSCs), which are operated by the parent company but situated in a separate location, can be established (Doxey, 2021, pp. 373–374). Shared Services Centers (SSCs) share numerous similarities with Business Process Outsourcing (BPO) arrangements; however, if the enterprise aims to gain strategic advantages, SSCs prove to be more effective than BPOs. BPO arrangements should be used solely for cost reduction as the primary objective (Klimek, 2020, p. 48). Through the variabilization of fixed costs and the utilization of economies of scale, they enable substantial cost savings. In contrast, SSCs are better suited to building and expanding internal process knowledge (Kajüter et al., 2017, p. 42). While this may be of minor importance for manufacturers, it is crucial for pure service companies.

The transition of processes to external providers (under a BPO arrangement) or internal centers (SSC type) necessitates the standardization of processes. To mitigate potential risks, such as loss of control and quality issues, companies must ensure a seamless transition by fostering a strong partnership with the service provider, whether internal or external. This transition is further supported by a clearly articulated vision shared by both parties (Doxey, 2021, p. 376). While both SSCs and BPOs are susceptible to operational risks, such as dysfunctional processes or even complete ruptures, only the latter are exposed to structural risks. This category encompasses the potential for a discrepancy between the anticipated functionality of the relationship between the client and the supplier. Consequently, companies are obliged to pay greater attention to the contractual specifics with the BPO provider to ensure the uninterrupted delivery of services following the transition (Oshri et al., 2022, pp. 33–35).

In practice, companies will find two types of Shared Services Centers (SSCs) (Brühl et al., 2017, p. 11). The first type focuses on transactions with high volumes and a large number of repetitive tasks (centers of scale). The second type is based on expertise and requires specific and technical knowledge, which is provided by qualified staff (centers of excellence). Transaction-oriented SSCs are centered on processes that are entirely independent from core processes (or can be easily separated) and can be categorized into major groups (Brühl et al., 2017, pp. 10–11). This purely volume-oriented restructuring does not offer any value to the organization (beyond cost reduction). Consequently, SSCs should ideally operate as autonomous business units within a larger organization, formulating their own strategies and seeking to generate value-added services (Klimek, 2020, p. 60).

In recent times, nearshoring centers have begun to evolve in this strategic direction. These centers are shifting from basic data entry tasks and customer contact centers to more complex responsibilities. They are integrating common corporate functions and providing knowledge services and even R&D solutions (Contractor et al., 2010, p. 13). Initially, cost was the primary motivator; however, it subsequently transitioned to customer orientation and, ultimately, the competitiveness of SSCs as they began to offer their services not only to internal customers but also to external clients (Brühl et al., 2017, p. 17). In this final stage, SSCs will also develop unique capabilities and thus become an integral part of a company's core assets. To provide this value, the centers will rely heavily on collaborative teamwork, which will also impact the required leadership styles and corporate cultural elements (Youngdahl et al., 2010, pp. 802–804; 812).

The high-volume/low-cost SSCs eventually develop into Global Business Services (GBS), which is defined as "an entity perceived as a further evolved form of shared service, which delivers more than one service, is characterized by multiple high-value functions (analysis, consulting) often associated with new technologies" (Kopyciński & Mamica, 2021, p. 8). As a result, GBSs are multifunction, multi-region (covering various subsidiaries of multinational enterprises), multi-location (typically distributed around the globe to use the "follow-the-sun" principle which guarantees a 24/7 availability of services), multisourced, and multi-business (Klimek, 2020, p. 62).

This evolution of SSCs into GBSs also changes the required skills for their staff. As operations become more complex and serve a larger number of international clients, required qualifications get closer to those in the home country where the tasks were run before. Therefore, a country is more likely to be a destination for service offshoring when conditions are similar to the home country (Caniato et al., 2015, p. 9). For Western European enterprises, this environment can be found in Central Eastern Europe, among other regions. This phenomenon underscores the notion that companies must consider not only the status quo but also future development prospects when evaluating potential locations (Kajüter et al., 2017, p. 27).

Sustainability and Cultural Aspects

It is evident that the relocation practices of backshoring processes to proximate locations will result in a reduction in CO_2 emissions due to the curtailed distances involved. This is particularly salient in the context of transporting goods manufactured abroad. The nearshoring phenomenon, in and of itself, does not inherently possess a favorable impact on environmental concerns; its impact is subject to the location of the activities prior to the shift. Nonetheless, nearshoring should generally result in enhanced contributions to sustainable development by companies.

Offshoring, in its own right, can have substantial negative ramifications for host countries, as it fosters business models that separate the production and consumption of CO_2, thereby rendering it less perceptible to consumers (Di Stefano et al., 2024, p. 864). Moreover, as offshoring is often combined with outsourcing organizations, it reduces the responsibility of the parent companies when it comes to salaries or financial sustenance (Mazur-Bubak, 2021, p. 54). Proponents of offshoring tend to "evade their domestic social regulations or occupational safety standards," adopting an "out of sight, out of mind" mindset (Kopyciński & Mamica, 2021, p. 5).

In host countries, offshoring businesses can also result in adverse outcomes in other areas of the Sustainable Development Goals (SDGs) established by the United Nations. These enterprises, by offering low-wage and unskilled employment opportunities, create incentives for their workforce to discontinue their education (SDG 4) and intensify the demand for natural resources (SDGs 12–15). Concurrently, the prevalence of low-skilled employment tends to draw a higher proportion of women, thereby undermining the goals of reducing inequalities and promoting gender equality (SDGs 5, 11). However, it is noteworthy that offshoring companies frequently contribute to economic development and poverty reduction (SDGs 1, 8) (Di Stefano et al., 2024, pp. 866–867).

The reshoring of production to countries with closer geographic proximity will likely result in positive developments within the global value chain of a company. This is due to a reduction in transportation-related emissions, which leads to a decrease in a corporation's CO_2 footprint. As production and consumption of goods become more geographically proximate, the generation of waste is reduced, and the implementation of a circular economy becomes facilitated. It is also reasonable to assume home countries are more advanced in innovation, corporate governance, or energy production, which would result in positive spillover effects (Di Stefano et al., 2024, pp. 868–869).

However, further examination of sustainability in nearshoring settings is still needed. As Fratocchi and Mayer (2023) note, "Very few authors specifically collected empirical evidence of reshoring strategies where sustainability issues assumed a relevant role" (p. 576). This is particularly salient in light of the UN Trade and Development Agency's (UNCTAD) 2020 proposal of four alternative post-pandemic production value chains, including reshoring and regionalization (Di Stefano et al., 2024, p. 864).

Given the cultural proximity that companies seek in nearshoring settings, further investigation of these aspects is necessary. While culture is inherently personal, it is also deeply intertwined with societal and group dynamics. As Hofstede et al. (2010, p. 6) point out, "Culture is always a collective phenomenon, because it is at least partly shared with people who live or lived within the same social environment, which is where it was learned." Despite the integration of international value chains, which connect various societies, there is a tendency for these chains to accentuate cultural differences between them (House, 2004, p. 5).

In the context of offshoring models, the cultural divergences between Western European societies and their distant partners are discernible, and companies demonstrate a willingness to allocate budgets toward addressing these issues (typically, employees are required to undergo "Doing Business in China" training or similar courses). However, the distinguishing characteristics of nearshoring cultures remain less perceptible. Consequently, companies may seek to reduce expenditures by downplaying the significance of cultural differences and underestimating the risks associated with failure.

CEE as Nearshoring Destination

A multitude of advantages are apparently offered by countries in Central Eastern Europe (CEE) when it comes to hosting nearshoring companies, both in the form of Shared Services Centers (SSC) and Business Process Outsourcing providers (BPO).

During the socialist era between the mid-1940s and the late 1980s, these countries placed significant emphasis on industrialization, a factor that made them appealing to foreign companies seeking to establish manufacturing facilities in the region following the dissolution of the Iron Curtain (Klimek, 2020, pp. 2–3). These subsidiaries subsequently attracted service companies, which were established in the same cities. Consequently, nearshoring can be regarded as an expansion of existing businesses in many cases (Klimek, 2020, p. 96).

Moreover, CEE countries offer a broad range of advantages that make them attractive for nearshoring of services (in all possible configurations, from pure SSCs with routine tasks over BPOs to Global Business Solutions providers). The strategic positioning of these countries in a geographically advantageous location, with Poland and the Czech Republic at the heart of Europe, offering direct connections to Western Europe, as well as to Caucasus countries and even Central Asia, is a significant advantage. The close political ties of these countries, who joined the European Union in 2004, provide political stability and significantly reduce administrative costs (Gál, 2014, pp. 72–73). While Western countries, such as Switzerland, have been encountering difficulties in identifying a sufficient number of talented and skilled professionals, numerous Central and Eastern European (CEE) countries continue to offer a sizable workforce of highly educated, well-trained, and motivated individuals (despite unemployment rates in certain regions of Poland being below those in Switzerland) (Piatanesi & Arauzo-Carod, 2019, p. 815).

As nearshoring also involves cross-border business, the legal and regulatory environment plays an important role, too. CEE countries benefit from their EU membership, which ensures comprehensive protection of intellectual property rights and data privacy (Piatanesi & Arauzo-Carod, 2019, pp. 814–815). Consequently, it is evident that, among foreign investors in Poland, EU membership is the primary factor contributing to the country's attractiveness. Employee-related factors, such as availability, motivation, and skills, remain among the top-ranked criteria, while labor cost is positioned at the 15th position among 17 factors (International Group of Chambers of Commerce, 2024, pp. 23–24).

From a cultural standpoint, Central and Eastern European (CEE) countries are well positioned, as they do not tend to adopt any extreme stance in intercultural aspects. In the World Value Survey by Inglehart-Welzel, Poland scores almost exactly in the middle between traditional and secular values, as well as between survival and self-expression values (World Values Survey, 2023). This strategic positioning enables seamless connectivity with other Western European countries and a diverse array of cultures, including Orthodox Europe and Confucian Asia.

In recent years, CEE countries have witnessed a notable transformation, with Poland emerging as the preeminent nearshoring hub. The business services sector has seen the establishment of nearly 2000 centers, employing over 450,000 employees and generating an export volume of USD 36.8 billion in 2023 (Association of Business Service Leaders [ABSL], 2024, p. 35). These entities offer services on a global scale, with Germany emerging as the predominant location (76.5%), followed by the UK (57.4%), France (45.1%), and the U.S. (40.7%) (Association of Business Service Leaders [ABSL], 2024, p. 52).

Furthermore, these business service providers are continually expanding their product portfolio, with a marked transition towards Global Business Services (GBS), which are characterized by the delivery of high-quality services by highly skilled professionals. Knowledge-intensive processes account for 56% of total activities, in contrast to the 44% attributed to transaction-based tasks (Association of Business Service Leaders [ABSL], 2024, p. 55). It is noteworthy that women comprise nearly 60% of the workforce in these enterprises, including almost 50% of managerial positions (Association of Business Service Leaders [ABSL], 2024, pp. 70–72).

Switzerland stands as a prominent player in the nearshoring service sector in Poland. Swiss companies have been responsible for the creation of over 90,000 jobs in recent years, and the trade volume with Poland has already surpassed that with markets such as South Korea, India, or Turkey (Schweizerische Eidgenossenschaft, 2024). The most prominent Swiss subsidiaries include banking giant UBS, which employs approximately 9000 employees, followed by food multinational Nestlé with 5500 employees, and technology conglomerate ABB with 2500 employees (Swisschamber.pl, 2025). On a global level, the largest employers in business services in Poland include Capgemini (consulting; 11,000–13,000 employees), Sii (technology), Atos (IT services), and Nokia (IT and telecommunications), all with approximately 6000 to 8000 employees (Association of Business Service Leaders [ABSL], 2024, p. 64).

Conclusion and Outlook

In the period following years of offshoring production and services to remote locations, companies have recently begun to reevaluate their location strategies, opting to return to geographically closer and culturally more similar countries. This trend of nearshoring is being reinforced by disruptions to global value chains caused by pandemics, extreme weather events, and increasing geopolitical tensions. Concurrently, as services are becoming increasingly important and acquiring strategic relevance for companies, the qualifications of potential employees must be elevated.

The nearshoring trend, also referred to as friendshoring when the question of shared values and mutual trust arises, is characterized by the outsourcing of services to either Business Process Outsourcing providers or the centralization of these services into Shared Services Centers. This trend offers enterprises a wide range of benefits, including the bundling of routine tasks, increased volumes, and the faster integration of new technologies. Despite certain limitations on the types of processes that can be outsourced or externalized, companies frequently employ Information and Communication Technologies (ICT) to overcome geographical distances.

Consequently, nearshoring processes are becoming increasingly strategic, replacing administrative, routine, and transaction-based tasks. Shared Services Centers (SSCs) are evolving into Global Business Solutions Centers, integrating value-adding activities and even research and development. Companies that seek to capitalize on these trends no longer prioritize low-cost destinations; instead, they direct their focus toward locations that offer a substantial supply of qualified and skilled labor.

Central Eastern Europe plays a crucial role in attracting these companies and hosting BPOs and SSCs. These companies benefit from a geographically optimal position in the heart of Europe and the availability of a substantial number of well-educated and trained employees. Cultural proximity to Western Europe facilitates collaboration, particularly in Poland, which has almost 2000 business service centers and almost half a million collaborators in the business service sector. This has led to the further development of CEE nearshoring.

Despite the comparatively limited research in this area, it is evident that nearshoring will likely generate substantial benefits for sustainability, particularly in the context of reversing prior decisions that involved offshoring. The strategic relocation of production closer to home offers several advantages. Firstly, it reduces CO_2 emissions by decreasing the distance between production sites and consumers, thereby lowering the environmental impact. Secondly, it facilitates a more synchronized alignment between the consumption and production of goods, enhancing operational efficiency. Thirdly, the alignment of labor laws and Western values with principles of equality can potentially mitigate the risk of exploitation within the value chain.

It can be reasonably anticipated that nearshoring of services will experience further growth as companies begin to recognize the benefits of geographical and cultural proximity. CEE countries are likely to maintain their position of significance in this sector, given their demonstrated capacity to deliver goods and services of a consistently high standard of quality and reliability over an extended period. However, it is crucial to emphasize the necessity for further research in the domain of sustainability, where numerous questions pertaining to the comprehensive impact remain unanswered.

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Chapter 13
Impact of Digital Transformation on Export Performance and Sustainability of SMEs in Vietnam

Minh Chuong Truong, Nguyen Gia Ky Tran, and Quoc Trung Pham

Abstract Digital transformation is very important for all enterprises to improve their performance in the digital age. However, it is difficult for SMEs to adopt digital transformation to gain competitive advantages and achieve sustainable development. This study explores the impact of digital transformation on the export performance and sustainability of SMEs in Vietnam. It investigates how digital transformation influences export performance and contributes to the long-term sustainability of SMEs, focussing on the enabling role of digital tools and the ways these technologies contribute to sustainability. The research employs a quantitative approach, using a structured questionnaire to gather data from a sample of SMEs in Vietnam. The study is guided by the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), and the Resource-Based View (RBV) to develop hypotheses and a research model. The research suggests practical implications for SME managers to leverage digital transformation to enhance their international competitiveness and achieve sustainable growth. In particular, the research suggests that SME managers invest in digital literacy and IT capabilities to strengthen export performance, while also utilizing digital tools to enhance international market insights and supply chain efficiency, ultimately fostering economic sustainability.

Keywords Digital transformation · Export performance · Sustainability · SME · Vietnam

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Introduction

Regarding ASEAN's diverse and dynamic economy, Small and Medium Enterprises (SMEs) are said to be the backbone of the economy, since they make up 95%–99% of all business establishments and more than half of the total employment in all ASEAN Member States (AMS) (ASEAN, 2021). It is also stated that because of the significant role SMEs play in economic development, they are considered the driving force behind progress and the backbone of socio-economic development (Bayraktar & Algan, 2019).

In recent years, digital transformation has been receiving a great amount of attention around the globe as well as in Vietnam. This trend revolves around embracing new technologies and driving innovation to reshape processes and products of businesses to gain competitive advantage in the market and change consumer behaviors (Martínez-Peláez et al., 2024). Enterprises, from large to small, have realized that the digital transformation trend is essential and have escalated their investments in digital technology applications to help them grow and adapt during this period of economic uncertainty, emerging technologies, and shifting market dynamics (MIC, 2023).

Embracing digital transformation in today's competitive business environment can be a key driver for the growth of SMEs. By adopting new technologies, SMEs can significantly enhance their efficiency, competitiveness, and overall performance. SMEs can utilize digital tools to automate processes, which lead to a reduction of time and effort for different functions. This also allows tasks to be completed in less time and more effective allocation of human resources for more human-demanding activities (Năstase et al., 2023). Moreover, by utilizing digital channels to establish online presence, SMEs can expand their market reach and access to more customers or suppliers.

In Vietnam, a survey has indicated that many businesses have perceived the digital transformation trend and started to leverage new technologies in a wide range of business functions, such as internal management, purchasing, manufacturing, logistics, marketing, trade promotion, payment, sales, and customer service (Chau, 2022). The Vietnamese government has also stepped into the trend of digital transformation by undertaking measures to promote digital transformation in businesses spanning all economic sectors, from industry, production, and services to agriculture or trading, logistics, finance, and banking (Tu, 2021). Despite the efforts, small- and medium-sized enterprises (SMEs) still face various challenges in their digital transformation journey (Chau, 2022). While the awareness of digital transformation has risen considerably since the COVID-19 pandemic in Vietnam, until now, business operations in Vietnam remain predominantly "traditional." Many businesses have not yet fully integrated digital transformation. This indicates that technology has not yet served as a key driver of the nation's economic growth (Anh, 2021).

Over the past two decades, exportation and internationalization have gained considerable interest from many businesses and researchers. Internationalization has been considered one of the primary objectives for many SMEs to gain more benefits from international markets (Altun, 2017). Whereas exportation is often the first step of internationalization for SMEs, and it is significant because it enables firms to acquire valuable market, institutional, and product insights that can be applied to other foreign markets (Love et al., 2015). In this context, digital transformation serves as a pivotal factor in enhancing export performance. Scholars have investigated the impact of digitalization on exportation, particularly in the fields of goods and services trading. They have claimed that digitalization has a positive effect on streamlining global trade by lowering costs, improving efficiency, and bridging information gaps, as well as by overcoming language barriers to promote specialized exports (Li & Li, 2022). Many researchers have examined the potential of digital technologies to serve as an enabler for SME internationalization. Digital technologies can significantly facilitate SME internationalization by expanding market reach, enhancing value creation for global customers, and fostering internationalization relationships. Other ways that digital tools can further internalization include overcoming barriers such as location and distance, optimizing resource utilization, delivering consistent customer experiences, and strengthening relational competencies and partner networks (Yordanova et al., 2024).

According to Zvarikova et al. (2024), the adoption of digital transformation in SMEs is essential for promoting sustainability across multiple dimensions. Recently, businesses are under increasing pressure to achieve sustainability, especially for SMEs. The Stakeholder Theory suggests that long-term sustainability should be the goal of any enterprise (Shim, 2014). Digital transformation serves as an enabler for SMEs to enhance operational efficiency (Martínez-Peláez et al., 2024) and to improve export performance (Li & Li, 2022). Strong export performance, in turn, equips SMEs with knowledge, market insights, and strategies needed for long-term success in global markets. Ultimately, the connection between digital transformation, export performance, and internationalization helps SMEs achieve business sustainability. However, realizing the full potential of digital transformation to drive sustainable growth requires careful management to ensure that economic stability, scalability, and long-term organizational goals remain aligned.

Despite being well-established areas of research, the relationship between digital transformation, internationalization, and export performance, especially in the context of small- and medium-sized enterprises (SMEs), is not yet validated in practice in Vietnam (Dethine et al., 2020). In comparison with large enterprises, SMEs are more agile in adapting themselves according to changes in the external environment, but they lack resources for pursuing many changes at the same time. There is much research that studies how digitalization can improve business operations or the way internationalization strategies are shaped by technology. However, research addressing the specific impact of digital transformation on both export performance and sustainability for SMEs remains inadequate, particularly in the context of developing countries, such as Vietnam (Minh et al., 2024).

Considering the above-mentioned significance, this topic "Impact of Digital Transformation on Export Performance and Sustainability of SME in Vietnam," is proposed. This study focuses on providing a comprehensive analysis of the impact of digital transformation on SME export performance and business sustainability. It will focus on the specific context of Vietnamese SMEs, exploring the enabling effects of digital tools on internationalization and the ways in which these technologies contribute to long-term sustainability. The structure of this study is organized as follows: (2) Literature Review and Proposed Research Model; (3) Research Method; (4) Analysis Results; and finally, (5) Conclusion and Managerial Implications.

Literature Review

Small and Medium Enterprises (SMEs)

Small- and medium-sized enterprises (SMEs) do not have a universal definition. How they are defined varies between countries. In Vietnam, SMEs are categorized based on their total workforce and capital investment. According to Decree 80/2021/NĐ-CP, SMEs are registered business establishments that fall into three categories: very small, small, and medium, determined by their total capital investment as reflected in their accounting balance sheets or their average annual employee count (Tuan, 2020) (Table 13.1).

Digital Transformation in SMEs

Digital transformation represents a fundamental organizational change process. Based on a comprehensive analysis of 134 definitions, Gong and Ribiere (2020) defined digital transformation as a fundamental change process, enabled by the innovative use of digital technologies, accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value proposition for its stakeholders (Melo et al., 2023). In the context of SMEs, this transformation specifically relates to the digitalization of organizational structure and operational processes (Bui, 2021).

Despite many benefits, such as performance enhancement, higher innovation, and sustainable growth, SMEs often show reluctance toward the adoption of digital transformation (Denicolai et al., 2021). This could be because many SMEs in developing countries, including Vietnam, face various challenges related to digital capabilities, management, and resource limitations (Bui, 2021). Although there is increasing awareness of the rise of technology in various fields and the global wave of digital transformation in both larger and smaller enterprises, as well as in Vietnam, many SMEs still hesitate to adopt digital transformation in their business operations. The current research landscape reveals a significant gap that while digital transformation has gained increasing attention globally, studies predominantly focus on developed economies and large enterprises (Bui, 2021).

Table 13.1 Classification of SMEs by sector and size criteria in Vietnam

Sector	Micro enterprises			Small-sized enterprises			Medium-sized enterprises		
	Number of laborers	Total annual revenue (VND)	Total annual capital (VND)	Number of laborers	Total annual revenue (VND)	Total annual capital (VND)	Number of laborers	Total annual revenue (VND)	Total annual capital (VND)
I. Agriculture, forestry, fishery	10 people or fewer	3 billion or less	3 billion or less	Between 10 people and 100 people (not a micro enterprise)	50 billion or less	20 billion or less	Between 100 people and 200 people (not a micro or small enterprise)	200 billion or less	100 billion or less
II. Industry and construction	10 people or fewer	3 billion or less	3 billion or less	Between 10 people and 100 people (not a micro enterprise)	50 billion or less	20 billion or less	Between 100 people and 200 people (not a micro or small enterprise)	200 billion or less	200 billion or less
III. Trade and service	10 people or fewer	10 billion or less	3 billion or less	Between 10 people and 50 people (not a micro enterprise)	100 billion or less	50 billion or less	Between 50 people and 100 people (not a micro or small enterprise)	300 billion or less	100 billion or less

Source: Decree 80/2021/ND-CP (Vietnamese Government)

Internalization and Export Performance of SMEs

Internationalization represents a strategic approach for firms to expand their activities across national borders. This expansion offers multiple advantages, including economies of scale and scope, enhanced market power, risk reduction, and learning opportunities (Olmos & Díez-Vial, 2015). In Vietnam, export activities serve as the primary channel for internationalization, providing a cost-effective means to expand market reach when domestic markets prove insufficient (Huynh et al., 2018). Through successful internationalization and strong export performance, SMEs can accelerate their growth by accessing less competitive foreign markets, diversifying risks, and developing new capabilities through international exposure (Olmos & Díez-Vial, 2015).

Digital transformation has emerged as a crucial enabler for enhancing internationalization capabilities and export performance of SMEs. This transformation facilitates international growth through multiple aspects, such as improving operational efficiency, reducing transaction costs, enabling market access and diversification (Nham et al., 2023), strengthening organizational capabilities (Luu, 2023), and helping overcome traditional export barriers (Elia et al., 2021). This digital enablement contributes significantly to SME growth through expanded market opportunities, increased operational efficiency, improved access to global value chains, and more cost-effective market entry strategies. Based on this understanding, digital transformation serves as a foundational enabler for SMEs' internationalization success, particularly in driving enhanced export performance. This relationship establishes the framework for examining how digital transformation impacts Vietnamese SMEs' internationalization efforts through their export performance.

Business Sustainability in SMEs

In an era of rapid globalization and technological advancement, the integration of digitalization, internationalization, and sustainability has transformed how SMEs operate, enabling them to remain competitive in a globalized marketplace (Durão et al., 2024). Digital transformation significantly influences SME performance by enhancing financial outcomes and supporting long-term business sustainability. Key digital resources, including advanced technologies, digital skills among employees, and transformation strategies, are critical to boosting SME performance and fostering sustainable development (Hilali et al., 2020; Teng et al., 2022). According to Pham and Pham (2024), digital transformation through KM processes could help to boost innovation and sustainable development of SMEs. In summary, digital transformation enables SMEs to adapt to dynamic market demands while achieving sustainable operational improvements.

Theoretical Background

To develop the hypothesis and the research model to study the impact of digital transformation on SMEs' export performance and sustainability, this research highlights the awareness and intention to adopt digital transformation through the application of the Theory of Reasoned Action (TRA) and the Technology Acceptance Model (TAM). Furthermore, to emphasize the relationship between organizational resources, export performance, and sustainability, this study also adopts the Resource-Based View (RBV).

In the Theory of Reasoned Action (TRA), behavioral intention is the measure of one's intention to perform a specific behavior (Fishbein & Ajzen, 1977). A person's beliefs and evaluations about the outcomes of a given behavior contribute to their attitude toward the behavior, which in turn affects the behavioral intention. Normative beliefs and motivation affect the subjective norm, which also influences behavioral intention. Normative beliefs refer to a person's perception about the expectations of important others (LaCaille, 2020), and these beliefs lead to the perception of social pressure and contribute to motivation to comply (Fishbein & Ajzen, 1977).

The Technology Acceptance Model (TAM) was introduced by Davis in 1989 as an extension from the Theory of Reasoned Action (TRA). The Technology Acceptance Model (TAM) is specifically used to explain information system adoption and usage behavior. The goal of TAM is "to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified" (Davis, 1989). According to TAM, the perceived usefulness and ease of use of technology are the predictors of subsequent behavioral intentions, user attitude toward using the technology, and actual usage (Masrom, 2007). Although TAM differs from TRA since it eliminates the subjective norms component, TAM also posits that actual technology usage is determined by the behavioral intention to use.

The Resource-Based View (RBV), developed through several studies of multiple scholars during the 1980s and 1990s, offers a fundamental framework for understanding firm composition and competitive advantage (Stroumpoulis & Kopanaki, 2022). Barney (1991) mentioned that RBV conceptualized resources as encompassing assets, organizational characteristics, processes, capabilities, information, and knowledge that are controlled by both the company and its employees (Srivastava & Srivastava, 2019). According to Barney (1991), sustainable competitive advantage emerges from resources and capabilities that possess four critical attributes: they must be valuable, rare, imperfectly imitable, and non-substitutable. Thus, based on RBV, organizations are basically composed of a set of specific resources, and the ability of an organization's management in combining the resources enables it to exploit market opportunities, which contribute to the performance of an organization (Taher, 2011).

Previous Studies

- A study by Tripathi and Singh (2024) investigates the impact of awareness and preparation for digital transformation on SMEs' business performance in Saudi Arabia. This study focuses on how awareness of, and readiness for, digital transformation among SMEs in the Ha'il region affects their intention to adopt digital transformation practices, as well as the role of government support and managerial skills as mediating factors. The study used a structured questionnaire designed with a seven-point Likert scale to measure variables, including awareness, preparation, intention to use, government support, and skills. Data were collected from 68 SMEs in Ha'il, Saudi Arabia. It found a significant positive impact of both awareness and preparation on SMEs' intention to use digital transformation. The variable intention to use was identified as a primary mediator between awareness/preparation and business performance, which helps them to create economic sustainability in the country.
- The research of Chen (2023) investigates the impact of employees' intention to adopt digitalization technologies, like AI applications, and the big data analytical capability of the firm on operational performance. The study focused on how employees' intention and big data analytical capability are related to integration capability and team collaboration in AI application processes. The study employed a quantitative approach, using structural equation modeling (SEM) to analyze data collected from a sample of 269 high-tech firms in Taiwan. Chen's study found that employees' intention to adopt AI applications positively influences integration capability and team collaboration. Importantly, both integration capability and team collaboration were found to positively impact operational performance. The results of Chen's study confirm that the intention to adopt AI applications of employees and big data analytical capabilities can improve the firm's operational performance. Thus, it supports the relationship between the intention to adopt digital transformation and IT capability, as well as the relationship between IT capability and export performance in this study.
- Study by Zhang et al. (2008): This study investigates the impact of IT capability on the performance of export-focused SMEs in China. The authors emphasize on the critical role of IT capability and its different dimensions, in determining the performance of export-focused SMEs in China. The study adopts a survey technique, which includes on-site interviews with key informants in 99 manufacturing enterprises in Chengdu and Zhengzhou, China. This study found that IT capability has a significant positive effect on the performance of export-focused SMEs in China. In addition, the study revealed that dimensions of IT capability, such as IT business partnerships and IT management, were identified as key drivers of Chinese exporting firms' performance. Meanwhile, other dimensions, including external IT linkages and IT-enabled business process integration, did not have a significant impact. Furthermore, the findings of this study suggest that investing in developing IT capability can enhance firms' performance, specifically export performance.

- Another study by Lai et al. (2024) provides valuable insights into examining the role of digital technology in driving the international diversification of firms within the context of China's unique market conditions. The research aims to understand how advancements in digital technology drive firms' expansion into international markets. This study employed a quantitative approach based on IAT, TCT, and RBV as the theoretical framework and utilized a sample of Chinese listed companies from 2005 to 2021. The study's findings indicate that there is a significant, positive correlation between digital technology innovation and international diversification. The findings show that, by lowering transaction costs and uncertainties and simplifying operational procedures, digital technology innovation promotes international diversification. Furthermore, the study's conclusions highlight the effectiveness of digital technologies, which help businesses make better use of their resources for global expansion and make it easier for them to enter and flourish in international markets.
- The research of Oura et al. (2015) examines the impact of innovation capacity and international experience on the export performance of SMEs in Brazil. This study aims to identify which factor has the most important influence on export performance in the context of emerging economies. A survey methodology was employed to collect data from 112 Brazilian industrial SMEs, all of which were exporters based in the southeast region of Brazil. The study's findings indicate that both innovation capacity and international experience have a significant positive impact on the export performance of Brazilian industrial SMEs. However, the impact of international experience on export performance was found to be greater than that of innovation capacity. This suggests that international experience plays a more critical role in driving export success for SMEs in emerging markets, particularly in the Brazilian context.

Hypothesis Development

SMEs' awareness is essential to the success of digital transformation. SMEs are aware of the need to adopt digital transformation because of the competitiveness that it creates for firms (Azevedo & Almeida, 2021). Many SMEs are setting digital transformation as their objective. A survey by the Vietnam Association of Small and Medium Enterprises found that more than 80% of professional leaders want digital transformation, and 65% of businesses are willing to invest heavily in digital transformation (Phuoc, 2024). However, since SMEs are usually financially constrained and averse to innovation (Azevedo & Almeida, 2021), some decision-makers see digital transformation as an obstacle and lack awareness to adopt new digital technologies. Furthermore, a survey indicated that participants perceive new processes and requirements during the digital transformation procedure as unfamiliar and are "afraid of extra tasks and duties" during the transformation process (Bui, 2021). This could mean that a lack of awareness of the potential that digital transformation could offer to the development of firms and the employees could lead to hesitance in the intention to adopt digital transformation. Therefore, Hypothesis 1 is proposed as follows:

H1: SME's awareness of digital transformation positively impacts the intention to adopt digital transformation.

The Theory of Reasoned Action (TRA) suggests that human behavior is determined by the behavioral intention to perform the behavior, this means if a firm has a strong intention to adopt digital transformation, it can result in that firm's development of IT-related resources and capabilities. Moreover, the Technology Acceptance Model (TAM) posits that the perceived usefulness and ease of use of technology drive the behavioral intentions, which leads to actual adoption and usage of the technology (Masrom, 2007). Firms that understand the benefits and productivity that digital technology and digital transformation bring will be more likely to develop the way to improve their IT capability. For example, when businesses realized the rising trend of AI technology and how crucial information technology is in sustainable development, many companies are developing their skills, resources and capabilities to adopt new technology to enhance their competitive advantage (Palmié et al., 2022). A study by Chen (2023) found out that the employees' intention to adopt AI applications have a positive influence on integration capability and team collaboration, ultimately enhancing operational performance. The result of the study suggests that the intention to adopt new technologies leads to a firm's capability to integrate internal and external resources and up-to-date technologies, which contribute to IT capability. Therefore, based on the above theoretical foundation, rationale and empirical findings, the following hypothesis is proposed:

H2: SME's intention to adopt digital transformation positively influences its IT capability.

Firms with superior IT capability can increase revenues, minimize operational and transactional costs, and thereby achieve better financial performance (Bharadwaj, 2000). IT capability also enables firms to access greater amounts of market information, integrate scarce information and technical resources into business processes, and facilitate the decision-making process, thus enhancing performance in export markets (Chae et al., 2014, 2018; Kmieciak et al., 2012). Moreover, studies have shown that IT capability is crucial for firms in understanding market fluctuations, thereby helping to identify new market opportunities (Chae et al., 2018, Dong & Yang, 2019). Based on the RBV perspective, IT capability is viewed as an organizational resource that is not easily imitated or substituted, which can create competitive advantages in international markets. This is especially true in the context of SMEs, where resource constraints limit their ability to expand internationally. By effectively leveraging IT capability, SMEs can connect with customers across different geographic areas, improve product mobility across national boundaries (Buckley & Casson, 2010), and enable firms to cater to customers from diverse geographical backgrounds, thereby improving customer perception and feedback in export markets (Kotturu & Mahanty, 2015). Therefore, the following hypothesis is proposed:

H3: SME's IT capability positively affects its export performance.

IT developments in the last two decades have facilitated the participation of SMEs in international business. Prior studies also suggest that IT capabilities play a crucial role in facilitating and accelerating firms' international experiences, particularly for SMEs (Spigarelli, 2003). Papadopoulos and Martín (2010) conceptualize international experience as the cumulative knowledge a firm acquires from its global operations. This knowledge is influenced by both the duration of these operations and the diversity of markets in which the firm is involved. IT capabilities enable firms to develop and leverage international networks more efficiently, which in turn results in the improvement of international experience. As Brock (2001) demonstrated, IT capabilities have a positive influence on aspects such as resource and information utilization and networking in exportation. Thus, enhanced networking capabilities allow SMEs to increase their global visibility and leverage international relationships at reduced costs (Spigarelli, 2003). Johanson and Vahlne (2009) also highlighted that digitalization facilitates knowledge acquisition and enhances business networking, creating a cultivating environment to accelerate international experience and knowledge for young exporters. Moreover, IT allows firms greater access to effective and efficient international market research and communication through advanced IT systems like customer relationship management, data warehousing, and data mining (Petersen et al., 2002). As a result, enhanced information accessibility can significantly reduce the uncertainty associated with foreign markets. Drawing on the Resource-Based View (RBV), which posits that firms' competitive advantages stem from their valuable, rare, inimitable, and non-substitutable resources (Barney, 1991), IT capability represents a critical organizational resource that can facilitate businesses in gaining international experience. Therefore, this study proposes the following hypothesis:

H4: SME's IT capability is positively related to its international experience.

A firm's international experience is considered an important determinant of export performance. Many prior studies have examined the relationship between international experience and export performance and suggest that international experience has significant effects on export performance (Sousa et al., 2008). For example, Madsen (1989) indicated that the international experience of a firm positively affects its export performance. Johanson and Vahlne (2017) highlighted that firms investing in acquiring market knowledge and international experience achieve more successful export performance. Moreover, it is pointed out by Borgersen (2005) that the international experience of managers is one of the most significant influencing factors of firm export performance. Uncertainty is an unavoidable factor when firms operate in the international environment, particularly in exporting. As a result, it requires international networks and knowledge about the fluctuations of the international market if firms want to increase the export performance (Madsen, 1989). According to the RBV perspective, international experience can also be viewed as essential organizational resources as it provides market-specific knowledge, unique cultural insights which are accumulated over time. Additionally, they

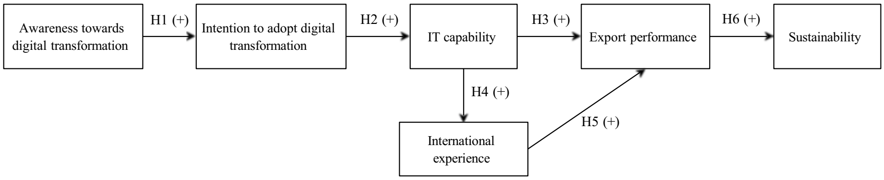

Fig. 13.1 The proposed research model

often involve tacit knowledge and unique network relationships developed through the internationalization process (Johanson & Vahlne, 2017; Eriksson et al., 2000; Dhanaraj & Beamish, 2003). Hence, this study proposes the following hypothesis:

H5: International experience positively affects the export performance of SMEs.

Export performance refers to "the outcome of a firm's activities in export markets," encompassing both an economic dimension (financial performance indicators) and a strategic dimension (achievement of the firm's broader objectives) (Katsikeas et al., 2000). The Resource-Based View (RBV) draws upon the firm's resources and capabilities to establish and maintain sustainable competitive advantages (Madhani, 2010). High export performance, therefore, can serve as a resource or capability that enhances the firm's financial position in export markets. In the case of SMEs, economic sustainability—the capacity to sustain profitable and stable growth—is particularly critical due to their limited financial resources. While sustainability is often viewed in terms of environmental and social impact, SMEs tend to focus on the economic dimension of sustainability, prioritizing profitability and financial stability (De Steur et al., 2019; Da Rocha Vencato et al., 2014). Achieving higher export performance generates greater revenue and profit, contributing to SMEs' economic resilience and long-term viability. This aligns with RBV, as effective use of resources to enhance export performance strengthens the firm's economic position, which, in turn, supports sustainable growth by ensuring profitability and financial health. Therefore, it is hypothesized that:

H6: Export performance positively influences the economic sustainability of SMEs.

In summary, the research model is shown in Fig. 13.1.

Research Method

Research Process

The research process of this study is developed based on the research process of Nguyen and Nguyen (2002), which includes qualitative research and quantitative research. The study process includes four main phases: Phase 1: Establishing the Theoretical Basis; Phase 2: Setting Up the Research Model and Measurement

Scales; Phase 3: Data Analysis and Hypothesis Testing using SPSS 27.0 software (descriptive statistics, reliability analysis, regression analysis); and Phase 4: Result Discussion and Reporting.

Data Source

There were two types of data gathered in this research including secondary data, which was already available on the Internet or in published documents, articles, reports, and primary data, which was collected for the specific purposes of this research.

The secondary data was collected from international organizational reports, academic journals, and government publications. This includes the Association of Southeast Asian Nations (ASEAN) Study on MSMEs Participation in the Digital Economy (2021), recent academic studies on digital transformation in Vietnamese SMEs (Bui, 2021; Minh et al., 2024), and comprehensive research on digitalization and sustainability (Denicolai et al., 2021; Durão et al., 2024).

The primary data is collected through structured online and offline surveys distributed to SME managers and owners. This included data from preliminary and primary quantitative research on demographic details of SMEs and respondents, SMEs' awareness and their intention to adopt digital transformation, the impact of international experience and IT capabilities on export performance, and the relationship between export performance and business sustainability in SMEs. The detailed questionnaire used for these surveys is provided in the Appendix for reference.

Measurement Scales

The measurement scales for SMEs' awareness and adoption intention were built upon the work of several scholars, including Onay, Lutfi et al. (2022), and Tripathi and Singh (2024). IT capability measurement scales were adopted the scales from Zhang et al. (2008, 2023), and Trieu et al. (2023). International experience measures were adapted from Lages et al. (2005), Clarke et al. (2012), and Papadopoulos and Martín (2010). The export performance and sustainability measures, focusing primarily on economic aspects, were derived from seminal works by Sousa (2004), Papadopoulos and Martín (2010), and Larimo (2006), and complemented by recent studies from Hilali et al. (2020), Hajishirzi et al. (2022), and Melo et al. (2023).

Analysis Results

Data Sample Descriptive Statistics

Data collection was conducted mostly online using the Google Forms tool and the questionnaire. The survey form was sent to manager-level employees of SMEs in Vietnam via email. The emails were collected from 16 SME associations in Vietnam, selected to represent a diverse range of industries engaged in international trade and exportation, including the Vietnam Food Association, Vietnam Rubber Association (VRA), Vietnam Coffee Cocoa Association (Vicofa), Vietnam Association of Seafood Exporters and Producers, and Vietnam Handicraft Exporters Association (VIETCRAFT). The potential participant list was classified as small- or medium-scale enterprises, with large firms or corporations intentionally excluded to maintain focus on the SME sector.

The data was collected from November 2024 to January 2025. Approximately 3000 emails were sent to SMEs from the listed associations, inviting them to participate in the study by taking the survey. Of these, 141 responses were received, representing a total response rate of 4.7%. After data validation, the survey yielded 108 valid responses. The remaining responses were rejected based on the following grounds: responses from non-target respondents (e.g., individuals who were not managers, founders, or CEO…), incomplete submissions where respondents provided ratings on only a single scale and inconsistent or illogical answers.

The demographic characteristics of these 108 respondents are presented in Table 13.2.

Most of the respondents in the survey were Department Heads at 34.3%, followed by Team Leaders/Supervisors at 25.9%. Business Owners/Founders and Top Management/Executives were also considerable, standing at 19.4% and 20.4%, respectively. The most common level of professional experience among participants was 3 to 5 years (32.4%). The other four categories of professional experience were relatively evenly distributed across the rest of the participants, 26.9% of participants had 6 to 10 years, 21.3% of participants had 11 to 20 years of experience, and 19.4% had experience of above 20 years. This suggests that the sample has a diverse range of experience levels among participants. As regards the responsibility of participants, the Sales & Marketing group presents the largest group with 32.4% of respondents. The second biggest group was Exportation/International Trade at 25.0%, and the third biggest was Production/Operations/Quality Management at 15.7%. Other responsibilities, such as IT, R&D, ESG, Human Resources, Customer Service, Financial Accounting, and Project Management, each represented a small share of the sample, between 1.9% and 8.3%. The scales of SMEs surveyed are presented according to the number of employees. Most of the respondents came from small enterprises with 1–100 employees, at 54.6%. 31.5% of respondents represented medium enterprises with more than 201+ employees. The smallest group of respondents came from small-to-medium organizations with 101–200 employees (13.9%). This indicates that the survey sample represents the target respondents of SMEs.

Table 13.2 Demographic characteristics of survey respondents (N = 108)

Demographic profile (organization/participant)		Frequency	Percent of valid responses	Cumulative percent of valid responses
Position of participant	Business owner/founder	21	19.4	19.4
	Department head	37	34.3	53.7
	Team leader/supervisor	28	25.9	79.6
	Top management/executives	22	20.4	100.0
Years of professional experience	11 to 20 years	23	21.3	21.3
	3 to 5 years	35	32.4	53.7
	6 to 10 years	29	26.9	80.6
	Above 20 years	21	19.4	100.0
Responsibility of participant	Customer service	2	1.9	1.9
	ESG	4	3.7	5.6
	Exportation/international trade	27	25.0	30.6
	Financial accounting	2	1.9	32.4
	Human resources	4	3.7	36.1
	Information technology (IT)	9	8.3	44.4
	Production/operations/QM	17	15.7	60.2
	Project Management	2	1.9	62.0
	Research & Development (R&D)	6	5.6	67.6
	Sales & marketing	35	32.4	100.0
Number of employees	1–100	59	54.6	54.6
	101–200	15	13.9	68.5
	201+	34	31.5	100.0

Cronbach's Alpha Analysis

After finishing the descriptive analysis, this study conducted a reliability analysis using two measures: (1) Cronbach's Alpha and (2) the Corrected Item-Total Correlation. Cronbach's Alpha coefficient served as the criterion for assessing the scale's internal consistency. Cronbach's Alpha for each variable is considered acceptable when it is equal to or greater than 0.6. The criterion for determining whether a variable genuinely contributes to the factor is a Corrected Item-Total Correlation greater than 0.3 (Hair et al., 1998). Table 13.3 below shows the results of the reliability analysis.

Table 13.3 Results of reliability analysis—Cronbach's Alpha analysis

Code	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's Alpha if item deleted
SMEs' awareness in digital transformation (ADX) with Cronbach's alpha = 0.915				
ADX1	13.27	6.441	0.775	0.901
ADX2	13.30	6.397	0.801	0.892
ADX3	13.29	6.506	0.822	0.885
ADX4	13.29	6.431	0.829	0.882
Intention to adopt digital transformation (IADX) with Cronbach's alpha = 0.916				
IADX1	12.64	6.270	0.879	0.866
IADX2	12.56	6.623	0.837	0.882
IADX3	12.60	6.933	0.752	0.910
IADX4	12.93	6.480	0.770	0.906
IT capability (ITC) with Cronbach's alpha = 0.889				
ITC1	11.85	6.352	0.744	0.863
ITC2	11.80	6.238	0.740	0.864
ITC3	12.01	5.710	0.792	0.845
ITC4	11.87	6.432	0.760	0.858
International experience (IE) with Cronbach's alpha = 0.908				
IE1	15.44	18.828	0.709	0.901
IE2	15.47	15.822	0.898	0.859
IE3	15.56	15.745	0.872	0.864
IE4	15.11	19.016	0.703	0.902
IE5	15.83	16.271	0.705	0.907
Export performance (EP) with Cronbach's alpha = 0.943				
EP1	14.09	16.272	0.854	0.929
EP2	14.09	16.870	0.861	0.927
EP3	14.12	16.742	0.868	0.926
EP4	14.10	17.756	0.785	0.941
EP5	14.26	17.409	0.868	0.927
Sustainability (Sus) with Cronbach's alpha = 0.926				
Sus1	15.30	10.958	0.842	0.902
Sus2	15.28	10.819	0.839	0.903
Sus3	15.21	11.141	0.812	0.909
Sus4	14.90	11.905	0.755	0.919
Sus5	14.94	12.165	0.799	0.913

In general, all scales demonstrated good to excellent internal consistency, with Cronbach's Alpha values ranging from 0.889 to 0.943. No items were removed from any of the scales, and all will be used in subsequent analyses.

Validity Analysis: Exploratory Factor Analysis (EFA)

The EFA for the scales was performed using principal component analysis and the promax rotation technique to evaluate the convergent and discriminant validity of the scales. The items' factor loading values were only considered if they were greater than 0.3 (Hair et al., 1998). The results must satisfy the following conditions: $0.5 \leq \text{KMO} \leq 1$; Sig. of Bartlett's test <0.05; Eigenvalues ≥1; Total variance explained >0.5; Factor loading >0.5; and Distinct value of cross-loading on factors >0.3.

The Kaiser-Meyer-Olkin (KMO) measure was used to assess the suitability of factor analysis for the data. The results show a KMO value of 0.9 and a significant Bartlett's Test of Sphericity (Sig. = 0.000), which proves that the observed variables participating in the EFA correlated with each other. The EFA result shows that the total variance explained, which reveals that five factors were extracted, with a total cumulative explained variance of 81.233%, exceeding the commonly accepted minimum threshold of 60%. Although only the first three factors had eigenvalues greater than 1 (9.430, 4.863, and 1.751, respectively), retaining five factors was considered appropriate for several reasons. First, the remaining two factors had eigenvalues relatively close to 1 (0.974 and 0.854). Second, after rotation, the Rotation Sums of Squared Loadings showed a relatively even distribution across the factors, ranging from 6.000 to 7.116.

During the analysis, one variable (IE5), intended to measure International Experience, was found to align more closely with Export Performance (EP) than with other International Experience items. This suggested that the variable IE5 did not accurately represent the intended construct. Therefore, IE5 was removed. After removing an invalid variable, the final EFA results showed that the KMO coefficient was 0.894 (>0.5), indicating that the factor analysis was appropriate for the dataset. Additionally, the significance of Bartlett's test was 0.000 (<0.05), which demonstrated that the observed variables were correlated with each other in the factor. The results of the total variance demonstrate that five factors were extracted, with a total cumulative explained variance of 81.603%, exceeding the commonly accepted minimum threshold of 60%. This indicates that the five-factor structure provides stability and is statistically meaningful (Table 13.4).

Table 13.4 The results of the pattern matrix—EFA analysis

	1	2	3	4	5
EP5	0.986				
EP3	0.961				
EP2	0.891				
EP1	0.819				
EP4	0.799				
ADX3		1.011			
ADX4		1.009			
ADX2		0.742			
ADX1		0.668			
IADX4			1.009		
IADX1			0.896		
IADX2			0.715		
IADX3			0.591		
ITC3				0.946	
ITC4				0.863	
ITC1				0.766	
ITC2				0.640	
IE1					1.012
IE2					0.857
IE3					0.739
IE4					0.562

Pearson Correlation Coefficient

Pearson correlation analysis was conducted before performing regression analysis to test the linear correlation between the dependent variables and the independent variables, as well as to identify any issues related to multicollinearity. If the significance value of the Pearson correlation exceeds 0.05, it implies that there is no linear correlation between the two variables. The correlations between Sustainability, Awareness in Digital Transformation, Intention to Adopt Digital Transformation, IT Capability, International Experience, and Export Performance are presented in Table 13.5.

Regression Analysis

After EFA analysis and correlation analysis, the authors conducted regression analysis to determine the degree of impact of independent variables on the sub-variable. Regression analysis was performed 6 times to test each hypothesis. The regression analysis results could be summarized in Table 13.6.

Table 13.5 Correlation analysis results among 6 variables

		Sus	ADX	IADX	ITC	IE	EP
Sus	Pearson correlation	1	0.480**	0.585**	0.747**	0.367**	0.444**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
ADX	Pearson correlation	0.480**	1	0.726**	0.452**	0.332**	0.137
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.157
IADX	Pearson correlation	0.585**	0.726**	1	0.618**	0.276**	0.170
	Sig. (2-tailed)	0.000	0.000		0.000	0.004	0.079
ITC	Pearson correlation	0.747**	0.452**	0.618**	1	0.416**	0.461**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
IE	Pearson correlation	0.367**	0.332**	0.276**	0.416**	1	0.702**
	Sig. (2-tailed)	0.000	0.000	0.004	0.000		0.000
EP	Pearson correlation	0.444**	0.137	0.170	0.461**	0.702**	1
	Sig. (2-tailed)	0.000	0.157	0.079	0.000	0.000	

Table 13.6 Summary of hypothesis testing results

Hypothesis	Sig	Beta	Conclusion
H1: SMEs' awareness of digital transformation positively impacts the intention to adopt digital transformation.	0.000	0. 733	Supported
H2: A firm's intention to adopt digital transformation positively influences its IT capability.	0.000	0.597	Supported
H3: SME'S IT capability positively affects its export performance.	0.000	0.256	Supported
H4: SME'S IT capability positively affects its international experience.	0.000	0.515	Supported
H5: International experience positively affects export performance of SMEs.	0.000	0.627	Supported
H6: Export performance positively influences the economic sustainability of SMEs.	0.000	0.363	Supported

H1 hypothesized that SMEs' awareness of digital transformation positively impacts the intention to adopt digital transformation, which is supported by the results of the study ($\beta = 0.733$, $p < 0.001$). This finding suggests that when SMEs are more aware of the potential benefits that digital transformation could offer in enhancing operational efficiency and reducing the costs of the business, they are significantly more likely to consider implementing digital technologies in their operations. This finding aligns with the Technology Acceptance Model (TAM), which emphasizes the role of perceived usefulness and awareness in shaping behavioral intention. The findings of this study are consistent with the result of the study by Tripathi and Singh (2024), which confirmed that SMEs' awareness toward digital transformation significantly impacts intention to use.

The findings indicate that a firm's intention to adopt digital transformation positively influences its IT capability, supporting Hypothesis 2 (H2). The regression result ($\beta = 0.597$, $p < 0.001$) demonstrates a strong positive relationship between intention to adopt digital transformation and IT capability. This shows that firms that have higher intentions to adopt digital transformation also develop stronger IT capability. This finding supports the idea that digital transformation is not solely about adopting new technologies but also about the effective integration of those technologies. Additionally, this finding is consistent with the results of a previous study by Chi-hsiang Chen (2023).

The direct relationship between IT capability and export performance shows a significant effect ($\beta = 0.579$, $p < 0.001$), suggesting that IT capability is crucial for export success (H3). It can be interpreted from this result that digital transformation can enhance SMEs' ability to operate efficiently, manage supply chains, and streamline processes, all of which contribute to improved export outcomes. Additionally, this finding is consistent with some previous studies on the importance and positive effect of IT capability on the performance of export-focused SMEs (Zhang et al., 2008; Oura et al., 2015; Lai et al., 2024).

Initially, the direct effect of IT capability on export performance was strong before considering the indirect effect. With international experience acting as a mediator between IT capability and export performance, the results show that the effect of IT capability on export performance decreased, although this effect is still significant. The partial mediation model suggests that IT capability enhances export performance directly through operational and strategic capabilities, indirectly through the development and leverage of international experience (H4), and potentially through other unmeasured mediating variables such as international network development, innovation in product design and customization, or supply chain optimization for international operations.

On the other hand, international experience strongly influenced export performance ($\beta = 0.627$, $p < 0.001$) (H5), and international experience showed a stronger effect on export performance than IT capability. This result indicates that international experience acts as a crucial link between IT capability and export performance. These results also indicate some important findings. First, to maximize performance in international business, SMEs should actively improve their international experience. Second, the findings further suggest that SMEs that leverage their IT capability effectively are more likely to gain exposure to international trade practices and develop international experience, which in turn enhances export performance.

The final relationship between Export Performance and Sustainability shows a positive result ($\beta = 0.363$, $p < 0.001$), indicating that international success can support economic sustainability of SMEs, thus supporting hypothesis 6 (H6). In other words, it is suggested that successful international operations can provide essential resources for economic sustainability initiatives. However, the strength of this relationship is moderate, suggesting that a high-level export performance alone might not be the only driver for economic sustainability. Achieving sustainability requires more than just export success; hence, other factors such as managerial capabilities, resource allocation efficiency, and other key competencies should be further explored to see which can play an important role in enhancing economic sustainability in SMEs.

Conclusions and Managerial Implications

Management Implications

The results of this study provide several practical implications for SME managers and decision-makers who are considering or implementing digital transformation initiatives to enhance their export performance and economic sustainability.

- First, this research suggests that SME leaders should invest in preparing digital literacy for employees to ensure their staff fully understand the benefits brought by digital transformation and have the necessary digital skills to adopt it. Additionally, managers need to cultivate a long-term vision to develop a successful digital business strategy by gradually integrating digital experiences into business operations. This could strengthen the SME's digital capabilities and boost participation in the broader supply chain, driving greater economic efficiency (Viet & Quoc, 2023).
- Second, given the results of this study, IT capability is an important driver of both international experience and export performance. SMEs should invest in developing IT capability, both technical infrastructure and human resource development, to strengthen their competitiveness, which in turn enhances organizational performance. Several measures to develop a higher level of IT capability could be implementing new technologies, such as cloud computing, data analytics, and automation tools, to enhance operational efficiency; investing in training IT skills for human resources to keep up with the new technologies; or establishing dedicated teams or departments responsible for digital initiatives.
- Third, it is also important to note that international experience plays a significant role in enhancing performance in the export markets of SMEs. Thus, managers need to increase the performance of SMEs in exporting through the power of digital capabilities. This can be done through different initiatives, for example, adopting e-commerce platforms suitable for international trade, integrating digitalization into the supply chain management system, and implementing digital tools for international market research and customer relationship management. Furthermore, the significant mediating role of international experience in the relationship between IT capability and export performance suggests that managers should improve their international experience by dynamically seeking opportunities in international trade, increasing global exposure by participating in international trade fairs and exhibitions, and building strong relationships with international providers and buyers. In addition, SMEs can leverage digital technology to analyze and gain deeper insight into fluctuation in the international market, which supports informed decision-making in dynamic business environments.
- Fourth, economic sustainability is an important aspect for SMEs to consider, given the resource-constrained nature of these firms. While domestic markets can also offer financial growth, for SMEs in developing countries such as

Vietnam, export performance serves as a strategic pathway to international market integration, helping firms connect with the global supply chain and fostering long-term development. According to the results of this research, export performance has only a moderate impact on economic sustainability; however, it can be suggested that by enhancing export performance, SMEs can consequently generate higher revenue and profit, establishing a higher position in the market share. As a result, enhancing export performance supports not only financial stability but also the broader goal of sustainable business development.
- Finally, this research highlights the need for suitable support programs for SMEs to help these organizations develop both awareness and capability effectively implement digital transformation. Furthermore, the findings suggest the need for facilitating programs to help SMEs improve their international business skills and policies that help SMEs establish stronger exportation and economic sustainability.

Conclusions

This study contributes to the existing literature by examining the sophisticated relationship between digital transformation, export performance, and economic sustainability among Vietnamese SMEs. Specifically, the study aims to investigate the relationships between SMEs' awareness of digital transformation, their intention to adopt digital technologies, and the development of IT capability. Furthermore, it then analyzes how IT capability, along with international experience, influences export performance and contributes to the economic sustainability of Vietnamese SMEs. Throughout the research process, the proposed objective is achieved.

The research model of the study consists of six variables, including one dependent variable (economic sustainability outcomes), four independent variables (awareness of digital transformation, intention to adopt, IT capability, and export performance), and one mediating variable (international experience), which are adopted and developed from previous studies about digital transformation, IT capability, international performance, and sustainability. Data analysis was performed using SPSS 27 software through sample descriptive analysis, reliability analysis, exploratory factor analysis, Pearson correlation analysis, and regression analysis.

The research results suggest the most significant positive relationship between awareness of digital transformation and adoption intention, emphasizing that SMEs' understanding of digital technologies' potential benefits prominently influences their intentions to adopt digital transformation initiatives. This finding aligns with the Technology Acceptance Model, confirming its relevance in the context of organizational digital transformation. The following relationship between adoption intention and IT capability is also substantial, highlighting the importance of intentional technological advancement in developing solid digital competencies.

Moreover, this study uncovers some valuable insights into the relationship between IT capability, international experience, and export performance. The significant direct effect of IT capability on export performance emphasizes the prominence of technological capabilities in international business success. However, the mediating effect of international experience between IT capability and export performance adds depth to this relationship, with international experience showing an even stronger influence on export performance than that of IT capability. This mediating effect suggests that even though IT capability is a crucial part in enhancing performance in export markets, it is also important to combine this competency with international business expertise to maximize the performance of SMEs. The final relationship between export performance and sustainability was moderate in strength, but it can confirm the role of international success in supporting the economic sustainability of SMEs.

The management implications of this research can provide valuable suggestions for SME managers, leaders, and policymakers for promoting digital transformation to effectively accelerate export performance and economic growth of SMEs in Vietnam. By fostering a facilitated environment to adopt informational and technological advancements and offering targeted support to international businesses, managers, and policymakers, they can critically enhance firms' performance in global markets and achieve sustainable growth.

However, there are some limitations of the study as follows: (1) a small sample size of data limits the possibility to generalize the results, (2) one-time data collection prevents the ability to see the time-order relationship of the influences, and (3) lack of a comparison between various sizes of businesses. Therefore, future research directions should extend the sample size, collect the data at different points of time for a better evaluation result, and compare the difference between various groups of businesses.

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Appendix: Questionnaire

Please indicate your level of agreement with each statement using the following scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree	
1	Our organization is aware that digital transformation is crucial for improving our organization's operational efficiency.
2	Our organization is aware that digital transformation enables us to enhance customer satisfaction and experience.
3	Our organization is aware that digital transformation is seen as a competitive resource that helps us differentiate in the market.
4	Digital transformation can help us respond quickly to changes in export demand and market conditions.
5	There is a strong awareness among management and employees of how digital transformation impacts overall business processes.

6	Our organization has IT management skills to effectively implement and integrate digital technologies.
7	Our organization effectively utilizes IT systems to facilitate cross-functional integration and streamline operational processes.
8	Our organization effectively leverages IT systems to collect and utilize market-relevant business information.
9	Our organization continuously upgrades IT-related knowledge and skills to enhance familiar technologies, systems, and services.
10	Our organization actively supports employees' digital transformation efforts.
11	Our organization has managerial skills for the effective implementation of digitization.
12	Our managers are proficient in using a wide range of digital devices, software, and applications to support their work.
13	Our employees demonstrate positive attitudes toward digital transformation.
14	Our employees have the skills necessary for digital transformation.
15	Our organization has a deep knowledge of the export markets we operate in.
16	Our organization has been engaged in export activities for many years.
17	Our organization has been involved in many export ventures.
18	Our organization has established and maintains close relationships with overseas customers, suppliers, and distributors.
19	Our exports make up a large percentage of our total sales.
20	Our export activities have generated a high volume of sales.
21	Our export activities have been highly profitable.
22	Our market share in the selected foreign markets has been satisfactory.
23	Our organization has effectively expanded into foreign markets in line with our strategic goals.
24	Our organization is satisfied with our export performance compared to the goals set in our primary international markets.
25	Our organization has achieved satisfactory sales growth through digital transformation efforts.
26	Our organization has improved our net profit through digital transformation efforts.
27	Our organization has increased our market share through digital transformation efforts.
28	Our organization has successfully reduced operational costs through digital solutions.
29	Our digital initiatives have led to better business processes.

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Part IV
Business Ecosystems and Governance

Chapter 14
Geopolitics and Corporate Governance: Are Boards of Directors Prepared for an Era of Global Uncertainty?

Beat Habegger

Abstract In an era of increasing geopolitical uncertainty, businesses must navigate a complex landscape shaped by trade conflicts, national security concerns, and shifting global power dynamics. While corporate leaders acknowledge the growing significance of geopolitics, it remains unclear whether boards of directors possess the necessary competencies to assess and respond to these challenges. This article examines the extent to which geopolitical expertise is integrated into the qualification profiles of board members in Germany's DAX 40 companies. Using an empirical analysis of qualification matrices mandated by the German Corporate Governance Code (GCGC), the article assesses whether boards include members with geopolitical skills and expertise. Findings indicate a pronounced lack of geopolitical expertise, as most firms fail to adopt systematic approaches for integrating such competencies into board composition. The article concludes with practical recommendations for strengthening board-level geopolitical expertise through targeted recruitment and training. Given the rising strategic relevance of geopolitics, boards that fail to integrate such expertise risk impairing their ability to guide companies in an increasingly fragmented global economy.

Keywords Geopolitics · Sustainability · Corporate governance · Board of directors · Germany

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Introduction: Doing Business in an Age of Uncertainty

After the Cold War ended in 1989, businesses experienced two decades of exceptional growth, enabled by U.S. geopolitical dominance and an expanding liberal market economy. Political stability and legal predictability enabled companies to focus on globalization, fueling rapid foreign direct investment and deepening trade interdependence. The perceived end of ideological conflict rendered it unnecessary for companies to engage in depth with the global world order. Instead, the stability of political and legal structures offered ample scope for economic players to concentrate on the opportunities of a globalizing world. A certain harmonization of cultural differences, the universal appeal of democratic political systems, and the levelling of socio-economic imbalances further reinforced this dynamic. As Thomas Friedman (2005) aptly argued, globalization created a playing field on which companies worldwide found almost unlimited opportunities for growth and development.

Geopolitical stability began to erode following the 2001 terrorist attacks in the U.S., but the definitive turning point came with the 2007–08 financial crisis. This crisis exposed systemic weaknesses, prompting unprecedented government intervention, including large-scale bank bailouts to prevent market collapse and a global recession. Still, the financial crisis led to considerable economic disruptions, such as the European debt crisis, and prepared the ground for the rise of political populism. In Western democracies, these developments culminated in 2016 in the election of Donald J. Trump as U.S. President and in the UK's vote to leave the European Union.

In the following years, the Covid-19 pandemic exposed the structural fragility of the globalized economy and, in particular, the dependencies on complex, cross-border supply chains. The escalating U.S.-China trade war, their intensifying strategic rivalry, and Russia's 2022 invasion of Ukraine marked the definitive end of post-Cold War geopolitical stability. Today, companies are confronted with a world characterized by geopolitical conflicts and a multitude of new cultural, legal, and economic fault lines. Navigating this turbulent international environment demands a fundamental realignment of corporate governance and strategic decision-making. The era in which political developments were seen as peripheral aspects of entrepreneurial activity is irrevocably over.

Are Companies Equipped to Deal with Geopolitical Change?

While dealing with geopolitics and political risks has a long history in international business (Giambona et al., 2017; Giersch, 2019; Jarvis & Griffiths, 2007), the fast-changing and increasingly volatile global reality has renewed the interest of business practitioners (e.g., Evenett, 2024; Grant et al., 2022) as well as in the academic community (e.g., Bozonelos & Tsagdis, 2023). Geopolitics has—after the long wave of globalization—once again become a relevant factor when doing business across borders, adding a new variable to the equation for companies shaping their non-market environment (Bach & Allen, 2010; Klopf, 2020).

Corporate leaders are increasingly acknowledging the strategic importance of geopolitics. McKinsey's quarterly "Economic Conditions Outlook," consistently identifies geopolitical instability as the foremost risk to global and domestic growth (McKinsey, 2024). The World Economic Forum Global Risks Report 2025 refers to "deepening geopolitical and geoeconomic tensions" as a key threat to the current political and economic order (World Economic Forum, 2025). And, in a 2022 survey of 420 board members of Swiss companies, 69% stated that they regularly discuss geopolitical developments in board meetings, while as many as 93% say that their board takes measures to identify, assess, and manage geopolitical risks and their consequences (SwissVR, 2022).

Given the geopolitical reality and changing risk perceptions, the question arises as to how companies are managing newly emerging geopolitical risks and how they prepare to react to transformed market realities (Bremmer, 2005). The literature on corporate answers is dominated by authors with experience at the interface of both business and politics (e.g., Bremmer & Keat, 2009). They propose to focus on internal geopolitical due diligence and external corporate diplomacy (Chipman, 2016), to integrate geopolitics into established risk management processes (Rice & Zegart, 2018a), or to identify and assess geopolitical exposures across multiple levels of analysis (De Villa, 2023). In light of the increasing importance of geopolitics, some authors suggest designating the CEO as the Chief Geopolitical Officer (Dhawan & West, 2019), to appoint an independent officer with that title (Rickli & Lukacs, 2024; Suder & Kallmorgen, 2022, pp. 35; 214–216), or to establish a dedicated geopolitical functional unit (Levy et al., 2024, p. 9). All these efforts intend to ensure that a company has the right capabilities in place to respond effectively to geopolitical change, because the ability to manage geopolitical challenges and political risks is a critical success factor. The way in which companies have dealt with war and terrorism, expropriation and regulatory change, or social unrest has made a difference throughout history (e.g., Bremmer & Keat, 2009).

Companies' focus is shifting to the boards of directors, whose primary task is to shape the strategic direction. This article will examine whether boards are adequately equipped to deal with geopolitics and a changing global order, given the knowledge, skills, or educational backgrounds of their members. The first step is to analyze which duties are imposed on board members and whether there are indications that geopolitical competencies should be included in the job profile. In a second step, it is then analyzed whether the qualification profiles of the 40 companies represented in the main German stock market index, the DAX 40, indicate that geopolitical competencies are a relevant criterion for appointing board members. Finally, the article outlines a few recommendations for business practice and further research.

Geopolitical Competency as a Requirement for Appointing Board Members

Boards of directors are responsible for setting strategic guidelines, overseeing risk management, and supervising executive leadership. Their mandate extends to all critical risks affecting the company. Equally, as companies have to deal with strategic risks, market risks, or operational risks, boards must therefore also appropriately cover geopolitical challenges in their business conduct. Yeoh (2023, p. 41) accurately concludes that "boards failing to give serious attention to political and geopolitical risks in their global business activities could risk facing business risks and operational mishaps".

In view of these observations, the question arises as to whether a company's board is effectively equipped to fulfil this task. As each board consists of several members, it is therefore relevant to consider the qualifications of the individual members—the skills, knowledge, information, and experience—as well as the composition of the board as a whole. No member will be fully knowledgeable about all aspects of the business. Therefore, the aim is for each member to contribute specific elements so that the board as a whole is appropriately staffed with the "right mix of directors" (Conger & Lawler III, 2001, p. 15). An effective board covers a range of knowledge and expertise as well as various other relevant competencies (Boshoff et al., 2019). According to Barth (2013, p. 41), a broad set of professional and personal qualities are relevant for selecting new candidates. Professional qualities include functional (e.g., finance, marketing, strategy) and industry-specific knowledge as well as general entrepreneurial expertise, while personal qualities refer to the "social fit" between the acting board and its chairperson and the potential new member. Conger and Lawler (2001, p. 12) also distinguish between generic knowledge for all boards (clustered into leadership, strategic, organizational, relationship, ethical, and functional knowledge) and unique competencies that are firm-specific depending on the stakeholders, the markets, or organizational specialties. Because not every company needs all potential knowledge elements, it is crucial to critically assess the company's situation and set priorities when appointing board members. For a company that is highly globalized and exposed to world markets, for example, it is imperative that board members have international expertise (Conger & Lawler III, 2001, p. 12). Depending on a company's reliance on global market access, the availability of critical resources, or the functioning of supply chains, members who understand the geopolitical contexts meaningfully complement the board's repertoire of knowledge and information.

What specific skills do boards need for dealing with geopolitics? (Cossin, 2024; Haider et al., 2023; Klemash & Shames, 2018; Yeoh, 2023):

1. *Prepare the board and its members for exercising geopolitical oversight*: The aim is to bring members onto the board who have an understanding of geopolitics (e.g., recruitment, third-party specialists) and to train (e.g., continued education, information access) and organize (e.g., assign responsibilities, establish committee structures) the board as a whole so that it is capable of taking action in response to geopolitical change.
2. *Steer the executive management on matters related to geopolitics*: The board must be able to assess the impact of geopolitics on the company (e.g., identification and assessment of risk factors, understanding the impact on strategy and operations), to identify strategic options for action (e.g., scenario planning, risk

prevention, resiliency preparedness, seizing opportunities), and to supervise executive management action in relation to geopolitics.

The question of how geopolitics affects companies and which management actions are suitable for an appropriate response is widely discussed in the literature (e.g., Bremmer & Keat, 2009; Rice & Zegart, 2018b; Suder & Kallmorgen, 2022), but often does not differentiate between executive management and the board. While the roadmap for management may be evident, it is often less clear for boards, and many directors feel "unprepared" for geopolitical shocks and crises (Haider et al., 2023, p. 2). More voices are now calling for a broadening of the board's expertise and experience by including the ability to understand how geopolitics impacts the organization (Evenett, 2024, p. 14; Suder & Kallmorgen, 2022, pp. 215–216). The question, therefore, is whether companies are already taking geopolitical expertise into account when recruiting new members and whether this is reflected in board membership.

Qualification Profiles of Board Members in Germany

Germany serves as an empirical case for examining how companies integrate geopolitical competencies into board appointments. The 2022 revision of the German Corporate Governance Code (GCGC, 2022) requires companies to disclose "qualification matrices" in governance reports, systematically mapping board members' expertise across key knowledge areas. Although the provisions of the GCGC are a form of self-regulation or voluntary commitment, in practice companies tend to comply with them.

The 2022 Revision of the German Corporate Governance Code

The latest version of the GCGC came into force on June 27, 2022, with the goal of integrating sustainability factors into the governance structures of companies and strengthening the transparency and accountability of the competencies of boards (Mock & Velte, 2022). Principle 11 of the GCGC stipulates that the "Board has to ensure that its members collectively possess the knowledge, skills and professional expertise required to properly perform their duties". In accordance with recommendation C.1, the board should therefore "determine specific objectives regarding its composition, and […] prepare a profile of skills and expertise for the entire Board" (GCGC, 2022). While the GCGC does not provide specific details of which particular skills and expertise are required, the new GCGC explicitly states, first, that this profile "shall also comprise expertise regarding sustainability issues relevant to the enterprise" in order to do justice to the growing importance of ESG criteria (environment, social, governance), and the GCGC recommends that a "qualification matrix in the Corporate Governance Statement" informs about the implementation status. The required skills and expertise do not relate to each individual member, but to the board as a body, as stated in the GCGC explanatory notes (Mock & Velte, 2022).

The qualification matrix comprises a broad range of skills and expertise for corporate management, encompassing technical skills and functional expertise (finance, marketing, HR management, etc.), entrepreneurial experience, as well as company- or industry-specific knowledge or personal characteristics that fit into the overall board profile (e.g., Barth, 2013; Boshoff et al., 2019). As the GCGC also contains further requirements, for example, on gender diversity, age limits, or the independence of members, companies are also integrating such aspects into their qualification matrices. Overall, the matrices, therefore, provide a comprehensive picture of a qualification profile of board membership.

Qualification Matrices According to the GCGC

As the GCGC has only been in force for about three years, the question arises as to how comprehensively companies are already complying with the provisions. The first empirical analyses show that most German companies have started including qualification matrices in their annual reports (or other corporate reporting documents). The European Center for Board Effectiveness (ECBE), for example, has prepared an overview of the qualification matrices in the 2022 annual reports of all companies listed in the DAX, MDAX, and SDAX stock market indices (European Center for Board Effectiveness, 2023).[1] With a total of 38 (out of 40) DAX, 44 (out of 50) MDAX, and 56 (out of 70) SDAX companies, around 90% of the analyzed companies comply with the requirements of the GCGC.

The publication of the ECBE study has led to criticism, including by members of the government commission responsible for drafting the new code (Michler, 2024). They recognized a considerable "overconfidence" on the part of board members, for example, when every second person attributes competence in the areas of digitalization, technology, and IT to itself. Furthermore, 62% consider themselves to have HR skills, and as many as 65% consider themselves to be competent in the areas of sustainability and ESG. At some companies, all board members claim to be competent in these fields. This outcome reflects the fact that companies decide themselves which competences they consider to be relevant and which members meet the

[1] The DAX stock index tracks the performance of the 40 largest and highest-turnover German stocks by market capitalization on the Frankfurt Stock Exchange. It represents around 80% of the market capitalization of listed stock corporations in Germany and around 90% of stock market turnover in German shares. The MDAX index tracks the performance of the 50 largest companies following the DAX stocks. The SDAX index comprises 70 companies in the Prime Standard segment that rank directly below the MDAX shares in terms of size. Source: https://www.boerse-frankfurt.de/en/know-how/glossary (last retrieved 23 February 2025).

required criteria. Overall, it can be concluded that the matrices do provide an insight into which qualifications the company considers relevant, but the results based on members' self-assessment must be used with care.

Assessment of the Qualification Matrices of the DAX 40 Companies

In the following, we examine how the boards of DAX 40 companies account for geopolitical competencies in their qualification matrices. All 40 DAX firms (reporting date: 31 December 2023) comply with the GCGC mandate to disclose such matrices, typically in their annual reports or corporate governance statements. However, the level of detail and structure vary significantly, complicating direct comparisons. While some firms provide granular insights, others offer only broad categorizations, which limits transparency. It is not surprising that there are already calls for a certain standardization of the matrix from board members and business practitioners (e.g., Michler, 2024) as well as academics (e.g., Feisel & Makowka, 2023;), especially with regard to the question of when a competence actually exists.

The analysis of DAX 40 qualification matrices reveals a notable absence of geopolitical expertise. Methodologically, we identified all terms in the qualification matrices that in some way indicate competencies relating to geopolitical, international, or cross-border business relationships.[2] Only Airbus explicitly lists "geopolitical economics" as a competency. Nine companies acknowledge board members' specific regional expertise, while fifteen highlight "international experience" in broad terms, often as a general trait rather than a functional skill. In most cases, the term reflects past work in different countries rather than formal expertise in political risk, international trade policy, or security affairs. Four companies explicitly refer to international management or leadership experience, which can be interpreted at least to some extent as an indication of some level of international expertise. Eleven companies mention no references to geopolitical or international competencies at all.

Table 14.1 categorizes companies based on how they reference geopolitical or international experience in their governance reports.

Overall, geopolitical competences have not yet found their way into the qualification profile of the DAX 40 boards of directors. International experience as a personal trait cannot be equated with a corresponding functional competence, i.e., an in-depth understanding of geopolitical change and its impact on the company. Similarly, in a study of 3000 U.S. companies (based on the Russell 3000 stock market index), Milhaupt (2025) found that the number of board members with international experience is significant and growing. However, very few have government or military experience, which he sees as an indication of geopolitical expertise (which is obviously context-dependent and does not apply equally to all companies). A

[2] A complete list of the terms used in the qualification matrices can be found in the appendix.

Table 14.1 Qualification matrices of DAX 40 companies

Geopolitical competency mentioned	Number of companies	DAX 40 companies
Explicit mention of "geopolitical economics"	1	Airbus
Specific mention of "regional experience," "regional expertise," "international markets" or similar	9	Airbus, Allianz, BMW, Continental, Deutsche Bank, MTU Aero Engines, Rheinmetall, Sartorius, Siemens
Generic mention of "international experience"	15	Bayer, Commerzbank, Deutsche Börse, DHL, E.ON, Fresenius, Hannover Rück, Infineon, Mercedes-Benz Group, Münchner Rückversicherungsgesellschaft, RWE, Sartorius, Siemens Energy, Siemens Healthineers, Symrise
Explicit mention of "international leadership experience"	4	Adidas, Covestro, Heidelberg Materials, Vonovia
No mention of geopolitical/ international expertise	11	

similar conclusion applies to the DAX 40 companies. Yet, it must be recognized that, in view of the relatively limited empirical basis resulting from the analysis of the DAX 40 companies, the analysis could be expanded to other companies from other markets to develop an even more nuanced picture.

The lack of geopolitical expertise in qualification matrices stands in stark contrast to sustainability and ESG competencies, which are now standard in board evaluations (Feisel & Makowka, 2023). A decade ago, sustainability was still underrepresented, suggesting that geopolitical qualifications may follow a similar trajectory. As geopolitical uncertainty continues to impact business strategy, it is likely that boards that fail to integrate political risk expertise will face increasing scrutiny from investors and regulators.

Conclusions and Recommendations

Amid rising geopolitical uncertainty, companies can no longer afford to treat geopolitics as a peripheral concern. Instead, they must embed it as a core element of their corporate strategy. Boards must elevate geopolitical awareness, yet many directors lack the expertise to identify, assess, and mitigate these risks effectively. The analysis of German DAX 40 companies' qualification matrices underscores this assessment. While many companies acknowledge the importance of "international experience," it often portrays a personal trait rather than a structured expertise in geopolitical affairs. However, given the global context, the latter would be essential to be able to lead globally active companies with the required strategic vision.

What should companies do? First, there is an apparent case for companies to nominate more candidates with geopolitical expertise to boards of directors. The targeted recruitment of individuals with experience in politics, diplomacy, security, or trade policy, or people who have special expertise in these areas, would strengthen both the oversight and strategic functions of boards. However, it is likely to be challenging to find enough people who have the required geopolitical expertise and, at the same time, an entrepreneurial track record. Second, in addition to recruiting new board members, it is therefore essential to strengthen the skills of existing board members on geopolitical issues through continuous education and training. Such training could come in various forms, including coaching, formal training, scenario exercises, or seminars conducted by leading experts and specialists (e.g., Cossin, 2024). Here, too, an approach modelled on the efforts to improve sustainability expertise of board members seems suitable.

Companies must decide whether to develop geopolitical expertise in-house or rely on external advisors (Milhaupt, 2025, p. 19). Regardless of their approach, however, boards must possess the ability to critically assess and act upon geopolitical intelligence from executive management or external consultants. Geopolitical expertise remains largely absent from board qualification matrices, but this may change as global instability continues to shape corporate strategy. Investors and shareholders will increasingly demand transparency on whether boards are able to navigate geopolitical risk. As seen with the rise of sustainability reporting, firms that proactively integrate geopolitical qualifications into their governance structures will likely gain a competitive edge in the long run**.**

Appendix

DAX 40 company (as of 31 Dec 2023)	*"Geopolitical," "international experience," or similar qualifications mentioned in the qualification matrix*
Adidas (2024)	International management: 8 of 16 (8/16) members of the Board of Directors
Airbus (2024)	Geopolitical economics (5/12) Global Business (12/12) Asia (3/12)
Allianz (2024)	Regional experience in North America, Europe, growth markets (12/12)
BASF (2024)	
Bayer (2024)	International business experience (16/20)
Beiersdorf (2024)	
BMW (2024)	International experience in Europe, China, USA, others (14/20)
Brenntag (2024)	

Commerzbank (2024)	International experience/competence (10/10)
Continental (2024)	International experience in Europe; north and South America; China; Asia-Pacific (20/20; if Europe is excluded: 12/20)
Covestro (2024)	Leadership in international corporations (12/12)
Daimler Truck (2024)	
Deutsche Bank (2024)	Regional expertise in Europe; America; and Asia-Pacific (12/20; if Europe is excluded 10/20)
Deutsche Börse (2024)	International experience (11/16)
Deutsche Telekom (2023)	
DHL (2024)	International experience (10/10)
E.ON (2024)	International experience (8/16)
Fresenius (2024)	International experience (9/16)
Hannover Rück (2024)	Internationality (9/9)
Heidelberg Materials (2024)	International leadership experience (6/12)
Henkel (2024)	
Infineon (2024)	International experience (10/16)
Mercedes-Benz Group (2024)	International experience (10/20)
Merck (2025)	
MTU Aero Engines (2024)	International experience with reference to relevant end markets (2/12
Münchner Rückversicherungsgesellschaft (2024)	International experience (13/20)
Porsche (2024)	
Porsche Automobil Holding (2023)	
QIAGEN (2024)	
Rheinmetall (2023)	Knowledge regarding internationally regulated markets (8/16)
RWE (2024)	International experience (9/20)
SAP (2024)	
Sartorius (2024)	International experience/personal background (4/12) International markets (4/12)
Siemens (2023)	International experience in Europe; north/south/Latin America; China; Asia-Pacific (13/20)
Siemens Energy (2023)	International experience (16/20)
Siemens Healthineers (2023)	International experience (10/10)
Symrise (2024)	International work experiences (6/6)
Volkswagen (2024)	
Vonovia (2024)	International Management, M&A, Capital Market (11/13)
Zalando (2024)	

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Chapter 15
Reporting on Non-Financial Matters: Recent Developments and their Impact on the Internal Control System (ICS)

Duties of the Board of Directors and Management to be Extended in Swiss Companies

Basil Sommerhalder, Emilio Sutter, and Petra Schwick

Abstract In 2008 and 2012, important revisions of the Swiss Code of Obligations (CO) were implemented regarding the ICS. In the meantime, the ICS has become an important part of governance, compliance management, and auditing for Swiss companies. Following the rejection of a popular initiative on corporate responsibility in 2020, international pressure on Swiss legislators increased significantly. Although Art. 964ff CO on the transparency on non-financial matters concerning Swiss companies entered into force in 2022, international pressure persists. Current climate discussions and the efforts of the European Union (EU) regarding the Corporate Sustainability Reporting Directive (CSRD) continue to put pressure on Swiss companies to make their non-financial efforts visible.

In parallel to mandatory financial reporting according to Art. 964ff CO, many Swiss companies prepare information on non-financial matters voluntarily. However, the debate on the national response regarding increased international pressure, e.g., to the CSRD, started at the meeting of the Federal Council on June 26, 2024. The draft of the new law anticipates that the Federal Council wants to expand the duty to prepare reports on non-financial matters on more companies. In particular, non-public companies exceeding certain thresholds would additionally be obliged. The Federal Council also anticipates to introduce an audit obligation—a novelty with regard to non-financial matters in Switzerland.

Moreover, reporting on non-financial matters is not to be underestimated and needs to be integrated into management processes. The ICS is an effective instrument for this purpose. This article demonstrates how internal control can help Swiss

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companies reduce their risks as well as operationally support the achievement of non-financial goals and aims to provide practical recommendations.

Keywords Internal control system (ICS) · Internal controls · Non-financial matters · Auditing · Reporting · ESG

Introduction

The Swiss Code of Obligations (CO) uses thresholds and other characteristics to specify whether Swiss companies are subject to an ordinary audit, a limited audit or to no audit at all. Besides the audit of the financial statements and the proposition of profit distribution, the existence of the Internal Control System (ICS) must also be confirmed by the external auditor annually—but only in the case of an ordinary audit. The focus of this examination is primarily on risks and associated internal controls concerning the financial statements and their underlying accounting practices.

In a broader organizational perspective, an ICS may, e.g., build and provide trust (PwC, n.d.) and contribute to greater security for supervisory and management bodies of companies in uncertain times (Sutter & Sommerhalder, 2023, pp. 71ff). For example, security may also mean effectiveness: planning, managing, and controlling the right objectives at the right place with the right resources at the right time.

Speaking of time and place, a time of intense developments can be observed not only in Switzerland, but worldwide. Current natural disasters, such as glacier collapses, debris flows, and floods, are often directly associated with climate change and may carry increased risks for business practices. For this reason, climate change has triggered an increase in sustainability efforts of regulators and public administrations. Consequently, Swiss companies also began to publish information on non-financial matters—either voluntarily or due to the legal obligation according to Art. 964ff CO.

This article elaborates on the above-mentioned subjects and will further answer the following question: How can the current ICS of Swiss companies be further developed so that the companies' non-financial (e.g., ESG) activities can additionally be optimally reflected in their reporting?

Financial Matters and ICS

This section will first focus on the currently applicable Swiss auditing requirements. Additionally, the ICS will be defined. This will mainly be done in connection with the so-called COSO framework. Furthermore, the duties of the organs of a Swiss limited company will be discussed when speaking of reporting, auditing, and the ICS.

Introduction to the Swiss CO

The Swiss auditing requirements are generally designed regardless of any legal form. First, for quick reference, Fig. 15.1 provides a general overview of the current legal situation in Switzerland according to the Swiss CO.[1]

Whether or not a Swiss company is subject to an audit mainly depends on economic key figures and other similar characteristics. According to Art. 727ff CO, companies of public interest (e.g., listed companies) are generally obliged to perform an ordinary audit, as well as companies exceeding two of the following three key figures (to be understood as thresholds) in two successive years:[2]

- Total of balance sheet: MCHF 20
- Total of revenues: MCHF 40
- Full-time equivalents (FTE) on annual average: 250

The other Swiss companies are generally subject to a limited audit, with the possibility to either perform an *Opting-Up* (perform an ordinary audit voluntarily) or an *Opting-Out*, which then leads to no obligation to perform any audit (Art. 727a CO). Regarding the scopes of an ordinary and a limited audit, Fig. 15.2 summarizes their key characteristics.

The limited audit as applicable in Switzerland is unique. For example, in the European Union (EU), no such audit type comparable to a Swiss limited audit exists (Federal Department of Justice and Police FDJP, pp. 16–17). The scope and depth

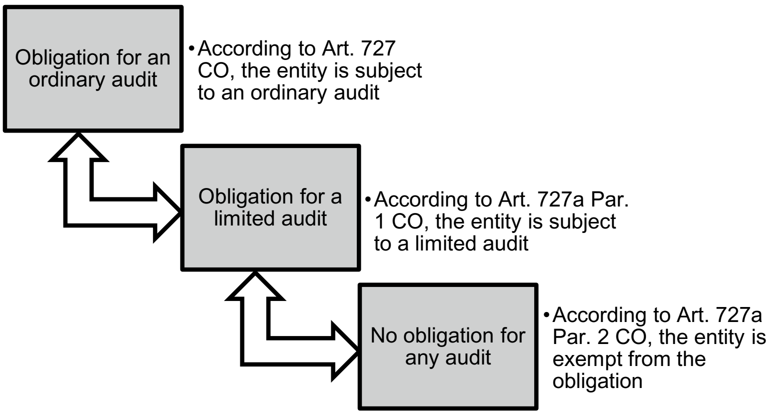

Fig. 15.1 Summary of the Swiss audit requirements according to the Swiss CO (based on Sommerhalder, 2020, p. 11)

[1] Besides the Swiss CO, the Swiss Audit Oversight Act (AOA) must be mentioned. It sets out the rules for the admission and supervision of persons and companies providing auditing services in Switzerland. Furthermore, the AOA serves to ensure proper performance and quality of Swiss auditing services.

[2] According to the Swiss Civil Code (Swiss CC), the thresholds for associations are different: Total of balance sheet MCHF 10; total of revenues MCHF 20; FTEs on annual average 50 (Art. 69b CC). However, associations will not be further mentioned in this article.

	Ordinary Audit	**Limited Audit**
Components and Scope	• Financial Statements[a] • Proposition of profit distribution • **Existence of the ICS**	• Financial Statements • Proposition of profit distribution
Assurance	*Reasonable* Assurance[b] General wording according to the audit report: *In our opinion, the (…) comply with (…)*	*Limited* Assurance[c] General wording according to the audit report: *(…) nothing has come to our attention that causes us to believe that (…) do not comply with (…)*

Fig. 15.2 Key characteristics of an ordinary and limited audit in Switzerland. [a]This also applies to consolidated financial statements. This will not further be discussed in the remainder of this article. [b]*Reasonable* Assurance is also commonly referred to as *Positive* Assurance. [c]*Limited* Assurance is also commonly referred to as *Negative* Assurance (own representation based on Swiss CO)

of a limited audit are significantly less than those of an ordinary audit (EXPERTsuisse, 2014, p. 58). Consequently, the latter one leads to a higher degree of assurance (so-called *Reasonable* Assurance) compared to a limited audit (with a so-called *Limited* Assurance).

Regarding this article's main topic, the following must especially be highlighted: Whether an ICS exists in a Swiss company does not primarily depend on the type of audit. Although the limited audit does not require the external auditor to examine the existence of an ICS—as shown in Fig. 15.2—companies subject to a limited audit (or even to no audit) are able to implement an ICS for their own (organizational) benefit, with good reasons as explained at a later stage of this article (EXPERTsuisse, 2022a, p. 11; Pfaff & Ruud, 2019, pp. 47–48).

The term "ICS" was mentioned above a couple of times. Thus, it is useful to discuss what is meant by it. The following section will first provide a widely known definition and then further elaborate on the purpose of an ICS.

Defining the ICS

When considering the Swiss legislation itself, no clear definition of the ICS exists. The external auditor must confirm the existence of the ICS in the case of an ordinary audit according to Art. 728a CO; further specifications are not apparent in the Swiss CO.[3] This also becomes evident when taking the following into account:

[3]According to Art. 728a CO in relation to an ordinary audit, the external auditor must take the ICS into account when carrying out the audit and in determining the extent of the audit. This particularly depends on the professional judgment of the external auditor. However, the *operating* effectiveness of the ICS is not confirmed due to no legal obligation.

"The Swiss law does not specify the content of the Internal Control System. The audited organization therefore decides for itself which control mechanisms would best suit the specific circumstances" (The Federal Assembly—The Swiss Parliament, 2005).

For a commonly known definition, the COSO framework (published by the Committee of Sponsoring Organizations of the Treadway Commission—COSO) may be consulted. It is widely accepted and provides the following concise definition:

> Internal control is a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting and compliance. (COSO, 2013, p. 3)

For a more intuitive overview, the framework also provides the so-called COSO cube, as shown in Fig. 15.3.

For the purpose of this article, *Reporting,* as one of the three categories of objectives on the lid of the COSO cube, is of special interest. Moreover, although all five components of internal control at the front are fundamentally important, mainly *Risk Assessment* and *Control Activities* will be pointed out in the Sect. "ICS with Focus on Non-Financial Matters".

At this stage, it appears crucial to clarify who is responsible for the ICS, and how. The following section will further elaborate on these considerations and clarify the responsibilities with regard to a Swiss limited company subject to an ordinary audit. The aforementioned legal form is the one most frequently used in Switzerland (Federal Department of Economic Affairs, Education and Research EAER, 2024) and is particularly suitable for an exemplary discussion of the topic.

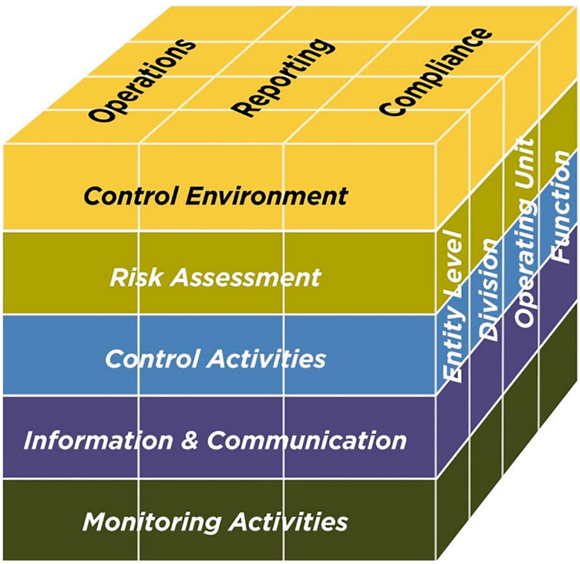

Fig. 15.3 The COSO cube (COSO, 2013, p. 6)

Duties of the Organs of a Swiss Limited Company

This section will now focus solely on the ordinary audit and a Swiss limited company. In this regard, the board of directors, the general assembly, and the external auditor are considered as the three organs (i.e., *governing bodies*) according to the Swiss CO. In the following, Fig. 15.4 gives a concise overview of their relationships and communication paths.

In a simple setting, the sum of all shareholders can be understood as the general assembly. In this regard, Art. 698 CO specifies the duties and responsibilities of the general assembly. On the one hand, the general assembly elects the board of directors as the company's main supervisory body, and on the other hand, it elects the external auditor. Additionally, the general assembly has the sole power to decide on the acceptance or rejection of the financial statements and the proposition of profit distribution.

Furthermore, the financial statements and the proposition of profit distribution are directly connected with the other two organs, as shown below:

– Both were prepared and proposed, respectively, by the board of directors (Art. 716a CO).
– Both were audited by the external auditor, following their preparation and proposal by the board of directors (Art. 727 CO).

A board of directors of a Swiss limited company is constituted as a so-called one-tier board (management functions are not separated from its supervisory function, this is also assumed in Fig. 15.4). The management function is often delegated to, e.g., a CEO or a managing director (Sommerhalder & Hüttche, 2023). This circumstance and the observations concerning the three organs inevitably lead to the so-called Principal-Agent Theory—an economic framework to support a comprehensible analysis of (corporate) relationships. In a simple setting, it is assumed that both the agent and the principal aim to maximize their own utility (e.g., growth,

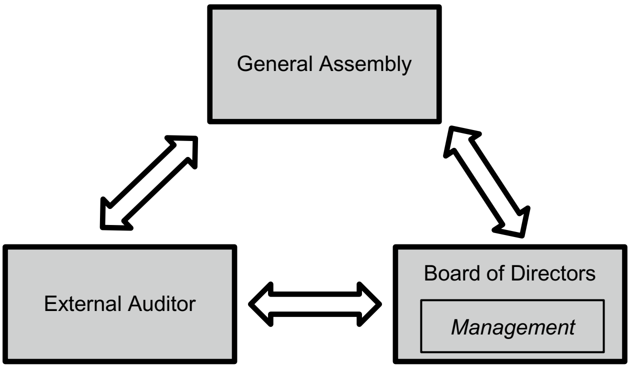

Fig. 15.4 Overview of relationships/communication paths in Swiss limited companies in relation to their organs (own representation based on Swiss CO)

dividends, etc.). However, the agent (e.g., board of directors/management) may be better informed than the principal (e.g., general assembly, i.e., the sum of all shareholders). Leading to these unfavorable information asymmetries, an external auditor is capable of being a suitable solution as an independent party between the agent and the principal (Sager et al., 2011, p. 444).

With this theory in mind: When now focusing on the ICS, all organs, as well as the management, are to be considered as indicated below according to PS-CH 890 (EXPERTsuisse, 2022b, p. 994):

- Board of directors' responsibility: Designing, implementing, and maintaining an appropriate ICS.
- Management's responsibility: Execution of the ICS as specified by the board of directors (however, the board of directors remains to bear the main responsibility regarding the ICS—but the execution might be delegated to the management in the sense of a one-tier board).
- External auditor: Examination of the existence of the ICS as specified by the board of directors.[4]

The external auditor either confirms or rejects the existence of the ICS. In this respect, the general assembly does not vote on its existence due to no legal requirements.[5] However, the general assembly is generally informed through the ordinary audit report regarding the confirmation or rejection of its existence by the external auditor. Furthermore, the board of directors is informed through a comprehensive report, which also contains findings on the ICS.

While the focus regarding the existence of the ICS mainly lies on its impact on financial reporting, the question now arises as to how the situation presents itself in the case of reporting on non-financial matters. In contrast to the financial statements, proposition of profit distribution and its underlying (mainly financially-focused) ICS as discussed in detail above, the following section will present important considerations regarding the emerging future of reports on non-financial matters and its (current and future) implications on the ICS—internationally and nationally.

Non-financial Matters and ICS

While the previous Sect. "Financial Matters and ICS", primarily addressed financial aspects and explained the current significance of the ICS in relation to Swiss law, this section will now focus especially on non-financial aspects. In the Sect. "Recent Developments of the International Environment", international developments will

[4] In addition, the external auditor must take the ICS into account when carrying out the audit and in determining the extent of the ordinary audit (Art. 728a CO).

[5] This is different from the financial statements and proposition of profit distribution, both of which must be approved or rejected by the general assembly (see Figs. 15.2 and 15.4).

be summarized, and relevant legislation and standards will briefly be discussed. Special emphasis will be added to international developments in relation to the EU, as these might be the most important drivers for past, current, and future developments in Switzerland. In the Sect. "Recent Developments in Switzerland", the anticipated new law regarding reporting on non-financial matters in Switzerland will particularly be outlined by discussing national developments. The Sect. "ICS with Focus on Non-Financial Matters" will conclude with specific consideration of the COSO framework and the associated COSO cube. The main focus will be on the objectives of *Reporting* (as referred to in Fig. 15.3), as well as the components of control, *Risk Assessment* and *Control Activities*.

Recent Developments of the International Environment

When the Non-Financial Reporting Directive (NFRD) came into force in the EU, certain large companies were required to report on non-financial matters from the year 2017 onward. However, due to increased expectations on the part of the readers/users of these reports, the Corporate Responsibility Reporting Directive (CSRD) was initiated. The CSRD will be implemented in a step-by-step approach (commonly referred to as *waves*):

– "Wave 1: For financial years beginning on or after January 1, 2024: Companies of public interest with more than 500 employees
– Wave 2: Additionally, for financial years beginning on or after January 1, 2025: All other large companies under accounting law.
– Wave 3: Additionally, for financial years beginning on or after January 1, 2026: Capital market-oriented SMEs (unless they exercise the option to defer until 2028)." (Federal Ministry of Labour and Social Affairs, n.d.).[6]

In addition to the increased number of obligated companies and the increased reporting obligations along the new European Sustainability Reporting Standards (ESRS) to be used in the process, one of the most far-reaching developments is the adoption of an audit obligation for these reports. The audit is carried out by means of *limited assurance*—comparable to the assurance level for limited audits in Switzerland (see Fig. 15.2). However, it is intended to gradually increase the level of assurance until the objective of Reasonable Assurance[7] (see Fig. 15.2) is achieved.

[6] According to the first *Omnibus-Package* as proposed by the European Commission on February 26, 2025, it is intended to postpone mandatory reporting for companies included in Wave 2 and Wave 3 by two years. It is also intended to increase the existing threshold to 1750 employees. The adjustments must first be reviewed and accepted by the European Parliament and the Council of the European Union (European Parliament, 2025; PwC Switzerland, 2025).

[7] See Footnote 6: The European Commission also proposed to remove the future obligation for *Reasonable* Assurance. Equal to the other proposed adjustments, it must first be reviewed and accepted by the European Parliament and the Council of the European Union (PwC Switzerland, 2025).

This would mean that the level of assurance would be of a similar level to that of the ordinary audit in Switzerland (Federal Ministry of Labour and Social Affairs, n.d.).

Speaking of ESRS, the term *Double Materiality* catches attention. It is a fundamentally new understanding of materiality and different to the one prevalent in traditional financial reporting/auditing. It can briefly be defined as follows:

> In a broader sense, the concept of double materiality ensures that sustainability reporting focuses on the topics that are most relevant for the organization and its stakeholders.[8] (PwC Netherlands, n.d.)

More precisely, this means that a company must consider sustainability aspects from two different perspectives—both from an *outside in* view and an *inside out* view:

> **Financial materiality**: This '*outside-in*' view focuses on how sustainability matters may pose either a prospective material risk or opportunity that could affect a company's financial performance and position over the short, medium, and long term. Sustainability matters are considered material for primary users of a company's financial reports if omitting or misstating the information could influence the users' decisions.
>
> **Impact materiality**: This '*inside-out*' view focuses on the actual or potential short, medium and long-term impacts on people or the environment that are directly linked to a company's operations and its value chain. These impacts can be both positive and negative. (PwC US, n.d.)

As the definitions above indicate, *Double Materiality* inevitably has an impact on the reporting and auditing of non-financial matters. Besides ESRS, other standards were also issued—for example, the IFRS Sustainability Disclosure Standards. In contrast to ESRS, such standards are not compatible with CSRD, so obligated companies in the EU have no choice as to which standard they would like to apply. The situation differs in Switzerland, as it pursues a different approach in this respect (see Sect. "Recent Developments in Switzerland").

In addition, the following must be highlighted with regard to Switzerland: It can be observed that Swiss companies, both small and large, may directly or indirectly be affected by CSRD due to advancements in the EU environment (The Federal Council, 2024). The Sect. "Recent Developments in Switzerland" will bring this into perspective.

Recent Developments in Switzerland

As described in the Sect. "Recent Developments of the International Environment", international developments with regard to reporting on non-financial matters are advancing rapidly. Focusing on Switzerland, important considerations on changes

[8] While Fig. 15.4 and the description relating to the Principal-Agent Theory in Sect. "Duties of the Organs of a Swiss Limited Company" have mainly focused on shareholders in relation to financial reporting, stakeholders are mentioned directly in relation to non-financial reporting. A shift from the traditional shareholder approach to the (broader) stakeholder approach is observable.

Fig. 15.5 Switzerland and its process on implementing transparency on non-financial matters in applicable law (own representation)

in the past, present, and future need to be taken into account at this point. Figure 15.5 shows the developments in Switzerland over the last 5 years.

In the following paragraphs, the different points in time as illustrated in Fig. 15.5 will be specified further. However, the focus will particularly be on the present and the future concerning the reporting on non-financial matters in Switzerland and the ICS.

2020 and 2022: Popular Initiative and Initial Inclusion of *Transparency on Non-financial Matters* in Swiss Law

In Switzerland, widely known for its direct democracy, the Swiss population had the opportunity to vote on the popular initiative *For responsible businesses—protecting human rights and the environment.* Although the result ended in a popular majority of 50.7% supporting the initiative, it was rejected due to the lack of a majority of the cantons. Consequently, the indirect counter-proposal to the aforementioned initiative entered into force on January 1, 2022. Art. 964ff CO—namely, *Transparency on Non-Financial Matters*—was a novelty and brought non-financial matters into Swiss applicable law. Art. 964ff CO particularly specifies the area of application regarding the preparation of reports on non-financial matters, their purpose and content, as well as the general responsibilities regarding approval and publication of the report.

Before discussing Art. 964ff CO in more detail, a description of current and future developments will first be provided.

2024 and Future: New Applicable Law

Triggered by international pressure as well as pressure arising from different stakeholders in Switzerland itself, the Swiss Federal Council opened a consultation process during its meeting on June 26, 2024. The subject was the revision of the current

Swiss law, especially Art. 964ff CO. First and foremost, the Federal Council wants to oblige more companies to prepare a report on non-financial matters. While approximately 300 Swiss companies are currently subject to the reporting obligations according to Art. 964ff CO, the legal revision would affect around 3500 Swiss companies[9] in the future—a significant increase (The Federal Council, 2024). In addition, it is anticipated that the responsibilities of a company's organs will be extended. The most obvious change is probably that the reports on non-financial matters will most likely be subject to an audit. Such requirements do not exist under the current legal situation in Switzerland but do so, e.g., in the EU (see Sect. "Recent Developments of the International Environment").

To put the current applicable law and the anticipated new law into perspective, Fig. 15.6 gives a brief summary covering their contents and their differences in particular. Similar to the Sect. "Duties of the Organs of a Swiss Limited Company", Swiss limited companies are used as a basis.[10]

The ICS as such is not mentioned in the current state of applicable law concerning non-financial matters, nor is it part of the newly anticipated law—in contrast to Art. 728a CO regarding the financial audit. Nevertheless, the current and anticipated law also mentions risks and controls in relation to non-financial matters. According to Art. 964b CO in its current state, the report must contain the following: A description of the main risks related to environmental matters and the business-related performance, results, and activities covered in the report, as well as a description of how the company is dealing with these risks. The anticipated new law provides a more precise description as shown below, according to Art. 964c CO:[11]

– A description of the material actual or potential negative impacts on sustainability aspects or of sustainability aspects that are linked to the company's business activities and its value chain, as well as a description of the measures taken to identify and monitor these impacts.
– A description of the measures taken by the company to prevent, mitigate, remediate, or eliminate actual or potential negative impacts in accordance with the aforementioned description of the material actual or potential negative impacts, and the success of these measures.
– A description of the material risks to which the company is exposed in connection with sustainability aspects and how the company manages these risks.

[9] See Footnote 6: If the European Parliament and the Council of the European Union accept this change, then an adjustment to the threshold regarding the legal implementation in Switzerland could also be expected.

[10] Figure 15.6 provides a general overview. Thus, it is therefore not intended to be conclusive in terms of content.

[11] The following section is translated analogously from the German language, as it is currently not available in English.

	Present – Art. 964ff CO	Future – Art. 964ff CO
Mainly affected companies	Companies (all must apply): • Of public interest • with ≥ 500 FTE on average in 2 successive years • exceeding at least one of following thresholds in two successive years: Balance sheet total MCHF 20; total revenue of MCHF 40	Companies: • Of public interest • exceeding at least two of following thresholds in two successive years: Balance sheet total MCHF 25; total revenue of MCHF 50; 250 FTE on average in two successive years[a]
Main content[b]	The report should address the following content in particular: • Environmental matters • Social matters • Employee-related matters • Matters regarding the respect for human rights • Matters regarding the fight against corruption	In a broad sense, the main content is largely identical to current applicable law as described on the left. However, the content must noticeably be more in-depth and expects a more extensive disclosure of information.
Basic Principle	The report does not necessarily have to be based on a national / international standard.	The report does have to be based on ESRS or a comparable standard.
Approval	• Approval and signature of the board of directors • Approval of the general assembly	
Publication	• Obligation to publish the report on non-financial matters online • Ensure availability of at least ten years	• Obligation to publish the report on non-financial matters and the related audit report online • Ensure availability of at least ten years

Audit of report on non-financial matters	No obligation	• Obligation
		• To be performed either by
		  ○ an audit firm according to AOA
		  ○ a conformity assessment body according to AOA[c]

Fig. 15.6 Contents and their differences—key-characteristics of the current and anticipated future legislation in Switzerland. [a]See footnote 6. [b]The perspectives from which the main contents should be disclosed are outlined in the remainder of this section. [c]Parallel to the revision of Art. 964ff CO, the AOA and Art. 728a CO as well as parts of the Swiss Criminal Code will also be revised. (The Federal Council, 2024; own representation based on current Swiss CO and Federal Department of Justice and Police FDJP, 2024)

Clearly, the duties of the organs of a Swiss limited company will be extended. Especially the external auditor, as an organ, bears more responsibility.[12] Also, the report prepared by the board of directors still needs to be approved or rejected by the general assembly according to the anticipated new law—similar to the responsibilities regarding the financial audit and the current regulations under Art. 964ff CO. As pointed out above, the report also needs to contain a description of associated risks and how the company addresses them. This is where the ICS comes into play as a suitable instrument to support these objectives. The Sect. "ICS with Focus on Non-Financial Matters" will therefore elaborate on the implementation of the ICS concerning non-financial matters.

ICS with Focus on Non-financial Matters

As pointed out in the Defining the ICS section, the main objective of the COSO cube for the purpose of this article is *Reporting*. Reporting objectives can be understood as follows:

> *Reporting Objectives*—These pertain to internal and external financial and **non-financial reporting** [emphasis added] and may encompass **reliability** [emphasis added], timeliness, **transparency** [emphasis added], or other terms as set forth by **regulators** [emphasis added], recognized standard setters, or entity's policies. (COSO, 2013, p. 3)

The paragraph above particularly shows (as highlighted in bold letters) that the COSO framework already refers to non-financial matters and their reporting.[13] Also, the objectives of *Reporting* include expectations of regulators, which in turn also fits the current situation in Switzerland. The reliability of reports on non-financial matters is of special interest due to the anticipated audit-obligation, as mentioned in the Sect. "Recent Developments in Switzerland", which can also represent an appropriate response to the Principal-Agent Theory as described in the Sect. "Duties of the Organs of a Swiss Limited Company". Furthermore, appropriate reporting of non-financial matters increases transparency for stakeholders of various types, as mentioned in the Sect. "Recent Developments of the International Environment".

In order to achieve the objectives of *Reporting*,[14] the five components of internal control (displayed on the front of the COSO cube as shown in Fig. 15.3) should be

[12] This especially has to be taken into account when the external auditor elected to perform the audit of the financial report also performs the audit of the report on non-financial matters.

[13] Also, COSO mentions an article on its website that demonstrates how the COSO framework can be leveraged for sustainability purposes. As the article was published in 2017, it shows that the ICS had already been addressed and linked to non-financial matters before the currently existing regulations (internationally and in Switzerland) (Herz et al., 2017).

[14] This also applies to the other objectives, *Operations* and *Compliance*. Although all three objectives may be equally important depending on a company's operations, business, and goals, the authors of this article consider that the objective of *Reporting* is of special interest regarding non-financial matters and their reporting (COSO, 2013, p. 3ff).

Risk Assessment
The organization specifies objectives with sufficient clarity to enable the identification and assessment of risks relating to objectives.
The organization identifies risks to the achievement of its objectives across the entity and analyzes risks as a basis for determining how the risks should be managed.
The organization considers the potential for fraud[a] in assessing risks to the achievement of objectives.
The organization identifies and assesses changes that could significantly impact the system of internal control.
Control Activities
The organization selects and develops control activities that contribute to the mitigation of risks to the achievement of objectives to acceptable levels.
The organization selects and develops general control activities over technology to support the achievement of objectives.
The organization deploys control activities through policies that establish what is expected and procedures that put policies into action.

Fig. 15.7 The principles of *Risk Assessment* and *Control Activities*. [a]An ICS is suitable for minimizing the risk of fraud, e.g. by management or other personnel. This circumstance is often explained using the so-called Fraud-Triangle, which includes the three factors *Opportunity, Pressure* and *Justification*. These three components must be given simultaneously for there to be a risk of fraud. An ICS particularly addresses the factor *Opportunity*. (Cressey, 1950, pp. 738–743; Sutter et al., 2014, p. 35; COSO, 2013, p. 7)

consulted. For the purpose of this article, the remainder of this section will primarily focus on the components *Risk Assessment* and *Control Activities.*[15] Regarding these components, the COSO framework lists individual principles that should be considered when designing, implementing, and maintaining an appropriate ICS, as shown in Fig. 15.7.

Examples of important risks resulting from a *Risk Assessment* and examples of *Control Activities* with regard to non-financially related reporting practices will be specified in the following section.

In order to visualize identified risks and associated controls, the so-called Risk-Control Matrix has become well established in practice in Switzerland. Firstly, it connects the individual processes, which might be particularly important for a specific company, with their corresponding risks. Secondly, controls are derived from these identified risks. The controls are intended to minimize the probability of negative incidents occurring (due to associated risks) to an acceptable level. Figure 15.8 shows a simple visualization of this matrix.[16]

[15] As already discussed, also the other components of internal control must be considered when designing, implementing, and maintaining an appropriate ICS and should not be omitted in its practical realization.

[16] The Risk-Control Matrix is often adapted to company-specific characteristics. For example, the matrix can be further expanded by differentiating between different types of controls (e.g., manual or automated controls) or by specifying responsible personnel.

Processes		***Risks***		***Controls***	
Number	*Description*	*Number*	*Description*	*Number*	*Description*
1	…	*1*	…	*1*	…
2	…	*2*	…	*2*	…
…	…	…	…	…	…

Fig. 15.8 Risk-Control Matrix (own representation based on Hunziker et al., 2008, p. 11)

The Risk-Control Matrix will be mentioned again in the following section.

Practical Implications and Recommendations for Swiss Companies

As the previous sections have made clear, there are still many questions regarding the legal implementations in Switzerland. Although the draft of the new law indicates the direction in which the rules for the preparation and the audit of reports on non-financial matters are heading, there are still constant developments expected in this regard. Nevertheless, it seems practicable—even if the final text of the new law has not yet been passed—for companies to address these topics in a managerial way.

These first three sections have already summarized some of the most important key elements to be considered regarding reports on financial and non-financial matters and their preparation and auditing. While the previous section examined the ICS from a more theoretical perspective, the following sections will now focus on the discussion of practical elements and will suggest important topics to be considered when implementing an ICS while targeting non-financial matters.

Building on Existing ICS-Practices

As previously mentioned, Swiss companies subject to an ordinary audit must have implemented and documented an ICS. In turn, the external auditor must confirm its existence according to Art. 728a CO. In contrast, other companies (subject to a limited audit/subject to no audit at all) are also assumed to have to address risks and controls in relation to financial reporting—although such risks and controls may not be documented and/or implemented at the same level of detail.

Therefore, it seems reasonable for companies to build on existing ICS principles and practices. Thus, leveraging existing processes and practices from a financial perspective into the non-financial perspective might be feasible. This can especially be achieved by using a possibly already existing Risk-Control Matrix (targeting financial matters). Such a matrix as described in the ICS with Focus on

Non-Financial Matters section is considered to be Best-Practice in Switzerland and is widely used in actual practice. Combined with a potentially existing, detailed ICS documentation (a prerequisite for the ordinary audit), companies can apply their knowledge and experience from the financial part also in the non-financial part. As a result, exemplary ICS documentation should include and address the following elements (this applies to both the financial and non-financial perspective):

– **Who** is responsible? (control owner(s)—e.g., who reviews/approves, etc.)
– **Which** type of control is performed, and **how**?[17]
– **When** is the control performed?[18]
– **Where** is the control evidenced/documented?

Furthermore, the COSO cube as described in the Defining the ICS section may also support designing, implementing, and maintaining an ICS that focuses on non-financial matters.

While leverage might be possible, some important considerations must be made when comparing the ICS from a financial and non-financial perspective. The Sect. "Adding Controls to Enhance Quality of Reporting on Non-Financial Matters" will therefore focus on the process stages where controls can create added value and mitigate risks.

Adding Controls to Enhance Quality of Reporting on Non-Financial Matters

While financial aspects are often easily/reliably measurable and often denominated in currency amounts and monetary values, non-financial aspects pose the following important problems:

– They are often more difficult to measure reliably.
– They are often denominated in different, non-monetary values.
– They are often results from questionnaires.

These circumstances give rise to new, additional risks. Companies do normally have control mechanisms in place between the creation/collection of data (e.g., the posting of a business transaction / bookkeeping) and the reporting of these figures (e.g., in the form of the financial statement). They can minimize the risk of errors in the process as a whole. Nevertheless, the situation differs, as not all such (financially focused) controls may be leverageable when designing, implementing, and maintaining an ICS regarding non-financial matters. Figure 15.9 shows exemplary

[17] The different types of controls and how they can be performed will further be discussed in the Sect. "Adding Controls to Enhance Quality of Reporting on Non-Financial Matters".

[18] The process stages where controls might be implemented will further be discussed in the Sect. "Adding Controls to Enhance Quality of Reporting on Non-Financial Matters".

Fig. 15.9 Process stages where controls might effectively be implemented (own representation)

process stages regarding non-financial matters and their reporting. In addition, possible stages where controls might be effectively implemented will be highlighted.

It should be emphasized that Fig. 15.9 assumes that the controls are carried out after a respective process stage (i.e., detective control). Of course, controls might also be implemented before a respective stage (i.e., preventive control). In addition, a differentiation can be made between the type of execution, i.e., whether a control is carried out manually or automatically—or a combination of both (i.e., semi-automated).

Figure 15.10 explains the different types of controls and further gives practical examples, which are based on the following assumptions: At the end of 2025, an international Swiss company decided, as part of its *Zero Emission* project, to reduce the fuel consumption of all fleet vehicles in Switzerland by 20 percent by the end of 2028 without investing in additional electric vehicles (50 percent of all fleet vehicles had already been replaced by electric vehicles by the end of 2025)

The type of control that best covers a risk depends on the individual case and must be adapted to the circumstances in the best possible way to minimize the risk of a misstatement in the report on non-financial matters. As highlighted in the Sect. "ICS with Focus on Non-Financial Matters", this can also efficiently be documented in the Risk-Control Matrix.

	Preventive *A control that should minimize the risk of an error / fraud before it occurs.*	**Detective** *A control that should minimize the risk of an error / fraud after it occurs.*
Manual *A control that is carried out exclusively by a person without the involvement of an IT system.*	The CEO meets the Chief Investment Officer (CIO) in February 2026. He asks him about the measures he has already initiated as CIO for 2026, 2027 as well as 2028 and how high he estimates the fuel savings associated with these measures in liters and CHF per year. The CIO is well prepared and sends a comprehensive documentation to the CEO.	At the end of 2026, the energy inspector approaches the fleet vehicle manager with a key-questionnaire. He asks him if and how he implemented the fuel reduction regulations issued by the company and compares the values with the actual target values.
Semi-automated *A control that is carried out by a person with the involvement of an IT system.*	On the last day of every month, all fleet vehicle managers and energy inspectors automatically receive a notification via e-mail – including a link to the ERP-system which informs them about the forecasts for fuel procurement and amounts in CHF for the next month. On the same day, all fleet vehicle managers and energy inspectors need to revise and approve the data in the ERP-system while explaining any differences to the target values to the controlling department.	On the first day of every month, all fleet vehicle managers and energy inspectors automatically receive a notification via e-mail – including a link to the ERP-system which informs them about the updated fuel liters procured and amounts in CHF in the last month. The actual values are automatically compared with the target values. On the same day, all fleet vehicle managers and energy inspectors need to revise and approve the data in the ERP-system while explaining any differences to the controlling department.
Automated *A control that is carried out by an IT-system without the involvement of a person.*	The ERP ensures that all necessary forecast data for the next month is entered seamlessly into the input grid by the fleet vehicle manager. If required data is missing or is entered in the wrong format, the ERP-system automatically blocks the entire data input.	The ERP ensures that all necessary actual data for the past month is entered seamlessly into the input grid by the fleet vehicle manager. If required data is missing, is entered in the wrong format or the actual values deviate to much from the target values, the ERP-system automatically blocks the entire data input.

Fig. 15.10 Types of controls and examples (own representation)

Conclusion

Currently, with regard to Switzerland, there are already companies that prepare and publish reports on non-financial matters. So far, such reports need not be audited by external auditors in Switzerland. In 2024 and 2025, Art. 964ff CO was under consultation and further decisions are expected by the Federal Council in spring 2026 at the latest—however, a more far-reaching obligation to prepare, publish, and review reports on non-financial matters is anticipated for Swiss companies. The authors of this article examined how the ICS can make a significant contribution while dealing with non-financial matters and the associated achievement of objectives in connection with said developments. The COSO cube gives a clear and concise assistance on how to design, implement, and maintain an appropriate ICS regarding non-financial matters, e.g., in connection with a Risk-Control Matrix as a useful tool. The associated processes, the risks assigned to them, and the related control measures should especially be highlighted.

How can companies take the complex aspects of non-financial matters into account and address them with an appropriate ICS? This article emphasized three challenging areas in this connection: Firstly, filtering out the data relevant to the non-financial target achievements is crucial. Secondly, taking the relevant data into account in a correct and purposeful way for the calculation is of special importance so that, thirdly, the non-financial target achievements can be shown in the reports on non-financial matters in the most meaningful way.

It is currently not possible to make a precise forecast as to when the new legal requirements concerning Art. 964ff CO will enter into force in Switzerland in the medium term. However, independent of any legal obligation, Swiss companies can use the ICS as an instrument to record and monitor important data and associated processes while contributing to the achievement of non-financial goals, e.g., goals with regard to carbon emission.

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Chapter 16
Sustainability Reporting by Pension Funds: How to Achieve Credibility?

Christina Meier and Matthias Härri

Abstract Pension funds are expected to align their investment strategy with climate targets and ESG. To avoid criticism of greenwashing, there is a growing need for credible communication and transparency on ESG. Switzerland has a long tradition of self-regulation in the financial sector, so it is not surprising that the Swiss Pension Fund Association (ASIP) published an ESG reporting standard for its members in 2022, which is to be applied for the first time for the 2023 financial year.

We analyze the first experiences and challenges of large pension funds with the implementation of the ASIP standard, where the opportunities and challenges lie and what best practice recommendations can be derived for the future.

We regularly exchange experiences with stakeholders from various pension funds, in our role as responsible for the Swiss Association for Responsible Investments (SVVK-ASIR) and as a member of the Board of Directors of the Basellandschaftliche Pensionskasse (blpk). In 2023, this exchange was formalized through interviews with representatives of Swiss pension funds and resulted in a bachelor's thesis, which forms the original basis for this paper (Meier Nachhaltigkeitsberichterstattung durch Vorsorgeeinrichtungen in der Schweiz - Handlungsempfehlungen für ein glaubwürdiges Reporting. Bachelor Thesis. Fachhochschule Nordwestschweiz, Hochschule für Wirtschaft., 2023). The main findings, the experience of pension funds since then and developments and changes in self-regulation are presented in this text.

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Key Findings: ESG reporting is complex and is aimed at a heterogeneous audience with different levels of knowledge and information needs. We find that the preparation is associated with considerable time and effort. Although there are improvements in the definition of relevant key figures, the reliable availability still appears to present some challenges. To maintain the credibility of the reporting and to prevent accusations of possible greenwashing, we propose that the best way forward is transparent and honest reporting, that also clearly identifies the problems and challenges where targets have not yet been met.

Keywords ESG reporting · Pension funds · Credibility

Introduction

In the last two to three decades, the topic of sustainability has increasingly corresponded to the zeitgeist of Western societies. Simultaneously, different stakeholders and target groups approached pension funds with different information needs. The need for credible communication and greater transparency on ESG has therefore increased considerably.

At the time of writing (early summer 2025), the importance and priority of sustainable development seem to be fading somewhat due to political changes in the USA and Europe. Our research relates to the years 2023 and 2024; the significance of the latest developments is difficult to assess at present, but we currently have no indication that this would change the fundamental considerations and recommendations presented here.

In our research, we focused on the situation of Swiss pension funds. As Switzerland has a comparatively well-developed pension system and a well-developed capital market, we assume that the insights gained here also have a certain relevance in a global context, as institutional investors around the world face similar challenges in terms of credible reporting on sustainability.

In this text, we outline the following two aspects: First, we develop seven current challenges of sustainability reporting by pension funds. Second, we formulate concrete recommendations for action in the implementation of sustainability reporting by pension funds.

By signing the Paris Climate Agreement, Switzerland has committed itself to defining binding targets and measures to reduce greenhouse gas emissions to limit the global rise in temperature. Pension funds also have a responsibility to align their investment strategies with climate targets, whereby they always operate in tension between return, risk and liquidity when fulfilling their fiduciary duty of care. Financial institutions' awareness of climate issues is increasing, not least due to the growing pressure exerted by a large number of stakeholders. However, as the market volume of sustainable investments increases, so does the concern about potential greenwashing. The need for credible communication and greater transparency regarding the impact of sustainable investments in the areas of environmental, social and responsible corporate governance is increasing (Swiss Sustainable Finance SSF, 2024).

To meet these transparency requirements and support pension funds in implementing sustainability reporting, the Swiss Pension Fund Association (ASIP) published a reporting standard in December 2022. An update with substantial improvements and clarifications followed in December 2024. Both were developed in cooperation with various stakeholders within the industry. The standard is of a recommendatory nature and is intended to serve as a guide for all Swiss pension funds (Swiss Pension Fund Association ASIP, 2022b, 2024).

Some Definitions

Before we display our findings about the main challenges Swiss pension funds face with respect to sustainability reporting, some relevant definitions and concepts are introduced here.

ESG Approach

Corporate sustainability is generally analyzed based on the three ESG dimensions: Environmental, Social and Governance. The aim is to address and quantify non-financially measurable aspects of a company within these three dimensions. This, in turn, enables stakeholders to assess the social, environmental and ethical impact of investments in companies. In terms of content, ESG is not yet subject to an exact definition. In the following, we use the descriptions and explanations as presented by Matos (2020) and summarized in Table 16.1.

Table 16.1 Allocation of the main topics to the three ESG dimensions (Matos, 2020, S. 7)

Environmental	Social	Governance
• Climate change and carbon emissions	• Workforce health and safety, diversity and training.	• Shareholder rights
• Natural resource use and energy and water management	• Customer and product responsibility	• Composition of boards of directors (independence and diversity)
• Pollution and waste	• Community relations and charitable activities	• Management compensation policy
• Ecodesign and innovation		• Fraud and bribery

Environmental

The ecological or environmental dimension measures the impact of a company on the natural ecosystem. This includes emissions (e.g. greenhouse gases), the efficient use of natural resources in the production process (e.g. in terms of energy, water, or materials), pollution and waste management, as well as innovation efforts to design products in an environmentally friendly way.

Social

The social dimension considers the company's interactions with its employees, customers and society. This includes attempts to build loyal relationships with employees (e.g. by promoting occupational health and safety, training and staff development), to satisfy customer needs (e.g. by producing high-quality products and services that ensure the safety of customers) and to be a responsible partner in the society in which the company operates.

Governance: Responsible Corporate Management and Control

The third dimension, governance, comprises functioning and established systems that enable the management of a company to act in the best interests of long-term shareholders. This includes the protection of shareholder rights (e.g. defense against takeovers), a well-functioning board (e.g. with experienced, diverse and independent members), a well-designed executive compensation policy and the avoidance of illegal practices such as fraud or bribery.

Double Materiality: Risk Perspective and Impact Perspective

When making investment decisions, two perspectives can be adopted regarding the integration of ESG. The European Financial Reporting Advisory Group (EFRAG, 2022) describes these as follows:

Risk Perspective (Financial Materiality, 'Outside-In'): This perspective considers and assesses opportunities and risks that climate change, for example, has on the value of an investor's assets in the short, medium and long term.

Impact Perspective (Impact Materiality, 'Inside-Out'): This perspective determines what actual and potential impact an investor's investment behaviour may have on the environment and society.

The adoption of these two perspectives, the principle of 'double materiality', is also required of reporting companies by the EU Corporate Sustainability Reporting Directive (CSRD, 2022). The materiality analysis helps companies to narrow down the sustainability topics that are relevant to them and to identify the most important stakeholders and their expectations. At the same time, the topic analysis can be used to prioritize sustainability reporting.

Current Situation in Switzerland

Currently (2025), there is no legal obligation to prepare and publish a sustainability report. The Swiss Federal Council welcomes sustainability initiatives of the pension funds and continues to rely on voluntary solutions, as a reporting obligation would, in its opinion, lead to considerable additional work for the audit and thus also to cost consequences for the pension funds. However, the number of pension funds that express their views on the topic in various ways is steadily increasing (Fusetti et al., 2022; ASIP-PwC, 2024).

In accordance with the Federal Occupational Pensions Act (BVG), Art. 51a, the fiduciary responsibility of a pension fund lies with its supreme body. According to Art. 71, this also includes the sustainable management of insured assets, considering an appropriate risk/return ratio. In its ESG Guidelines for Pension Funds (2022a), ASIP states that pension funds must take material ESG risks into account when making investment decisions in accordance with Art. 50 para. 3 BVV 2. This is also the conclusion of a legal opinion commissioned by the BAFU (Eggen & Stengel, 2019), which examined, among other things, the question of the extent to which financial market players are required under current Swiss law to assess climate risks and impacts in their business activity. Since climate risks can have a very diverse impact on the individual positions in the investment universe of pension funds, pension funds are already obliged under current law to take them into account in their investment strategies as part of an appropriate risk distribution.

In Switzerland, as already mentioned, pension funds are not obliged to issue an integral report on sustainability. However, as far as disclosure in the sense of transparency is concerned, Eggen and Stengel (2019) conclude that such disclosure may be required as part of the duty to inform policyholders about the material investment risks if this is necessary for risk assessment and the assessment of the management task by the governing bodies.

To support pension funds in voluntary ESG reporting, ASIP published a reporting standard in December 2022 (V 1) and updated it in December 2024, V 1.1 (ASIP, 2022b, 2024).

ASIP's ESG reporting standard provides a framework to meet the growing transparency requirements of diverse stakeholders and to support pension funds in implementing sustainability reporting. Although the standard is not legally binding and has a recommendatory character, it aims to be established as an industry standard to pre-empt a harsh legal regulation.

The reporting standard is intended to serve as a guide for the industry and enable regular progress to be measured, which allows a limited comparison with other pension funds and an assessment of developments over time. To ensure that the standard is as widely accepted as possible, it was developed in cooperation with various stakeholders within the industry.

The ASIP standard is divided into two parts: on the one hand, qualitative statements on the pension fund's sustainability strategy, like climate issues or voting rights policies, are required, and, on the other hand, quantitative reporting based on specific ESG key figures is recommended. Some of these quantitative indicators in the ASIP standard refer to the Swiss Climate Scores, where this is appropriate for pension funds (Schweizerische Eidgenossenschaft, The Federal Council, 2023).

Importance of Credibility

Credibility is essential in the context of sustainability reporting. Being perceived as a credible institution must be the highest goal of reporting. Stakeholders should be convinced that there is serious transparency. This is even more important as most ESG reports are not externally audited. Adherence to an ESG reporting standard such as ASIP gives readers a degree of assurance that the report has been prepared properly and in line with the general consensus of an industry.

It is a matter of trust: an open and honest approach, even to a perceived weakness, can be interpreted as a strength: having the stature to tackle difficult issues strengthens the basis of trust. The question of what makes ESG reporting credible was also raised in our discussions with pension funds. In addition to reliable data, it is considered important for a pension fund to report where it is not yet on track, where it has identified conflicts of interest, or where there are uncertainties. Reporting on this, explaining the circumstances and tackling difficult issues gives a credible impression. In any case, it is important to avoid presenting something that does not reflect reality.

Challenges of Sustainability Reporting

Academic debate on ESG reporting is increasing, but the actual benefits are the subject of controversy. Heeb et al. (2022), for example, emphasize the need for standardization and political regulation in order to provide companies with clear and materiality-oriented key figures. In contrast, Arvidsson and Dumay (2022), in their study of ESG reporting by companies in the real economy, point out that the quality of ESG data, and thus the quality and quantity of ESG reporting, has steadily improved in many areas in recent years, while ESG performance has in some cases remained at the same level. They therefore advocate the development of credible and comparable metrics for assessing ESG performance, rather than focusing solely on reporting.

In our roles as a specialist responsible for the Swiss Association for Responsible Investments (SVVK-ASIR), an association of larger Swiss pension funds, and as a board member of a pension fund (blpk), we are in regular contact with industry representatives and monitor the development of sustainability reporting. After the release of the first ASIP reporting standard V 1 (ASIP, 2022b), we conducted formal interviews with representatives of six of the eleven members of SVVK-ASIR to document their first experiences and challenges with sustainability reporting. Those institutions represent six of the largest pension funds in Switzerland. In 2024, we deepened our discussions with the members of the association and with ASIP before its release of the second version of the reporting standard in December 2024, V 1.1 (ASIP, 2024).

In doing so, we have identified several issues and summarize here, from our point of view, seven main key challenges, which we list below. We then discuss them to finally suggest possible best practice recommendations.

Challenges

1. Size and structure of ESG reporting
2. Reporting to a heterogeneous target audience
3. Reporting is not read by primary beneficiaries
4. High demand for financial and human resources
5. Different, sometimes lacking data sources
6. Climate data for real estate investments
7. Talking about positive impact without losing credibility

Recommendations for Action

Challenge 1: *Size and Structure of ESG Reporting*

Due to the breadth and complexity of the topics, it is challenging to create a lean ESG report that is clear, structured and easy to understand.

Recommendation 1: Focus on the Essentials
Less is more: for the benefit of clarity, but also to minimize the use of resources, it makes sense to focus and limit the sustainability report to the essentials.

- Adopt two perspectives before starting to prepare the ESG report, to identify the material topics:
  - Inside-out: What message should reach the key stakeholders?
  - Outside-in: What external requirements should ESG reporting fulfil?
- Look for inspiration from peers and observe how they organize the structure of ESG reporting to derive possible ideas for your own report.

Challenge 2: *Reporting to a Heterogeneous Target Audience*

ESG reporting appeals to a very heterogeneous target audience that places a wide range of demands on pension funds and differs greatly in terms of technical know-how. It is challenging to address the complex topic in a way that is appropriate for the target group, whereby the persons and institutions addressed can basically be divided into three groups:

- The beneficiaries and thus the general population as the primary target group, with all levels of knowledge and interest, whose compulsory savings from their employment (second pillar in Switzerland) are invested by their pension funds
- The specialized, critical specialist audience, e.g. regulators, NGOs or rating agencies
- The pension fund itself and its employees

Recommendation 2: Target-Group-Oriented Reporting
In our interviews and discussions, pension fund representatives repeatedly told us they suspect that most people do not read their ESG report in detail but rather skim it. Therefore, readers seem to need a good overview of what is important to them as quickly as possible. This is challenging. As the saying goes, 'If something is easy to read, then it was difficult to write' sums it up perfectly. We consider the following points to be crucial:

- Use simple language, short sentences
- Use storytelling to convey the pension fund's sustainability efforts in a lively, emotional way
- Use easy-to-understand visualizations
- Publish a clearly structured overview of the most important key facts and figures

Challenge 3: *Reporting Is Not Read by Primary Beneficiaries*

The elaborate ESG reporting does not reach the beneficiaries or is insufficiently recognized and not (or hardly) read by this target group.

According to an opinion survey, a large proportion of people insured under Pillar 2 in Switzerland have no strong connection with their mandatory retirement savings: 47% of respondents do not consider this capital to be a component of their assets. This figure is considerable and surprising, as these assets represent a large part of the total savings for many (Hermann & Craviolini, 2023). This supports the pension funds' assumption that ESG reporting receives little attention from policyholders, and therefore there is little pressure from the primary target group with regard to reporting and improving ESG indicators (Hermann & Craviolini, 2023).

Recommendation 3: Communication of ESG Reporting

- Before preparing the ESG report, consider the aim and purpose of the report and who the ESG reporting is intended to reach
- Develop a coordinated communication framework using existing communication channels
- However, be aware that successful management of these communication channels will depend on the financial and human resources available
- Make ESG reporting easy to find on the website and accessible throughout the year

Challenge 4: *High Demand for Financial and Human Resources*

The preparation of ESG reporting requires significant human resources and takes place in parallel with regular day-to-day business. At the same time, the procurement of climate data to calculate the recommended metrics is associated with a high financial outlay.

Recommendation 4: Careful Use of Resources

Pension funds are faced with a fiduciary conflict between return, risk and liquidity. They consciously operate with reduced resources to minimize the negative impact on the profitability of the assets insured. Concentration on what is necessary. This appears to be a crucial point: any human resources that are tied up in the preparation of ESG *reporting* cannot be actively used to achieve real ESG *impact* during this time.

- Think about the purpose of the report and carefully consider what is possible in terms of human resources
- Focus on what is essential and absolutely necessary
- If possible: build purchasing groups for data collection to achieve price advantages by pooling resources

Challenge 5: *Different, Sometimes Lacking Data Sources*

It seems to be challenging and time-consuming to systematically collect high-quality data from third parties (e.g. information on exposures by external asset managers) and then aggregate it to the pension fund's overall portfolio. However, this aspect is somewhat mitigated in the ASIP Standard V 1.1 in relation to KPIs around active stewardship, as the majority of these indicators should now be reported qualitatively.

In addition to the database, which is still sometimes difficult to acquire, the update from V 1 to V 1.1 has brought some useful clarifications and a stronger focus on qualitative aspects. Some KPIs have also been deferred to await market developments (e.g. energy and water consumption for equities/bonds).

Recommendation 5: Comply or Explain

- When collecting data from external asset managers, work—where possible—with standard templates to promote quality improvement for both pension funds and external asset managers
- Communicate clear expectations for ESG integration and reporting in collaboration with asset managers. Also focus on the asset manager's assessment of responsible investment performance
- Create an overview of the annual ESG report and check which key figures are currently still difficult to determine based on the current database. The pension fund should actively seek dialogue with the service providers involved to promote understanding of the difficulties and discuss possible solutions
- Engage with the (Global) Custodian and observe how their ESG reporting services are changing and expanding
- Critically examine the data and key figures recommended for disclosure. A reporting recommendation such as the ASIP standard provides guidance
- Disclose those key figures in ESG reporting that are considered robust and reliable
- For metrics that are not disclosed in the ESG reporting, the *comply-or-explain* approach seems appropriate: explain openly and transparently the reasons for not disclosing the indicator at this time
- Providing *qualitative* commentary on a key figure may help readers to better classify a value. Proactive, trust-building communication promotes the credibility of a pension fund

Challenge 6: *Climate Data for Real Estate Investments*

The procurement and aggregation of all data from one's own, directly invested real estate portfolio is challenging and ties up human resources. Fortunately, the REIDA methodology (Real Estate Investment Data Association, 2022) for real estate is now recommended in the ASIP Standard V 1.1, to simplify and standardize the evaluation of climate indicators such as CO_2 emissions or energy consumption. In the case of indirectly held real estate, the pension funds are dependent on the fund managers providing the corresponding data in a suitable form.

Recommendation 6: Focus on Reduction Path for Real Estate

- If a pension fund is a direct owner of real estate, it has an immediate opportunity to reduce emissions by making energy-efficient renovations
- Define a reduction path for *directly* held real estate. Systematically align with it, obtain and process the data for it. At the outset, it is not the methodology used that is important, but rather the strategy consistently pursued to reduce absolute CO_2 emissions
- Require managers of *listed* real estate funds to define a reduction path and strategic implementation, as well as to disclose transparent and comprehensible data and make it available in regular reporting

Challenge 7: *Talking About Positive Impact Without Losing Credibility*

Several studies examined the question of which impact channels are available to financial market players to influence companies in the real economy in a climate-relevant way. For example, Kaiser and Oehri (2020) conclude that the two investment approaches of active ownership on the secondary market on the one hand, and impact investing, e.g. via private equity or private debt investments on the other hand, can have a social and climate-relevant impact. Other ESG investment approaches have not yet demonstrated a similarly effective and direct impact (Kaiser & Oehri, 2020).

Demonstrating the positive impact that can be achieved by implementing a pension fund's ESG investment strategy is a powerful message to communicate to beneficiaries. However, proactive impact communication also carries the risk of being suspected of greenwashing. This is the case when impact is reported where there is no direct, real impact or where it cannot be directly linked to a pension fund's activities. However, credibility is the most valuable asset of ESG reporting and must not be jeopardized.

Recommendation 7: Prudent Communication About Impact

The pension fund must critically question how and where it intends to deal with the issue of ESG. This also includes an examination of the intention pursued, because the pension fund is always operating in the area of conflicting priorities between return, risk and liquidity in order to fulfil its fiduciary duty of care.

- The credibility of ESG reporting is key. Sending the wrong message must be avoided. To date, the two investment approaches of active ownership in the secondary market and impact investing, e.g. private equity or private debt, have been scientifically described as having a direct social or climate impact

- The presentation of impact should be very deliberate and cautious, and a direct impact should only be presented where it is clearly and directly linked to the activities of a pension fund

Conclusion

Reporting on a complex subject like ESG is aimed at a very heterogeneous audience with different expertise, requirements and information needs. This is one of the biggest challenges. Knowing that the result of the elaborate report will only be read by a minority is unsatisfactory for pension funds, as the preparation of the report ties up considerable human resources. However, the pension fund needs to consider the extent to which it can support the publication of an ESG report in terms of communication and which channels to use. Reactions to the report on these channels need to be managed, which in turn requires resources. However, a pension fund deliberately operates with reduced resources to minimize the impact on the profitability of the invested assets.

The ASIP standard has three main objectives: in addition to avoiding harsh legal regulation, the pension fund should transparently demonstrate how it manages its portfolio and strategically integrates ESG. In addition, the pension fund itself should consciously and deliberately address the issue at the highest level.

One of the key messages we have found in our research in relation to active ownership is that quality is more important than quantity. Some institutions report high numbers on engagement—the question is whether it is credible that these are all effective and qualitatively relevant engagements. This is an increasingly common view among asset owners: to focus on quality rather than quantity. However, asset owners such as pension funds also have a responsibility to explicitly demand quality from their external asset managers.

In the context of ESG reporting, another aspect takes centre stage: credibility. Being perceived as a credible institution is one of the most important objectives of reporting. Stakeholders have a strong need for credible communication and transparency. At the same time, however, there is growing scepticism towards financial market players in connection with potential greenwashing. In the context of greenwashing, it is essential that the measures in place support the objectives clearly. When a coherent overall picture is created by principles, goals and measures, there is greater credibility. Communication about a positive real economic effect that a pension fund claims to have triggered by its so-called sustainable investments must be handled very carefully.

The creation of trust as a basis for credibility is promoted if a pension fund also addresses issues where it is not on target, for example, or if it explains transparently and honestly why it does not disclose a quantitative key figure in line with the comply-or-explain approach.

As legitimate as the information needs of different stakeholders may be, one aspect of the debate on ESG reporting cannot be overemphasized: the time and money invested in producing such a report—which, obviously, is often not read at all or only very superficially. A pension fund should consider what it wants to achieve with ESG reporting and what resources it wants to devote to it. The human resources tied up in preparing the report are not available to work on effective impact, i.e. by doing active engagement.

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Chapter 17
Artificial Intelligence (AI) & Decision-Making: Will AI Trustworthiness Facilitate Progress Towards Sustainability?

Marta Ottogalli and Ben Sebian

Abstract Decision-makers, from governments to the private sector, are pressured to tackle global sustainability challenges. Applications of artificial intelligence (AI) aim to help decision-makers by simplifying access to a large amount of information, addressing data gaps, improving decisions' efficiency, automating burdensome processes and more. Humans have been reluctant to adopt AI to take decisions, even when, in some cases, it has proven to outperform humans' judgement. Hence, the research aims to investigate the influencing factors that generate algorithm aversion among decision-makers during decision-making processes aimed at addressing sustainability challenges. Through a series of mixed research methods, participants including governments, the private sector and intergovernmental organisations (IGOs) took part in the preliminary research by completing a scenario-based survey and semi-structured interviews to further investigate algorithm aversion during sustainability decision-making. It must be noted that a multi-stakeholder approach is necessary to coordinate groups of stakeholders that are required to drive sustainable progress. This preliminary study showed that there is algorithm aversion and as a result: (i) Decision-makers are not willing to use AI cost-benefit analysis models that they do not understand to evaluate decisions; (ii) Decision-makers are more interested in using AI technologies that are based on factors they have helped co-design; (iii) Decision-makers are mostly interested in automating secondary tasks that can help identify the correct data and information to take a decision effectively; (iv) Decision-makers are interested in using AI that helps them identify knowledge that can directly support their decisions.

Keywords Artificial intelligence · Sustainability · Decision-making · Risk · Trust

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Introduction

Today's decision-makers, from governments to businesses, dealing with sustainability challenges, must navigate a landscape filled with volatility, uncertainty, complexity and ambiguity (VUCA). The complexity faced lies in identifying strategies to address the three planetary crises (e.g. climate change), political instability, changing policies and standards and the ever-growing amount of data (Mondejar et al., 2021) documenting existing impacts and forecasting future scenarios. The complexity is deepened by the volatility of existing data, which is ultimately required to measure the progress of sustainability strategies. In fact, existing data gaps (Bolton et al., 2021) and lack of data comparability are hindering progress towards sustainability. To enable effective global, yet localised, sustainability strategies, decision-makers are turning to AI systems to reduce the ambiguity and uncertainty of their decisions. AI systems, and the underlying algorithms, play a vital role as catalysers of data and information to enable knowledge utilisation and speedier action, which can result in quicker evidence-based decisions (Mondejar et al., 2021). However, studies have shown that humans have been reluctant to adopt AI to take decisions, even when in some cases, it has proven to outperform humans' judgement (Castelo et al., 2019).

Decision-makers have expressed contrasting opinions on the benefits and threats AI can bring. While some leaders believe that its ability to augment human intelligence will improve the human condition, others recognise it can pose a threat to humans (Duan et al., 2019). Stakeholders utilising and creating AI have the duty to proactively engage in "responsible stewardship of trustworthy AI" (The Group of Twenty [G20], 2023). However, identifying how AI systems are being designed following ethical principles can be a great challenge for most decision-makers that are in the position of steering action.

Algorithm aversion is the phenomenon by which "people often consciously or unconsciously display reluctance to rely on algorithms" (Mahmud et al., 2022). Algorithms are, along with skills, resources, data, code, models, research, know-how, training programmes, governance, processes and best practices, an essential part of the "AI knowledge", which is required to engage with AI systems across their lifecycle from their planning and design until their operationalisation and monitoring (Organisation for Economic Co-operation and Development [OECD], 2023). As part of an AI system, an algorithm is defined as a "set of steps that a computer can follow to perform a task" (Castelo et al., 2019). Algorithms have demonstrated that they can perform human tasks, that they can learn from experience, and that they can interpret human emotions (Castelo et al., 2019; Dietvorst & Bharti, 2020). Furthermore, big data technologies, by offering enhanced storage and computational capabilities, can be used to reveal trends and patterns that are not obvious to humans and that can drastically improve the speed at which AI systems process data and information (Duan et al., 2019). AI and big data systems have the potential of enabling seamless decision-making and are increasingly deployed to process complex and high-resolution environmental data (Li et al., 2021) to support decision-making towards sustainability.

The foreseen benefits have incentivised the use of AI systems to lower countries' and organisations' footprints and to create ambitious sustainability action plans. In fact, the United Nations Sustainable Development Goals (UN SDG) (2023a) reports the role innovations can play to enable progress measurement, but also warns that innovative approaches, including AI, should be carefully and ethically designed and assessed to avoid inadvertently reinforcing inequalities and exclusion, to ensure a just transition and to meet sustainability goals (Bolton et al., 2021; United Nations, 2023b; Vinuesa et al., 2020). AI tools can support this transition by making necessary data and information available to key decision-makers (Mondejar et al., 2021).

Duan et al. (2019), after having conducted an extensive literature review, called for new research propositions to address existing gaps and challenges. Investigating further the technology-human interaction can bring insights into the role that AI should have in decision-making. Further experiments are needed to identify if AI will be mostly accepted by human decision-makers as an augmentation tool or as an automation system for their decision-making processes.

This preliminary study aims to identify influencing factors of algorithm aversion and to investigate further the technology-human interaction. The research aims to identify when users of AI are likely to adopt such technology to support their decisions and when they instead show aversion to using it. The following primary research question aims to help investigate further the research problem: "Which are the influencing factors that generate algorithm aversion among decision-makers during decision-making processes aimed at addressing sustainability challenges?" Secondary research questions include:

1. Would decision-makers trust an AI cost-benefit analysis model to evaluate their decisions?
2. Should decision-makers and major groups of stakeholders co-design together risk criteria of a risk-based cost-benefit analysis to prioritise decisions effectively?
3. How much would a decision-maker automate the tasks of their decision-making process?
4. How can decision-makers convert knowledge into impactful decisions?

Literature Review

AI Cost-Benefit Analysis

The OECD (2018) highlighted the role cost-benefit analysis (CBA) has as a core tool in policy supporting decision-makers to identify the costs and benefits of an evidence-based decision. The CBA is mandated by law in many regions, and the European Union (EU) has made it an explicit requirement (European Union [EU], 2023). However, research argues that CBA results can be ambiguous, since CBA lacks the robustness to be the only decision tool (Åstrom, 2023). Mouter (2017), after having interviewed 28 politicians and 10 civil servants, found that CBA was not used to form politicians' opinions about their decision. Experts' opinions and verbal discussions may be preferred over CBAs, since politicians don't trust CBA's impartiality, they have limited explanatory power, or they are simply accessed too late in the decision-making process. Dehnhardt et al. (2022), by means of a case study and expert interviews, highlighted that CBAs can be useful tools in raising awareness and spurring systematic discussions, but decision-makers are reluctant to use them as decision criteria for prioritising measures. Although, results appeared to be similar, these studies have several limitations, since they focus on small samples in specific geographical areas. Lastly, the literature reports that decision-makers may be unwilling or unable to quantify environmental costs and benefits (Pearce, 1998; Russel & Jordan, 2007).

AI and big data technologies could automate the creation of CBA models. However, criticism around ethics and completeness of CBA (Åstrom, 2023) may worsen if CBAs are automated. The "black box problem" is an inherent issue of such models, which implies that decision-makers are less likely to trust AI technologies whose working they do not understand (Burrell, 2016; Ribeiro et al., 2016). Ensuring the correct application of explainable artificial intelligence (XAI) (Swartout & Moore, 1993) requirements can enhance the perception of risk, fairness and usefulness of AI. XAI face several challenges including a lack of people's expertise to understand explanations, contented and biased explanations, explanations that need to reflect the dynamic nature of data and decisions, and inference of algorithms among others (De Bruijn et al., 2022).

Based on the literature review Objective 1 was devised as follows: Identify criteria for creating user-friendly AI cost-benefit analysis models that empower decision-makers to effectively evaluate their decisions.

Risk-Based Cost-Benefit Analysis

Risk management is considered a potential shared tool, bridging the public and private sector spheres, to establish a common framework and drive sustainability action (Gaziulusoy et al., 2013; Zetterlund et al., 2016). The U.S. EPA (2009) established a committee of experts to provide recommendations to improve risk analysis approaches. To ensure transparency in the risk framework, a participatory design process for stakeholder involvement in the framework for risk-based decision-making was recommended. A participatory design would allow for balanced participation of stakeholders in the design stage of the risk-based framework, including impacted communities and less advantaged stakeholders. Additionally, Metcalf et al. (2021), through a comparative review, argue that to reduce the risks associated with automated decision systems and provide appropriate governance, the input of various types of expertise and affected communities is required. Similarly, Aven (2016), in the reviews of recent advances on the foundation of risk assessment and management, notes that risk assessment should be created to describe, visualise and communicate the outcome of the risk assessment to support societal decision-making involving multiple and diverse stakeholders; to account for multiple approaches to ensure the value-generating process at the societal level is well represented; and to adapt managerial reviews and judgement to account for environmental, economic and societal risks. Although risk assessment and management for the development of trustworthy AI risk-based technologies should be developed following the principles demonstrated by the U.S. EPA (2009), Metcalf et al. (2021) and Aven (2016), it is not clear to what extent these factors have been considered by decision-makers.

Based on the literature review, Objective 2 was devised as follows: Identify effective co-creation mechanisms necessary for developing AI technologies that decision-makers can trust. Specifically, evaluate the potential for decision-makers and major groups of stakeholders to collaboratively design and determine risk criteria in a risk-based cost-benefit analysis.

Automated Tasks

AI has been used in decision-making either to support human decision-makers or to replace them (Edwards et al., 2000). With the advancements in technology, a surge of fully automated AI systems (without human control and supervision) has been deployed (Złotowski et al., 2017). Moreover, several questions around complementary and partnership between human-machine to augment each other's capabilities remain unanswered.

Hoff and Bashir (2015), through a systematic literature review, noted that the degree of influence trust plays in discouraging automation misuse depends on several situational factors, including decision freedom and their ability to effectively compare automation. "Human-automation trust depends on the performance, process, or purpose of an automated system" (Hoff & Bashir, 2015; Mayer et al., cited in Hoff & Bashir, 2015, pp. 11). Moreover, Leichtmann et al. (2023), through an experiment with 410 participants, found that the group that received explanations on AI to perform a high-risk task outperformed the group that did not and showed better calibrated trust levels. Mishler and Chen (2023) proved through an experiment that trust levels of participants simulating driving an autonomous vehicle were positive before and after the test. Such approaches, however, are based on simulated experiences and limited to very specific scenarios. Results may differ in real-life situations when AI failures occur and cause harm.

Due to the enormous pressure and complexity of sustainability decisions, decision-makers face challenges in identifying solutions that can be taken efficiently, accurately, ethically, morally and fairly, and where AI and big data technologies can be adopted as the main facilitator of decision-making processes (Li et al., 2021). Ethical considerations on the challenges automation poses are needed. The benefits of AI systems automation should be measured along with risks posed by unethical use of AI, which may produce biased and discriminatory outcomes, infringe human rights and privacy, erode human self-determination and enable wrongdoing among many other challenges (Leslie, 2019; Mökander et al., 2022).

Based on the literature review, Objective 3 was devised as follows: Identify effective use of secondary tasks automation to enable decision-makers to focus on primary decision-making tasks that require human intervention.

AI and Knowledge

Although AI technologies can facilitate access to information and data, a higher volume of data does not guarantee decision correctness. Dietvorst et al. (2015) recruited thousands of participants to conduct five studies to test whether an AI model would outperform participants. They concluded that seeing an algorithm perform makes people less likely to use it even if it outperforms humans' forecasts. Users lose confidence and punish algorithms for bad decisions and inaccuracies several times more than those generated by humans. Moreover, Madhavan et al. (2016), through two experiments with around 50 participants each, supported that the simplicity of errors made by automation undermines users' trust and confidence levels. Trust decreases even more if the AI system fails to provide accurate decisions in early tasks. Similar findings were supported by Bogert et al. (2021).

Along with trust in using the information provided by algorithms, knowledge purpose (Knorr, 1977) and use (e.g. instrumental, conceptual and symbolic) (Innvær et al., 2002; Lavis et al., 2003) should be analysed. Recommender systems can predict the probability of users' preferences and aid decision-makers in knowledge retrieval and dissemination to guide action (Sandhu & Tripathy, 2018). To ensure knowledge can be converted to impactful actions by decision-makers, it is important to identify which information will be most useful when recommended to decision-makers. Understanding how recommendations provided by AI systems are adopted is necessary to identify key criteria decision-makers use to convert knowledge into action. Wang et al. (2022) systematically examined the trustworthiness of recommender systems and found that innovative systems should ensure fine-grained personalisation based on trustworthy frameworks.

Based on the literature review, Objective 4 was devised as follows: Explore which are the most relevant approaches for decision-makers to access, through AI technologies, the knowledge that is directly supporting their decision.

Methodology

A qualitative research approach was selected to answer the research questions. This was a suitable approach since it allowed gathering relevant data in a short time frame and pointing out interesting findings that could inform future research, which are discussed further below. Interviews were conducted directly with participants to learn about their 'lived experiences' with technology. AI is often perceived as a complex topic, so exemplifications were used to observe real lived experiences of participants. On many occasions, these experiences expand further, so gaining the necessary context can give the research a holistic sense, uncontaminated by existing theories (phenomenology) (Smith, 2008). The data collected through the interviews was coded, compared, categorised, and analysed to develop the results (content analysis). With the aid of levels of measurement, key questions were rapidly assessed for the semi-structured interviews that could inform the interaction with participants (descriptive statistics).

These analysis approaches were used to showcase participants' preferences when using AI systems. The validation of objectives aimed to identify participants' preferences by analysing the frequency of key themes, phrases and central tendency of survey answers.

A comprehensive explanation of the literature review is presented as the first stage of the method. Furthermore, the study guides how the stakeholders' data collected will be assessed. Predetermined stakeholder groups were devised to gain further insights on the research questions in the context of AI and decision-making in sustainability. Scenario-based surveys and semi-structured interviews will be the main mechanisms of data collection used during the research. The data was collected from November 2022 until January 2023 by means of a scenario-based survey and semi-structured interviews.

Scenario-Based Survey and Semi-structured Interviews

The study applies scenario-based interviews useful to develop research into practice (Beighton, 2021). Upon invitation, each participant provided ethical procedural material, a one-pager summary of the research and a link to a 10-minute scenario-based survey, which was followed by 30-minute individual interviews. The scenario-based surveys were adapted to the three decision-maker types.

A scenario-based survey was shared with those who responded positively and consented to take part in the study. The survey ensured participants had a clear understanding of what aspects of AI are included and how they would relate to the decision-making processes addressing sustainability issues. The four proposed scenarios illustrate how AI could influence participants' decision-making processes. In addition, they allowed understanding of participants' preferences in adopting AI during such decision-making processes. The scenario-based surveys were used as a preparatory exercise for the semi-structured interviews. Hence, participants were asked to complete the surveys before the interviews. This approach was beneficial for participants who were familiar with the decision-making processes discussed but did not have a technical background and required context on the AI-related discussions before the interview.

After the completion of the survey, the preliminary findings were used to have an open discussion with participants during the semi-structured individual interviews.

They are a qualitative tool organised around a topic guide comprised of an ordered set of broad topics (Knott et al., 2022; Newcomer et al., 2015). All interviews were kept at an individual level to ensure that the interviewees felt comfortable sharing potentially sensitive information. These interviews helped explore the influencing factors generating algorithm aversion during decision-making processes tackling sustainability issues. This was also an opportunity to make the data analysis a collective endeavour by allowing participants to make sense of data that their representative group provided and by comparing their conclusions with those of other participants. Interested participants could eventually adopt the recommendations and findings of this research in their work.

Sampling Procedure

Due to research limitations, the samples selected to take part in the research amounted to a total of 12 participants. The size of the sample was selected in accordance with phenomenological research guidance providing a range between 6 and 12 interviews (Ellis, 2016). This should be considered a "purposeful sampling" which is suitable for a small number of cases and allows for a more in-depth analysis (Onwuegbuzie & Collins, 2017; Thierbach et al., 2020). In research, purposeful sampling strategies are implemented following the similarities between three identified stakeholders' groups (governments, the private sector and intergovernmental organisations), since the intention is to compare shared views of representatives of these groups for in-depth follow-ups in the future (Palinkas et al., 2015). Participants were screened for eligibility based on several criteria. This research is both for users and non-users of AI since feedback is shared on hypothetical scenarios. Lastly, participants were selected based on their job titles and affiliation to a government or organisation (Chevalier & Buckle, 2008).

A diversified set of candidates was recruited based on their age (3 participants were less than 30 years old, 5 were between 31 and 40 years old, 2 were between 41 and 50 years old, and 2 were between 51 and 60 years old); gender (6 females and 6 males); education (3 had undergraduate education, 8 master's degrees and 1 PhD); years of work experience (4 had 1–5 years of experience, 4 had 11–20 years of experience, 2 had 21–40 years of experience, and 2 had 6–10 years of experience). Participants were recruited from developed and developing countries to ensure balanced regional representation (2 had work locations in Africa, 3 in Asia, 1 in Latin America and 6 in Europe). Additionally, the sample was selected to represent different organisations and government sizes (4 worked in organisations of 0–1000 employees, 5 worked in organisations of 1001–5000 employees, 1 worked in an organisation of 20,000–100,000 employees and 2 worked in organisations of 100,000+ employees).

Results

As described above, this study was developed with the objective of investigating influencing factors that generate algorithm aversion among decision-makers during decision-making processes aimed at addressing sustainability challenges. The following sections describe how each objective has been validated. The sampled participants were not required to be users of AI since the research was conducted using hypothetical scenarios. As part of the survey, participants were asked to express their level of familiarity with AI technologies, frequency of use and, if they were not using it, their preferred AI examples.

The results showed that 27% of the participants were familiar with AI and 65% were somewhat familiar with AI. Among the 36% of participants that are currently using it, different frequencies of use (monthly, weekly, daily and other) were provided. Lastly, many participants selected "advanced and analytics and forecasting" functionalities among their three preferred types of use of AI. This demonstrates that there is an interest in using AI to conduct improved analyses supporting decision-making.

Criteria for Creating User-Friendly AI Cost-Benefit Analysis Models (Objective 1)

Decision-makers interviewed indicated that their decisions could directly impact their teams, organisations, clients and partners (at different scale depending on their seniority, responsibilities and clients' base) and indirectly impact the population of the geographical areas they provide services in. Specifically, those representing the IGOs mostly supply advisory or data services to countries and other stakeholders. On the other hand, the private sector entities make decisions to enhance the efficiency of their organisation or of the products they serve to their clients.

"Cost of the decision" ranked as the second most important information criterion along with forecasted impacts (Fig. 17.1). However, the private sector and governments highlighted the need to have clear suggested actions to take decisions.

It was noted by participants that to use these types of technologies to inform their actions, they need to understand how AI works. However, "understanding" had slightly different meanings for each group. Most participants indicated that to trust the technology, they would need to have information on the data source and variables as well as to acknowledge the underlying calculations (Fig. 17.2). In addition, experts' opinions were valued since several participants provided examples where such opinions had been key in determining the success of their project. Lastly, experts can help validate results of both known and unknown matters (Fig. 17.2).

Due to the political nature of the information supporting sustainability decisions, decision-makers cannot simply rely on CBA suggestions. Experts' opinions can be more effective since they take into consideration the overall context and are based

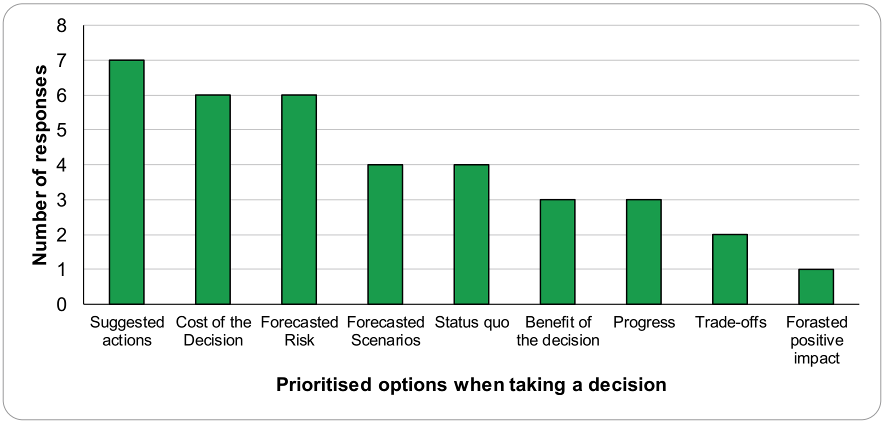

Fig. 17.1 Participants' indication of the most useful criteria in the AI dashboard cost-benefit analysis framework to feel confident of their decision

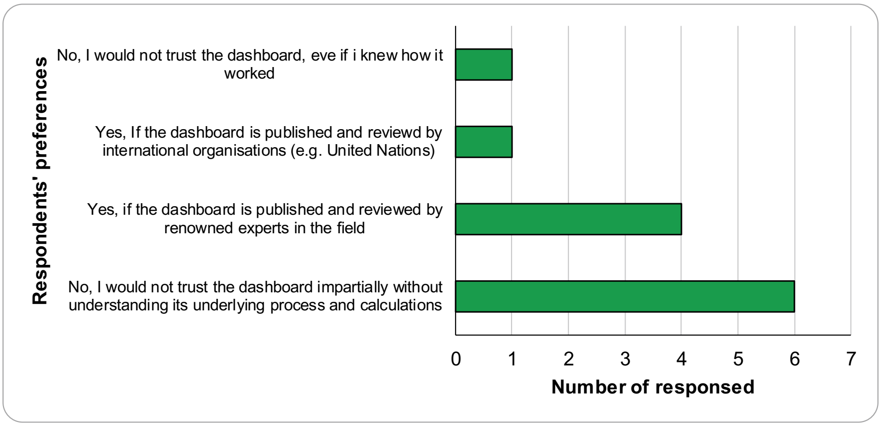

Fig. 17.2 This graph indicates what participants would do if they were unable to prove the trustworthiness of the dashboard information

on experiential knowledge. Lastly, acknowledging the data sources is as important as the data types. For example, it was noted by a participant that citizen science data alone is not often trusted by governments, which would refer to governments validated data instead (Fig. 17.3).

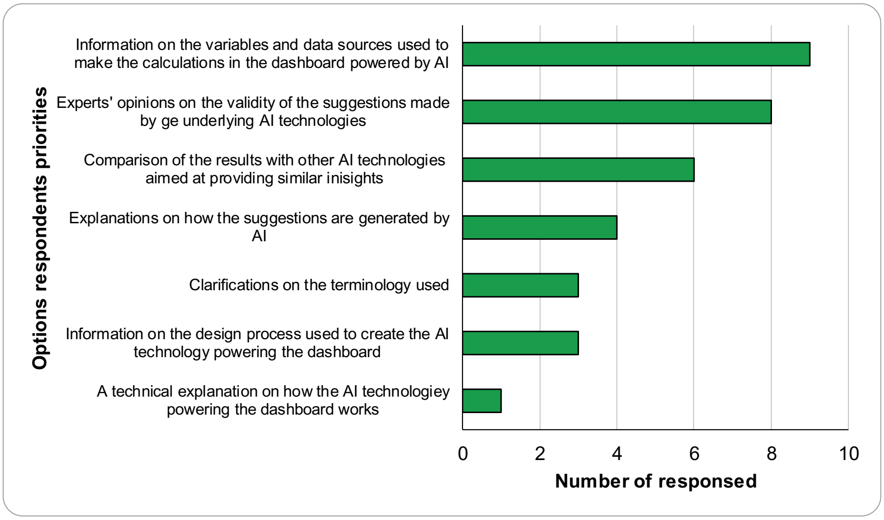

Fig. 17.3 This graph indicates that participants also selected the explanations that they found most useful to trust the AI Dashboard using the CBA framework

Effective Co-creation Mechanisms Necessary for Developing AI Technologies that Decision-Makers Can Trust (Objective 2)

Participants believed that "decisions that will have significant impacts" were the most suitable for decision-making. All IGO representatives indicated that "decisions that have significant uncertainty in their outcomes" would be the most suitable for risk assessments, as it is important for experts to assess the risks to advise on potential impacts (Fig. 17.4).

Participants also confirmed that "co-designing risk criteria" was necessary to create meaningful assessments, especially when those must be tailored to the organisations' needs. Co-designing can build trust and ownership of risk frameworks supplied by AI. However, it was highlighted that suggested risk criteria with good justifications would help simplify the decision-making process and could potentially provide a broader assessment of forecasted risks. Verifying the key sources of data is necessary to trust the suggested criteria. Unforeseen risks may not be identified prior to the decision, so it becomes essential to have complementary experiences and personalities take part in the decision-making process to create consensus around a decision. Some participants also mentioned that in their experience co-designing can enhance success rates of using a technology, so personalisation is essential (Table 17.1).

Lastly, it was suggested by participants that decision-makers in organisations with limited budget tend to trust AI since they can use it as a tool to assess their baselines. These organisations don't have the expertise to assess the technology, so predetermined criteria can simplify their decision-making processes. The higher the

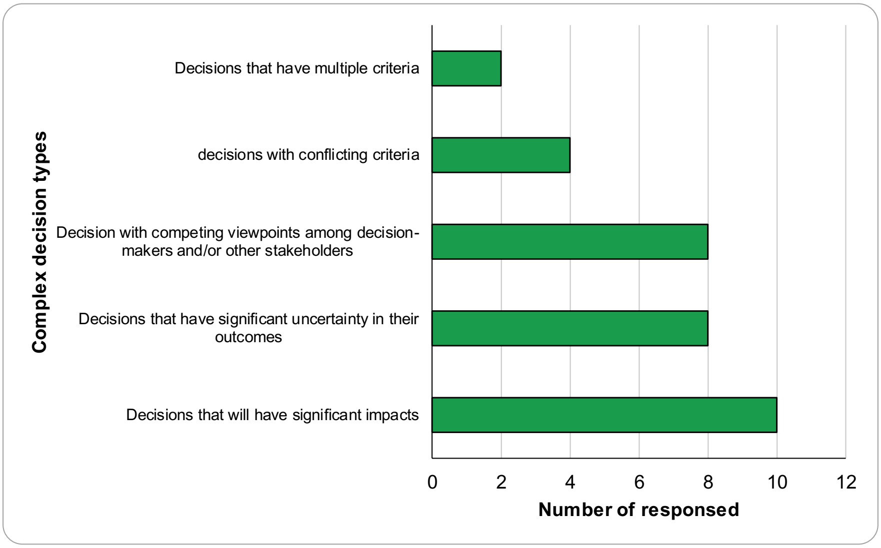

Fig. 17.4 These graphs indicate the type of complex decision that participants believed requires a risk assessment

Table 17.1 Participants highlighted which risk statements resonated most with them

Risk Approaches	Number of responses
Co-desing risk criteria with a multi-stakeholder group can improve decision effectiveness	34%
Risk assessment can help identify areas of action and enable prioritisation	31%
Sound design of a risk assessment can inform effective decision-making processes	28%
Complex risk methods may hinder effective decision-making processes	7%
None of these sentences	0%
No human intervention is required to define risk indicators as data is sufficient	0%
System generated risk assessment are sufficient ti define need actions	0%
Aknowledging consequences can condition actions	0%

level of expertise in-house, the more likely it is that the governments or organisations will have a more advanced process to select the criteria. Industry-based or international organisation standards are used as a benchmark for organisations, since they establish consensus and simplify the co-designing process.

Effective Use of Secondary Tasks Automation to Enable Decision-Makers to Focus on Primary Decision-Making Tasks that Require Human Intervention (Objective 3)

All participants found that "gathering information" was a task better suited for AI. Preparatory tasks to the decision, which includes gathering, identifying the problem and solution alternatives, and the review of the decision effectiveness should also be automated through AI (Table 17.2). Humans should focus on providing the direction, selecting the decision criteria to streamline the decision and to ensure its effectiveness (Table 17.3).

Participants were open to the idea of automation and expressed interest in the future developments of AI. However, questions around accountability and morality of the decision cannot be answered simply, and they should be addressed for humans to trust machine automation of primary and secondary tasks. A precautionary principle in using AI should apply for riskier and more impactful decisions (with greater scale and higher financial impact). On the contrary, AI can save time and resources for decisions which are considered less risky. Involving the right expertise to assess the functioning of AI is necessary. Hence, they all agree that secondary tasks can be automated, but they found it challenging to determine how the primary tasks could be fully automated.

It was suggested that automation might not happen simply at a task level but also based on the decision-making type. For example, well-known and standardised decision-making processes, for which AI automation has been tested, are more likely to be trusted since humans will be aware of what to expect from AI and would be able to evaluate the results.

Table 17.2 Participants' preference on which tasks (primary and secondary) should be machine-led

Task Type	Number Of Responses
Gather information	23%
Review the decisoin effectiveness	17%
Identify and analyse the problem/s	15%
Identify alternatives and weigh evidence	13%
Engage with and collect feedback from stakeholders	10%
Guide discussions during the selection process	6%
Implement the decision/alternative	6%
Influence decision-making outcomes	6%
Select non-negotiable objectives and decision criteria	0.02
Choose among alternatives	2%

Table 17.3 Participants' preference on which tasks (primary and secondary) should be human led

Task Type	Number Of Responses
Select non-negotiable objectives and decision criteria	17%
Guide discussion during the selection process	15%
Choose among alternatives	15%
influence decision-making outcomes	15%
Implement the decision/alternative	12%
Engage with and collect feedback from stakeholders	10%
Identify alternatives and weigh evidence	6%
Review the decision effectiveness	6%
Identify and analyse the problem/s	0.04
Gather information	0%

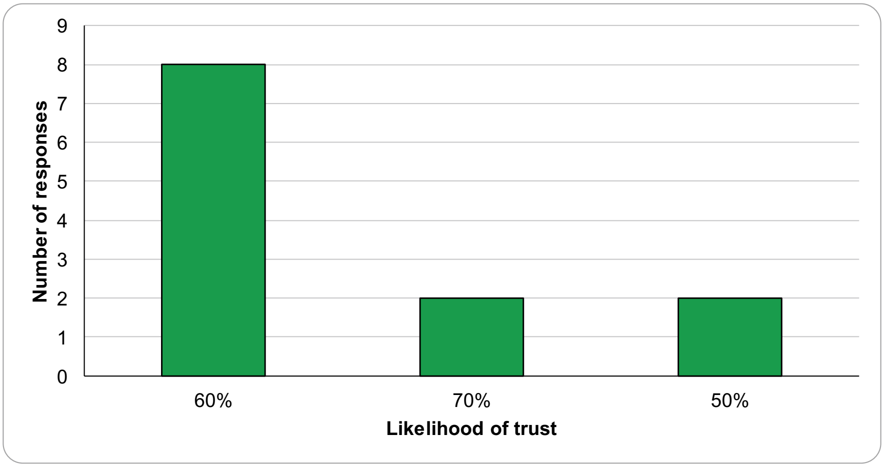

Fig. 17.5 Participants' responses on their level of trust in recommender systems

Approaches for Decision-Makers to Access, Through AI Technologies, the Knowledge that Its Directly Supporting Their Decision (Objective 4)

Eight participants stated that they would trust AI recommender systems around 60% (Fig. 17.5). They complemented their answers, clarifying that acknowledging the relevance of the results and the data source would contribute to raising the trust in the AI system.

Several participants also suggested that AI can play a role in identifying patterns unthought of to stimulate human creative decision-making. Using AI simulations and scenarios has been highlighted as an effective way to deliver knowledge. Often, understanding future patterns can influence behaviours.

The preferred knowledge that they wish to receive through such recommendations needs to be personalised to allow them to refine their criteria and to enhance the relevance of the suggestions. It should, as much as possible, guide and support the decision directly by being relatable and relevant. Preferred recommendation types include: "a list of case studies to use as benchmarks" and "a list of suggested contacts of experts and/or organisations to engage with". As in the case of the CBA AI Dashboard scenario "suggested actions", practical solutions and suggestions were mentioned repeatedly together with the need to have clear experts' opinions to validate and support the decision-making processes (Fig. 17.6).

Lastly, conciseness of knowledge and data, standardisation of information, inclusion of multi-jurisdictional requirements, and visualisation of the information are key criteria to strengthen knowledge utilisation. Exemplifications can help strengthen communication, and innovative channels of communications (e.g. avatars, data visualisations, text analysis, etc.) can make communications more related.

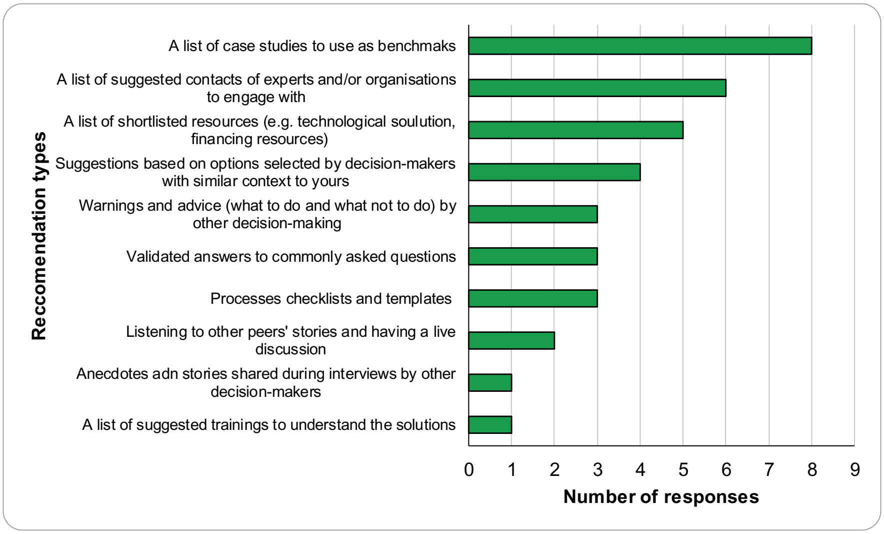

Fig. 17.6 Preference on the types of recommendations they found most useful

Discussion

To address sustainability challenges at scale decision-makers are under pressure to make informed decisions quickly (Mondejar et al., 2021). Decision-makers find that AI can help evaluate decisions, identify risks, automate secondary tasks, and access knowledge directly supporting their decisions. However, the study aims to demonstrate when decision-makers, in the context of sustainability, are willing to use AI systems. Identifying key opportunities for use of AI systems can lead to the successful implementation of sustainability strategies in a global context, while taking local differences into account. The correct use of information made accessible through AI systems can help establish a balance between local adaptation and global consistency during the implementation of multi-stakeholder sustainability strategies.

This research should be considered a preliminary study as several limitations apply. For this reason, further research opportunities are discussed in the following paragraphs. A primary limitation of the study is that the scenario-based survey results are not statistically significant since the data was collected from a small sample. However, complementary interviews have helped highlight key themes that should be further investigated to identify influencing factors generating algorithm aversion. Additionally, decision-makers selected have different roles within their organisations, so a broader sample could help understand in more details the level of use of AI based on their level of seniority and responsibilities. For example, in the interview representatives from governments selected were civil servants and advisory scientists, not politicians. The same applies to organisations were collecting data from a board member, a chief executive officer (CEO) or sustainability managers would most likely bring different results. Lastly, future samples should highlight key findings providing insights on the different use of AI between the global south and the global north, as well as based on gender criteria.

Decision-makers are not willing to use AI cost-benefit analysis models Dehnhardt et al. (2022) that they do not understand to evaluate decisions. Although several participants identified data analysis and forecasting functionalities as useful when evaluating decisions, they believed that cost-benefit analysis models are one of the models that can be used but it might not be the most effective if used alone. Understanding the underlying calculations and processes will be necessary to trust the impartiality of the algorithm. Real-life experiences and experts' opinions have proved to be effective mechanisms to complement these models in the participants' experiences.

Decision-makers aspire to employ AI technologies that incorporate risk criteria they've actively co-developed alongside essential stakeholders affected by the decisions, with the goal of optimizing decision prioritisation (Metcalf et al., 2021). Co-designing risks with other stakeholders is essential to prioritise decisions effectively since different experiences can complement the risk analysis. AI generated risk criteria can serve as useful recommendations to support the relevant stakeholders (both internal and external to the organisation or government), but they should be tailored to the stakeholders' needs to enhance their trust and use. Lastly, co-designing risk criteria strengthens ownership and accountability.

AI has been used in decision-making either to support human decision-makers or to replace them. Due to the enormous pressure and complexity of sustainability decisions AI and big data technologies can be adopted as the main facilitator of decision-making processes (Li et al., 2021). Decision-makers are mostly interested in automating secondary tasks that can help identify the correct data and information to take a decision effectively. All participants agree that AI can be effective in gathering information and most also believed that it can be useful in reviewing the decision effectiveness, and in identifying and analysing the problem. Participants were open to the idea of future innovations, where AI could lead a central role in decision-making if issues around accountability would be addresses.

Decision-makers are interested in using AI that helps them identify knowledge directly supporting their decisions. Most participants trust the recommendations system they use, and they wish to use AI to access directly applicable knowledge in the form of examples, case studies as well as simulations could help influence key stakeholders involved in the final decision (Sandhu & Tripathy, 2018).

This preliminary study is not sufficient to statistically prove algorithm aversion. Further research is needed to investigate the role of technology-human interaction in the context of sustainability. The following recommendations for future research can help strengthen the findings of this preliminary study.

Firstly, faster, and evidence-based decisions can only be achieved if decision-makers can trust the AI systems they are using to take speedier action. Decision-makers might not be aware of when and how to best use AI to support or automate their work. Therefore, it is essential to identify, which are the "trust criteria" they would rely on to assess whether they can effectively trust or not AI systems. Identifying a set of shared "trust criteria" could help guide those who wish to validate the trustworthiness of AI before using it. Additionally, further investigating the role of co-designing AI systems plays in developing trustworthy systems will strengthen future research findings. It is to be noted that existing studies assessing AI trust levels and AI automation are using very specific tests that don't always replicate in complex and highly politicised scenarios, where an active role in influencing the decision is required. This makes the generalisability of this research on these interconnected issues hard to replicate. There, a multi-stakeholder approach must be considered to fully understand the applicability of businesses strategies in ever-evolving policy frameworks. Future studies should further examine the application of AI and trust levels in these complex scenarios.

Secondly, if we cannot compare sustainability strategies, and their impact, we will not be able to know if any progress was ever made. Comparing actions adopted by different decision-makers is key to identify progress in addressing sustainability challenges. When decision-makers speak about "impact" of a decision they often refer to underlying criteria that can help define how to measure such impact. The impact of a decision was indicated as an important rationale along with "risk" to define whether AI could help automate the decision-making process. Hence, understanding how different impact criteria compare can help shed light on existing sustainability processes that should be re-designed to support more impactful multi-stakeholder action. As mentioned in this research decision-makers will be more reluctant to use AI for highly impactful decisions, so it would be important to determine in which circumstances they would be willing to use AI.

Thirdly, with a growing number of AI systems applied to sustainability, it is essential to understand the most effective use of such technologies. Assessing automation effectiveness and efficiency tailored for sustainability challenges by mapping successful use of AI within this context. Future research should aim to analyse through a systematic review and compare a broad sample of human-led, machine-led, and mixed processes to define which criteria should be adopted to evaluate the "effectiveness" and "efficiency" of a decision-making process supporting sustainable development. Additionally, understanding what future implications of human-machine interactions is key.

Lastly, compliance with ever evolving policy framework globally and locally must be simplified to facilitate sustainable business growth. Analysing the relationship between compliance and risk. Understanding if AI can play a role in influencing proactive compliance behaviour is an essential element to analyse to what extent AI technologies can influence use of trustworthy AI during decision-making. Risk and compliance requirements can influence decision-makers in different ways, so assessing whether this leads to proactive or reactive behaviours is necessary to drive effective sustainability action plans.

Conclusion

To conclude, businesses face challenges adopting AI systems effectively to devise and implement sustainable business management strategies. However, such strategies should be aligned with government strategies aimed at establishing both global and local policy frameworks following a multi-stakeholder approach. AI systems can play a role in supporting coordinated and evidence-based strategies that can reduce complexity and enable predictability and ultimately support action for sustainable growth. To this end, emphasis should be placed on the creation of tailored guidance for decision-makers to better understand AI functionalities that can be applied within the context of action aimed at achieving sustainable development.

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Part V
Education for Economic and Sustainable Development

Chapter 18
Interdisciplinary, Practice- and Project-Oriented Sustainable Business Education in a Swiss University of Applied Sciences and Arts

Stefanie Flotho, Craig Thorrold, and Andrea Ochsner

Abstract Business students are highly motivated to apply entrepreneurial principles to deal with real-world problems. However, tertiary business education continues to emphasize theory over practice and abstract models over real-life problem-solving. Two related courses in the internationally-oriented IBM bachelor degree programme of the School of Business of the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) seek to provide a student-driven, project-oriented, international and interdisciplinary learning experience that extends beyond the conventional lecture format.

The first course focuses on evaluating real-world examples of sustainability in economics. It thereby provides a framework for understanding sustainability challenges in the broader economic sphere and for identifying sustainability opportunities in the business world. The second course focuses on presentation skills in English through the preparation of an entry for the Swiss Sustainability Challenge. The aim of the course is to teach communication skills through a motivating entrepreneurial project in which students can apply the knowledge gained in the course on sustainable economics.

Together the courses aim to promote independent project creation amongst students in an international context. The objective is to inspire entrepreneurial thinking, foster innovation and provide both intellectual and skills-based tools for leading and implementing the transformation across national borders towards a sustainable economy.

Keywords Sustainable economics · Interdisciplinary teaching · Project-based learning · Experiential and constructivist learning · Swiss sustainability challenge · Intercultural collaboration

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Introduction

As we navigate the challenges of the twenty-first century, the need for sustainability teaching in higher education has never been more apparent. The problems posed by global environmental change, social inequities and economic instability call for a transformative approach to education, one that not only imparts theoretical knowledge but also actively engages students in real-world sustainability practices that are embedded in international contexts. The United Nations Sustainable Development Goals (SDGs), particularly Goal 4, highlight the crucial role of universities in advancing sustainability on a global scale. Tertiary educational institutions are expected to incorporate sustainability principles into their curricula, equipping students, researchers and the wider academic community with a holistic understanding of environmental management, social responsibility and ethical practices (United Nations, 2025; Martínez-Bravo et al., 2024).

Universities of Applied Sciences are especially well positioned to serve as incubators for sustainable business practices, as they are able to integrate practical sustainability activities into their curricula. This integration requires didactic approaches that complement traditional lecture-based teaching with experiential learning, problem-solving tasks, communication training and critical thinking that challenges, where appropriate, prevailing norms and conventions (Kalamas Hedden et al., 2017). The very nature of sustainability as a contested, multi-layered and multifaceted subject offers substantial opportunities for critical thinking and transformative learning (UNESCO, 2014; Scarff Seatter & Ceulemans, 2017). Furthermore, the multifaceted and complex nature of sustainable development at various levels demands a multidisciplinary and international approach (UNESCO, 2014). The overarching objective of sustainability teaching in higher education is thus to empower students to recognize and comprehend the intricacies of sustainability issues, to critically evaluate assumptions, biases, beliefs and attitudes, and to proactively engage in the resolution of sustainability challenges. This chapter describes various didactic strategies for sustainability education within two modules that will be taught in Semester 6 of the new curriculum of the International Business Management bachelor degree programme at the School of Business of the University of Applied Sciences and Arts Northwestern Switzerland (FHNW). Its aim is to highlight the benefits of these approaches and to discuss the challenges and considerations that arise in implementing practical sustainability activities in higher education courses.

The Need for Active and Constructivist Approaches to Sustainability in Higher Education

There is a growing consensus on key competencies in sustainability learning in higher education institutions (Wiek et al., 2014; Annan-Diab & Molinari, 2017; Mulà et al., 2017; Willamo et al., 2018; Horn et al., 2023). These include systems-thinking, futures-thinking, values-thinking, strategic-thinking and interpersonal competencies (Brundiers et al., 2021; Redman et al., 2021). Educators and researchers advocate effective and efficient pedagogical approaches based on active learning methodologies to develop these competencies (Martínez-Casanovas et al., 2022). Furthermore, the ability to adapt to different situations and solve problems in diverse contexts is considered a key predictor of future success in sustainability-related fields (King, 1993). As future decision-makers, problem-solvers and agents of change, students greatly benefit from sustainability education that is rooted in active learning and a constructivist approach.

King (1993) defines active learning as actively engaging with presented information—analysing, synthesizing and evaluating it; rather than passively receiving and memorizing it. Following Kalamas Hedden et al. (2017) we argue that active learning is particularly well suited for teaching sustainability in higher education, as it is inherently practice-oriented and experiential. Similarly, the application of constructivism in sustainability education requires a hands-on, experiential learning approach, enabling students to actively engage with real-world sustainability challenges. By interacting with complex sustainability issues, students develop a deeper and more comprehensive understanding of the subject while enhancing their problem-solving and critical-thinking skills (Kalamas Hedden et al. 2017; Willamo et al., 2018).

Unlike traditional learning theories, constructivism emphasizes active student involvement in the learning process, where knowledge is continuously constructed and reconstructed based on prior experiences. In this model, educators act as facilitators, guiding students to explore concepts, engage in discussions and solve authentic problems (Ozkal et al., 2009). Constructivist teaching fosters critical thinking by encouraging students to question existing knowledge, integrate new information and develop fresh perspectives (Taylor et al., 1997). Given the complexities of sustainability, passive learning through lectures or textbooks alone is insufficient — active participation is essential for meaningful learning (Scarff Seatter, 2003).

Specific Didactic Frameworks

The process of embedding sustainability into higher education thus requires pedagogical frameworks that promote active learning and student engagement. Several specific didactic approaches lend themselves to these objectives, and these are described below.

Project-Based Learning

Project-based learning is one of the most effective didactic methods for integrating practical sustainability activities. In PBL, students work on short- or long-term projects that address real-life sustainability challenges. This method encourages learners to conduct research, collaborate in teams and apply theoretical knowledge to design solutions (Ferry, 2022). For example, a course on environmental management might include a semester-long project where students analyse local water quality issues. By working in groups to collect data, engage with community stakeholders and propose improvements, students gain first-hand experience in environmental monitoring and policymaking. This not only reinforces theoretical concepts but also trains skills such as problem-solving, project management and communication.

Experiential Learning

Experiential learning emphasizes learning through direct experience. This approach often involves field trips, internships or simulations that allow students to immerse themselves in sustainability practices. Experiential learning enables students to reflect on their experiences, drawing connections between classroom theory and real-world applications (Kolb, 1984; Adib, 2024). For example, a course on urban sustainability might incorporate a field study component where students visit green infrastructure projects such as urban gardens, renewable energy installations or green rooftops. These visits can be complemented by reflection sessions and discussions that help students to situate their experiences within broader sustainability frameworks. The iterative cycle of doing, reflecting and conceptualizing is central to experiential learning and helps develop lifelong learning skills.

Service Learning

Service learning combines community service with academic study, creating opportunities for students to address community-identified sustainability needs while gaining practical experience. This approach benefits both the students and communities they serve by fostering a sense of civic responsibility and mutual learning. In a service-learning model, students might partner with local government agencies or non-profit organizations to implement sustainability projects such as developing community recycling programmes or energy conservation campaigns. The integration of service learning into curricula provides a dual benefit: students learn about sustainability from an academic perspective while directly contributing to community well-being (Calvert, 2011; Rodríguez-Zurita et al., 2024).

Interdisciplinary Teaching and Collaborative Learning

Sustainability challenges are inherently complex, often requiring insights from multiple disciplines. An interdisciplinary didactic approach encourages students to engage with concepts across various fields. Courses designed with an interdisciplinary focus often involve co-teaching by faculty from different departments, ensuring that students gain a comprehensive understanding of sustainability (Cortese, 2003). Collaborative learning, wherein students work in diverse teams, encourages the exchange of ideas and perspectives that are crucial for addressing sustainability issues. Such approaches help students appreciate the interconnectedness of ecological, economic and social dimensions of sustainability (Barth & Rieckmann, 2012). For example, a project that examines sustainable urban development might involve students from architecture, environmental science, business and design who work together to propose a development plan that balances economic growth with ecological preservation.

Problem-Based Learning

Problem-based learning revolves around the investigation of complex, real-world problems. In this model, students are presented with a sustainability-related issue that lacks a straightforward solution. Through guided inquiry, students identify the problem's underlying factors, research possible interventions and propose solutions. This approach not only develops analytical and research skills but also promotes creative thinking. By grappling with open-ended problems, students learn to navigate uncertainty—a critical skill in sustainability management. Problem-based learning sessions often culminate in presentations or written reports, providing opportunities for students to articulate their findings and receive feedback from peers and instructors (de la Fuente, 2022). Furthermore, such participatory processes help students critically self-evaluate their learning experiences regarding sustainability, which promotes reflective practice (Curtis et al., 2021).

Challenges and Strategies for Effective Implementation

The integration of practical sustainability activities into higher education thus provides significant benefits, but it also presents challenges. One common issue is the potential lack of alignment between traditional assessment methods and practical learning outcomes. Standardized exams may not effectively measure competencies such as critical thinking, collaboration or real-world problem-solving. Institutions need to adopt alternative assessment strategies such as reflective journals, project reports and peer evaluations to better reflect the breadth of student learning (Redman et al., 2021). In addition, these innovative teaching approaches must be continuously aligned with evolving industry standards and accreditation criteria through dialogue between academia and industry stakeholders.

Another challenge is the requirement for faculty development. Many instructors may be accustomed to traditional lecture-based teaching and might need additional training to design and facilitate experiential and interdisciplinary learning experiences. Some lecturers might also perceive sustainability as an add-on rather than an integral part of education. Professional development programmes that focus on sustainable education practices can help instructors acquire the necessary mind-sets, skills and pedagogical strategies. Faculty collaboration, supported by institutional policies that reward innovative teaching, is central to overcoming this barrier (Barth & Rieckmann, 2012).

Resource constraints can also hinder the implementation of practical sustainability activities. Field trips, laboratory experiments and community projects often require financial investment and logistical coordination. Institutions may consider partnering with local organizations, securing grants or utilizing community resources to offset these costs. The development of virtual simulations and online platforms is another strategy that can extend the reach of experiential learning without incurring prohibitive expenses.

With regard to the challenges presented and faced by students themselves, it should first of all be noted that students, like instructors, may perceive sustainability as a minor element of their study programme, rather than an integral part of their educational experience. It is thus essential to communicate the relevance of sustainability across disciplines and to demonstrate how practical sustainability activities enhance academic learning and future career prospects. Embedding sustainability themes into course objectives, learning outcomes and assessment criteria can help ensure that sustainability is viewed as a core component of the educational experience (Cortese, 2003). In the context of PBL, Bell (2010) discusses how students' prior knowledge and motivation as well as group dynamics can influence learning outcomes. He proposes that additional support may be necessary to ensure equitable progress among all students, and his recommendations are even apposite in the context of courses with international participants. Furthermore, Helle et al. (2006) posit that the efficacy of project-based initiatives depends on factors such as effective teacher facilitation and structured guidance. If these elements are not in place, some students may not develop the intended competencies at the same rate as their peers. To address these variations, the implementation of effective assessment and support strategies is imperative.

Assessment and Evaluation of Sustainability Education

While active learning methods engage students, they frequently fall short in providing a comprehensive framework for evaluating long-term learning outcomes compared with traditional assessment methods. Conventional assessment methodologies are inadequate in capturing the profound and enduring learning that occurs in active learning environments (Hattie, 2008). Hattie additionally notes that while conventional examinations can effectively assess short-term knowledge, they frequently fall short in terms of evaluating long-term skill development.

Assessing the impact of practical sustainability activities requires a shift from traditional testing methods to more dynamic and formative assessment techniques.

Reflective practices, such as learning journals and portfolios, allow students to critically evaluate their experiences and the development of their sustainability competencies. These tools provide insight into how students integrate theory and practice and can serve as valuable artefacts for both self-assessment and instructor evaluation. Moreover, formative assessments during a project can offer immediate feedback, allowing students to adjust their approaches during the course. Peer reviews, self-assessments and iterative project presentations are additional methods that support continuous learning and improvement. By fostering a culture of reflection and feedback, teachers can ensure that the experiential aspects of sustainability education translate into meaningful, long-term learning outcomes (Redman et al., 2021).

The Two Sustainability Education Modules at the FHNW

The viability of implementing these innovative methodologies in larger groups or in under-resourced settings remains to be determined. This leads to concerns about their long-term sustainability and potential for broader implementation. It is therefore necessary that pilot programmes in sustainability education be initiated with subsequent modifications made as necessary. The following paragraphs describe the didactic approach of the two modules in Semester 6 of the IBM curriculum with this aim. It should also be noted at the outset that both courses are taught in English. The use of English as a language of instruction reinforces the international dimension of the courses, firstly in the widened scope of the case studies and academic literature, and secondly because it allows the participation in the courses of not only the trinational student body in the IBM programme (French, German and Swiss) but also exchange students from the FHNW's partner universities.

Module Sustainable Economics

The module 'Sustainable Economics' is designed to equip students with both the theoretical foundations and practical tools necessary for assessing environmental policies and developing sustainable business strategies. This interdisciplinary approach blends theory with real-world applications, allowing students to engage actively with the content and apply what they have learned through case studies and practical exercises. By using active learning strategies such as problem-based learning and project-based learning, the module not only shares knowledge but also helps to develop key skills in critical thinking and team work.

The course will cover a variety of sustainability-related topics, including economic concepts such as externalities and market failure, while emphasizing the importance of environmental policy-evaluation tools. Throughout the lectures, students will also explore international case studies, with a particular focus on the DACH region (Germany, Austria and Switzerland) and France. Students meet in total seven times during the semester on a weekly basis. A lecture lasts approximately three hours.

The first lecture begins with an overview of sustainability theory based on the three-pillars model of the Brundtland Report (Brundtland, 1987). Following this students are introduced to sustainable economics, highlighting its importance and relevance in the contemporary world. It also provides an overview of essential economic concepts such as externalities and market failure, explaining why they necessitate regulatory intervention (Harris & Roach, 2018). Students are then introduced to a policy assessment toolkit, which includes evaluation methods such as cost–benefit analysis, lifecycle assessments and ecological footprints. To anchor these concepts in practice, students will perform a simple cost–benefit analysis of a hypothetical environmental policy, such as the implementation of a carbon tax. A combination of interactive lectures and case studies is utilized to demonstrate the application of teaching methods in addressing real-world sustainability challenges. This approach ensures that students acquire a comprehensive understanding of the theoretical principles and also observe their practical implementation. However, a drawback of conventional lectures is their potential to lose the attention of students, which highlights the need for other, more active learning activities.

In the second lecture, students will dive deeper into environmental regulation and policy evaluation. They will learn about various environmental protection instruments, such as emissions trading systems, carbon taxes and environmental certificates, and how these tools can address market failures and externalities. Students will apply these concepts to real-world examples, assessing the effectiveness of carbon pricing models within the European Union and evaluating the implementation of a carbon tax. This practical application allows students to better understand the challenges and opportunities of different regulatory tools. The analysis of real-world examples together with comparative analyses helps students to understand the strengths and weaknesses of both traditional and contemporary assessment methods. However, as with all experiential learning approaches, it is necessary to provide close supervision in order to ensure that knowledge and skills are acquired in a consistent and uniform way.

The third lecture focuses on the principles of doughnut economics (Raworth, 2017) and in particular the circular economy, a model that contrasts with the traditional linear economy. Students will explore the key principles of circular economy, such as design for longevity, reuse, recycling and the Cradle-to-Cradle concept. The lecture will discuss the potential benefits and challenges of implementing a circular economy, emphasizing the role it plays in sustainable business practices. To further engage with these concepts, students will analyse a product and explore how it could be integrated into a circular economy, identifying the steps necessary to reduce waste and enhance resource reuse. They will also work in groups to brainstorm ideas on how a fictional company could transition to a circular business model. These interactive group exercises and product analysis tasks are integrated to stimulate creative problem-solving while addressing sustainability. The advantage is that such methods encourage innovative thinking; the downside is that group dynamics can sometimes hinder balanced participation, which once again calls for sensitive supervision of the exercises by the lecturer.

In the fourth lecture, students will apply their knowledge to case studies from the DACH region and France, examining how these countries are tackling sustainability challenges. This comparative analysis will cover policies and strategies in Germany, Austria, Switzerland and France, focusing on issues such as CO_2 reduction, sustainable agriculture and circular economy practices. For example, students will evaluate Germany's 'Energiewende' (energy transition) and its role in promoting renewable energy, as well as analyse France's 'Anti-Waste' law and its impact on the circular economy. In group work, students will choose a country from the DACH region or France and propose improvements to the sustainability strategies in place. This session highlights the advantages of comparative case studies, while noting that regional differences may complicate direct comparisons.

The fifth lecture shifts focus to the political economy of sustainability, exploring how environmental policy decisions are made in political and economic contexts. Students will implement and analyse the UN Climate Change Conference simulation game developed by Climate Interactive (Climate Interactive, 2025). In an interactive role-playing exercise, students will take on various roles such as policymakers, business leaders, NGOs and citizens to develop a sustainable energy policy, reflecting on the challenges of balancing diverse interests. The aim of the simulation game is to raise students' awareness of the importance of business ethics and sustainability. By actively participating in this realistic simulation of the UN climate negotiations, students learn about the complex interrelationships and challenges of global climate policy from different perspectives. Students will study the role of stakeholders in these decisions and examine the intersection of political power, economic interests and environmental goals. They will also learn to differentiate between positive and normative analysis in policy debates. The use of simulations demonstrates how experiential learning methods can foster a deep understanding of complex global issues. The advantage of such role-playing exercises is that they boost engagement and empathy. However, they can oversimplify real-world complexities, and it is therefore important that the lecturer points out this limitation in advance.

The sixth lecture takes a practical approach by providing students with an opportunity to develop their own policy proposals for sustainable environmental practices. Building on the tools and concepts learned so far, students will create a sustainable environmental policy for a company or city and assess its potential impact using the evaluation methods covered in the course. They will then present their proposals to the class, receiving feedback and refining their strategies in the process. This practical session thus combines theoretical knowledge with hands-on application.

The final lecture of the series focuses on the future of sustainable economics and the strategies necessary for transitioning towards a more sustainable economy. Students will reflect on the trends, challenges and opportunities that lie ahead, exploring how countries and companies can shift from a linear to a circular economy. They will consider the role of innovation in driving this transition and discuss the political and economic measures that must be implemented on a global scale to foster sustainability. In their final project, students will design a transition strategy for a company or city to adopt circular economy practices and other sustainable solutions.

Teaching methods such as case studies, group projects, simulations and reflective exercises, when combined, provide a varied approach to sustainability education. These methods make learning more interesting and useful, but also present challenges in terms of comparing how well students learn in different ways and ensuring that all students reach the desired learning outcome.

Throughout the lecture series, active learning is emphasized, with students engaging in hands-on activities that allow them to apply theoretical concepts to real-world scenarios. Case studies from international contexts, particularly the DACH region and France, provide a rich basis for comparative analysis, while group work and discussions foster collaboration and critical thinking. The course encourages independent work, with students taking responsibility for tasks such as developing policy recommendations or analysing products. This approach ensures that students not only acquire theoretical knowledge in sustainable economics but also gain the practical skills necessary to assess and implement sustainable strategies in their future careers.

Module English as a Foreign Language

In the IBM programme, the English course that will be taught in the sixth and final semester of the programme has been relocated from the second semester, where it successfully ran for several years. It functions as a curricular context for practical sustainability education. The location of sustainability education in the foreign languages section of the curriculum might seem an unusual choice, especially as German and French, rather than English, are the main languages of the trinational region in which the degree programme is located, but it has several benefits. Firstly, the English course is not restricted to any specific subject area in terms of its content. The course focuses on the extension of grammatico-lexical competence and the acquisition of specific communication skills, but these goals can be connected with any number of content areas, including sustainability. Secondly, didactic approaches in foreign language learning have for many years been influenced by practical frameworks such as Project- and Problem-Based Learning, interdisciplinary teaching (e.g. in languages across the curriculum models) and experiential leaning (e.g. immersive language learning). Foreign language teachers thus tend already to possess the didactic skills required for practical sustainability education, and they often have access to networks of colleagues with specific expertise in the various subject areas connected with sustainability education. Finally, the incorporation of a sustainability project in the English course valorizes the course itself, by bringing it closely into line with the sustainability values upon which the IBM programme is built.

The specifics of the course are as follows. Students are divided into groups and are given the task to prepare an entry for the Swiss Sustainability Challenge (SSC). The SSC, formerly the Swiss Student Sustainability Challenge, is a competition that was founded by the FHNW and is conducted every year in partnership with the PAX Life Insurance company. The competition is designed for start-ups in the areas of environmental and social sustainability, and it offers prizes with a total value of CHF 20,000. The SSC runs every year from the end of May, which is the application deadline, until the end of October, when the winners of the competition are announced in an awards ceremony (Swiss Sustainability Challenge, 2025). Its timeline is therefore best suited to a course in the Spring Semester, which in the IBM programme typically runs until the end of May. At the end of the course, the students are assessed by means of a group presentation in which they communicate their concept to the rest of the class and a learning journal in which they record the intellectual, social and emotional journey that the project takes them on.

Students are therefore required to develop a sustainable business concept that could be entered into the SSC. However, it is not possible to make the submission of the project to the competition a compulsory element of the English course, firstly because external criteria cannot be used to assess the course and secondly because IBM students are required to conduct an internship after the sixth semester that includes a project about which they will write their Bachelor Thesis. This internship thus clashes with the later stages of the SSC. In other words, there is unfortunately, at the present time, a structural disincentive to actually participate in the competition, and this is a weakness that hopefully will be addressed in the future, for example, by making the criteria for the Bachelor Thesis project flexible enough to include a start-up project of the type that is eligible for the SSC.

In spite of these constraints, the SSC provides an excellent framework for practical sustainability education. The competition requires students to identify a real-life problem or challenge in the area of sustainability that is susceptible to an entrepreneurial solution and to develop a solution to the problem that apply the various intellectual, communicative and practical didactic approaches described above. The specific applications of these approaches in the English course are as follows.

Firstly, during the course, students are given coaching sessions by the course lecturer. They are also encouraged to contact experts in the field of their project, both inside and outside the university, in order to gain additional input. This interdisciplinary and collaborative learning environment promotes critical reflection and practical initiative-taking.

Secondly, students are required to conduct research on their topic, in order to gain a deep understanding of its various elements. In this context, students are encouraged to apply the knowledge of macroeconomic sustainability concepts acquired in the partner course in the same semester in order to reflect on the way in which business and macroeconomics intersect, and especially to situate their project inside larger models of sustainable economic activity. This is especially important in order to avoid the all too common blinkered, bolt-on view of sustainable business, in which a sustainability initiative might make a positive difference in the narrow context of a company's processes or operations, or of a specific product, but which is not aligned with broader imperatives with regard to the transformation of business models and social mindsets.

With regard to the search for existing solutions to the problem, students take advantage of the multinational and multilingual character of their groups. As noted above, student groups in IBM include at least Swiss, French and German students, with the additional possibility of incoming exchange students from the international partner schools of the FHNW. The search for already existing solutions to the problem therefore brings a high degree of internationalization to the project. Furthermore, if students discover that a solution to their specific problem already exists, they are not forced to choose another problem but are rather encouraged to adapt the solution that they have found to the specific local cultural and institutional circumstances, whether French, Swiss or German, in which their project is embedded.

The third and fourth didactic approach that is realized in the course are those of Project- and Problem-Based Learning. Through their engagement with a problem-based project, students practise research and critical thinking skills, as noted above with regard to interdisciplinary teaching and collaborative learning, and are also forced to think creatively, to communicate effectively within their groups and to ensure timely completion of tasks.

Finally, and perhaps most importantly, the project provides students with a holistic experiential learning environment in which the challenges and rewards of sustainable business become not only intellectually but also socially and emotionally tangible. It should be recalled, however, that this experiential process is very difficult to extend within the current structure of the degree programme to the professional and entrepreneurial reality of an actual entry in the Swiss Sustainability Competition. This weakness should be addressed as a matter of priority in the continuing development of the English course.

Conclusion

The SSC project in the IBM English module thus provides an ideal complement to the more theoretical and more general insights into the interface between economics and sustainability that are offered by the partner module Sustainable Economics. Taken together, they offer a learning journey at the end of the IBM degree programme that will hopefully act as an impetus for students' development into the business leaders that we urgently need to navigate the profound economic and social transformation that lies before us.

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Chapter 19
Collaboration Between Universities and SMEs for Value Co-Creation in Business Model Innovation for Sustainability

Michael von Kutzschenbach, Ananda Wyss, Maya Hoveskog, Joakim Tell, and Fatima Khitous

Abstract True value co-creation initiatives on Business Model Innovation for Sustainability (BMIfS) are essential for universities and Small to Medium Enterprises (SMEs) for addressing the challenges created by the wicked problem of sustainability. Currently, however, such inter-organizational collaboration initiatives are understudied. This article, which examines two inter-organizational collaboration initiatives involving two universities and two SMEs that were engaged in true value co-creation in BMIfS, makes a two-fold contribution. The article unravels the opportunities and risks associated with two true value co-creation BMIfS initiatives (between university students and SME managers) and proposes a set of key

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principles underpinning the success of inter-organizational collaboration for true value co-creation in BMIfS.

Keywords Business Model Innovation for Sustainability · Inter-organizational collaboration · Value co-creation · University · SMEs · 7C principles

Introduction

The many social and economic issues confronting companies today, such as climate change, social inequality, and digitalization, present both opportunities and risks (Kohn Rådberg et al., 2020; Sharma et al., 2022). Managing these opportunities and risks requires re-thinking the business-as-usual, profit normative logic and instead focusing on innovation and sustainability (Snihur & Bocken, 2022; Upward & Jones, 2015; von Kutzschenbach et al., 2023).

Re-thinking traditional education and business practices can have enormous significance for the transition toward sustainability and systemic change in business and in academia. To be successful, inter-organizational collaboration, such as true value co-creation in Business Model Innovation for Sustainability (BMIfS), is a key requirement. Based on Ehrenfeld and his concept of "true sustainability" (2008), true value co-creation is seen as a process that benefits the entire system. Kohn Rådberg et al. (2020, p. 24), for example, emphasize the important role students can play in "open collaboration for the purpose of creating, elaborating, and prototyping radical solutions to open-ended systemic challenges."

Academia should equip students with the skills needed to navigate the VUCA (volatile, uncertain, complex, and ambiguous) world. On the one hand, academia should focus on the expansion of curricular content to reflect the interconnected and systemic nature of socio-technical and economic developments and to introduce students to the complex concept of BMIfS (e.g., Geissdoerfer et al., 2018) and "real-world" situations where they can exercise a high degree of autonomy, and in co-creation with Small to Medium Sized Enterprises (SMEs).

Traditionally, the role of universities has been to educate the future workforce and to create new knowledge. However, in inter-organizational collaboration for true value co-creation in BMIfS, their role shifts to capacity building for the entire ecosystem (Lundberg & Öberg, 2021).

Likewise, the business community needs to understand how management routines must transform to leverage diverse stakeholders' learning capabilities to engage in true value co-creation in BMIfS (von Kutzschenbach & Brønn, 2010; von Kutzschenbach & Daub, 2021). Complex and systemic changes require new approaches and managerial mindsets (Perna et al., 2022). Given the nature of sustainability, which is dynamic, complex, and impacts diverse stakeholders, it can be classified as a "wicked problem" (Rittel & Weber, 1973; Brønn & Brønn, 2018). This process, which requires changes in current innovation practices, may reveal organizational and cognitive barriers (Chesbrough, 2010). The process also requires the inclusion and critical discussion of broader stakeholder perspectives acquired in value co-creation, thereby inter-organizational collaboration.

For this article, we build on the Service Dominant Logic (SDL) as described by Vargo et al. (2017), and Vargo and Lusch (2008, 2016). While critics admit that the SDL acknowledges that value co-creation occurs in systems, it lacks principles for inter-organizational collaboration that supports true co-creation. Moreover, most co-creation literature focuses on traditional actors (e.g., collaboration among companies), thus overlooking other important stakeholders in the system (e.g., students and society). To address these research gaps, we examine the use of SDL in a new context, here universities and SMEs, thereby responding to recent calls to study value co-creation with other stakeholders (cf. Thomas & Ambrosini, 2021).

True value co-creation in BMIfS is important because it provides an opportunity for the expression of less traditional insights and opinions than are typically voiced in the innovation process (Vargo & Lusch, 2008, 2016). However, value co-creation in BMIfS currently focuses more on how single organizations create value and less on the systemic nature of BMIfS, the "true" value (Fehrer et al., 2020; Geissdoerfer et al., 2018).

In other words, BMIfS requires companies to engage inter-organizational collaboration to co-create value that addresses these challenges (Rill, 2016; Fehrer & Wieland, 2021). However, several difficulties arise that question the effectiveness of inter-organizational collaboration for true value co-creation in BMIfS initiatives.

The use of the adjective "true" to characterize value co-creation has inspired researchers to emphasize its aspirational vision. True value co-creation, building on the concept of "true sustainability" from Ehrenfeld (2008), is seen as a process that benefits the entire system. Therefore, our research question is the following: *How can inter-organizational collaboration between universities and SMEs be supported in true value co-creation in Business Model Innovation for Sustainability in ways that have systemic implications?*

We begin by reviewing the literature on BMIfS and value co-creation. We then describe the opportunities and risks in true value co-creation in BMIfS. We next describe insights gained from two true value co-creation initiatives that were conducted in 2021 and 2022. These inter-organizational collaborations took place in two countries between university students from various disciplines (e.g., psychology, engineering, and business) and managers from SMEs. This approach allowed us to formulate tentative principles for true value co-creation in BMIfS and to discuss related issues from inter-organizational collaboration perspectives.

The article makes a two-fold contribution. It presents two true value co-creation in BMIfS initiatives in the university-SME context; and it takes a systemic perspective in proposing seven tentative principles that may underpin the success of inter-organizational collaboration.

Business Model Innovation for Sustainability with SMEs and Universities

The growing interest in sustainability presents significant opportunities and risks for the business world. This calls business to embrace a fundamental shift from the "profit-normative" logic (Upward & Jones, 2015) to the logic of sustainability-as-flourishing or by becoming "positive-impact companies" (Pavez et al., 2021). A flourishing organization aspires to "do good to do well" (Upward & Jones, 2015, p. 10). To realize this aspiration, an organization must conceptualize and implement a new business logic, mastering BMIfS. This involves altering organizations' value creation, delivery, and capture mechanisms (Teece, 2010), allowing them to develop, diversify, acquire, and/or transform their business (Geissdoerfer et al., 2018). Established organizations face challenges when they attempt to change their business logic (Chesbrough, 2010). While the importance of the role of the organization in facilitating this transition is well-known, little attention has been paid to how organizations (including SMEs) can effectively engage in BMIfS (Bidmon & Knab, 2018). Furthermore, research is needed on how inter-organizational collaboration for true value co-creation in BMIfS can be supported. The practical implementation of learning activities that strengthen students' and managers' capabilities for value co-creation has not been adequately investigated (Wyss et al., 2021).

True Value Co-Creation in BMIfS

Various researchers emphasize that multiple stakeholders are needed in true value co-creation in BMIfS (e.g., Breuer et al., 2018; Fehrer & Wieland, 2021; Perna et al., 2022). Other researchers emphasize that collaborative dialogue among multiple stakeholders is essential for addressing "wicked" problems involving diverse values and perspectives (Head, 2019) and for advancing a shared understanding of possible solutions (Innes & Booher, 2016). To study true value co-creation in BMIfS, consistent with these researchers' insistence on multiple stakeholder participation, we rely on the SDL (Vargo & Lusch, 2008, 2016) that posits that value is co-created in service ecosystems by various stakeholders who exchange resources and services. This logic also suggests that value is context-specific because context influences the definition and understanding of value (Vargo & Lusch, 2008, 2016). Therefore, this article explores true value co-creation in BMIfS in a specific inter-organizational setting, wherein SMEs' managers meet with university students.

True value co-creation in general is different from other forms of mass collaboration (e.g., crowdsourcing and brainstorming) because it involves generative dialogue. While other collaborations may generate multiple ideas, they lack the transformative, inspirational experience of innovation fostered by true value co-creation in BMIfS. The emphasis on generative dialogue in true value co-creation in BMIfS facilitates the integration of diverse values and perspectives with the development of a shared vision around a mutually beneficial goal (Nicholas et al., 2019; Prahalad & Ramaswamy, 2004). This defining characteristic of true value co-creation in BMIfS, which distinguishes it from mere brainstorming, is evidenced by the active and required stakeholder involvement and collaboration.

University settings provide the ideal platform for engaging multiple stakeholders (students, teachers, practitioners, and others) in generating new knowledge and in testing solutions to contemporary "real-world" challenges (Beynaghi et al., 2016; Holgaard et al., 2016; Muff, 2013). In these settings, students can address such challenges through open inquiry and experimentation and can propose possible configurations that enable true value co-creation in BMIfS. Laszlo and Brown (2014, p. 65) suggest that open inquiry and dialogue "allow a group to learn its way through complexity to sustainable action." In this context, students and managers can participate in learning in action, thus making sense of complexity and creating reflexive practitioners (Holman, 2000).

To move beyond incremental changes to create true value in BMIfS, organizations must understand the necessity of a shared vision for sustainability. According to Senge et al. (2012, p. 88), "[s]hared vision strategies should be developmental." It is essential to take the time needed to craft a better vision of the future, to share it with others, and to include others' visions. Thus, a shared vision provides the motivation and energy needed in BMIfS.

Challenges for True Value Co-Creation in BMIfS with Universities and SMEs

Although the research interest in BMIfS has increased considerably in recent years, the theory behind BMIfS has not developed as rapidly. Some conceptual inconsistencies and ambiguity remain in BMIfS theory (Foss & Saebi, 2017; Snihur & Bocken, 2022). Furthermore, despite the interest in inter-organizational approaches that connect university students from different departments with managers from companies, the SME-university collaboration in true value co-creation in BMIfS is still at an early stage.

In this section, we examine three BMIfS issues that are relevant to our study: (1) Fragmented Views of BMIfS Collaborations, (2) Limitations of Traditional Educational Settings in BMIfS Collaborations, and (3) Limited Engagement by SMEs in BMIfS Collaborations.

Fragmented Views of BMIfS Collaborations

In Walsh's (1995) meaning, business models act as cognitive maps that managers use to process information and make decisions. However, managers, teams, and external stakeholders have fragmented and often contrasting views of

BMIfS (Amit & Zott, 2015; Sund et al., 2021). To achieve superior performance in a context with multiple values (social, environmental, and economic), companies must adapt their assumptions about value creation, delivery, and capture as they collaborate with new stakeholders (Fehrer & Wieland, 2021; Mohammed et al., 2000). Achieving such collaboration in BMIfS requires that all parties engage in a process of shared sensemaking through dialogue, co-creation, and learning activities focused on value co-creation. Standardized frameworks and visualization tools are needed to support this process (Sund et al., 2021; Taescher & Nizar Abdelkafi, 2017). Therefore, it is necessary to understand how to integrate the various stakeholders in true value co-creation in BMIfS (Brodie et al., 2019).

Limitations of Traditional Educational Settings in BMIfS Collaborations

Traditional educational settings can hinder the initiation, design, implementation, and institutionalization of pedagogic approaches that connect students with companies. The result is that emergent learning (e.g., self-organized and student-led learning, action-learning, and experiential learning) does not develop. Pedagogies have long discussed the need to prepare engineering students to manage complex wicked problems in work life. One recommendation is that students should receive more practical experience during their university studies (Crawley et al., 2007; Lehmann et al., 2008).

Some researchers also criticize business programs for placing too much emphasis on shareholder value and profit maximization while neglecting the broader social and environmental contexts of business operations (Dyllick, 2015; Hoffman, 2020). These critics question whether business programs provide students with the skills and values needed for work life. A specific criticism is that business education, which is fundamentally disciplinary, is silo-structured such that learning is compartmentalized with little opportunity for students to deal with “messy” real-world challenges (Dyllick, 2015; Hoffman, 2020).

Sustainability challenges, which are “wicked,” require creative, systemic, and divergent approaches. Thus, sustainability instruction should be taught in inter- and trans-disciplinary programs rather than in isolated disciplines (Muff, 2013).

Many organizational and practical impediments, however, block the implementation of such innovative learning approaches. These impediments include fixed curriculum timeframes in place, limited resources of various kinds, and the perception that the new approaches should only be used in elective courses or as add-ons in required courses. As many researchers have observed, this inability or reluctance to provide students with opportunities to future relevant learning limits their preparation for work life (Dyllick, 2015; Muff, 2013).

Limited Engagement by SMEs in BMIfS Inter-Organizational Collaborations

SMEs are acknowledged as a fundamental component of the European Union's economy (Angelova & Gkofas, 2021). Yet numerous studies reveal that SME managers require significant support as they lead and develop their companies (Storey, 1994). They often lack the resources necessary to address internal development issues (Rothwell, 1991). Paradoxically, although SME managers need advice, they are often reluctant to discuss their BMIfS experiences with others (e.g., Hillary, 2000). According to Chesbrough (2010), this hesitancy can be partially attributed to organization and cognitive barriers like those encountered in traditional business model innovation. Resource allocations or missing fit with existing business logics may also erect cognitive barriers. These barriers can stem from managers' insufficient knowledge of alternative business models or from their resistance to change (Chesbrough, 2010; Prahalad & Bettis, 1986). In such cases, it is difficult for organizations to learn new things (e.g., Argyris, 1999; Levitt & March, 1988). Given this attitude, SMEs may resist engagement in radical, proactive BMIfS. To enable true value co-creation in BMIfS, inter-organizational collaboration, which is open to entrepreneurial thinking and experimentation, is necessary (Fehrer et al., 2020; Vargo & Lusch, 2016). However, proactive engagement in and commitment to true value co-creation in BMIfS between SMEs and universities are more the exception than the rule today.

Illustrative Experiences from Two Value Co-Creation Initiatives with Universities and SMEs

Universities can originate and support educational initiatives for collaborative, inter- and trans-disciplinary true value co-creation in BMIfS with students and company managers (Wyss & von Kutzschenbach, 2020). True value co-creation in BMIfS, however, is a challenging task. To illustrate, we describe two university/SME initiatives: (1) Think Tank-Business Model Innovation (TT-BMI) and (2) Project 0 Polestar. In this section, we report on how learning spaces for true value co-creation in BMIfS developed in the two initiatives.

Think Tank-Business Model Innovation (TT-BMI)

The Think Tank-BMI initiative (www.TT-BMI.ch) involved an inter-disciplinary group of students and a German SME that was part of an elective module in the tri-national, Bachelor's degree program in international management at the University of Applied Sciences and Arts FHNW. The SME, an incubator for innovative theme park design, media-based entertainment, and media content, is a division of a 245-year-old family business with a good reputation in the entertainment industry. This industry has experienced extraordinary technological advances in recent years, particularly in emerging digital technologies such as virtual reality (VR) and augmented reality (AR). Therefore, the YY-BMI initiative focussed on leveraging sustainability via digitalization in the entertainment industry.

Twenty-seven university students and five SME managers participated in the YY-BMI initiative. They formed six inter- and trans-disciplinary teams comprised of students from the University of Applied Sciences and Arts FHNW (Switzerland) degree programs in Art and Design, Engineering, and Business, and engineering psychology students from Furtwangen University (Germany). The four workshops, which were held in the SME's theme park, followed the YY-BMI Design Sprint approach (Wyss et al., 2023). In this approach, an engagement phase, which precedes the workshops, includes a case acquisition and an initial problem-framing session with the SME managers. The activities that follow this session are in seven phases: understand, discover, define, ideate, decide, prototype, validate, and deliver. Figure 19.1 illustrates the TT-BMI design sprint approach and activities.

The first three phases of the approach introduced the concept of BMIfS, the SME, and the sustainability challenge. The students engaged in a vision co-creation exercise using a backcasting logic (Broman & Robèrt, 2017; Vergragt & Quist, 2011) in which the goal—the "north star" for the BMIfS challenge—was defined. The managers gave the students a tour of the company's theme park and described their experiences with VR technologies. This information helped the students define the sustainability challenge as they identified industry trends and the direct and indirect stakeholders. The students also interviewed the managers and potential target groups, who explained their goals, needs, challenges, and points of view. Each student team synthesized its findings as a problem statement that was reframed into a "How might we?" question to prepare for ideation and opening the solution space.

The solution space, introduced in the ideate phase, was intended to generate as many ideas as possible around the "How might we?" question and to identify the

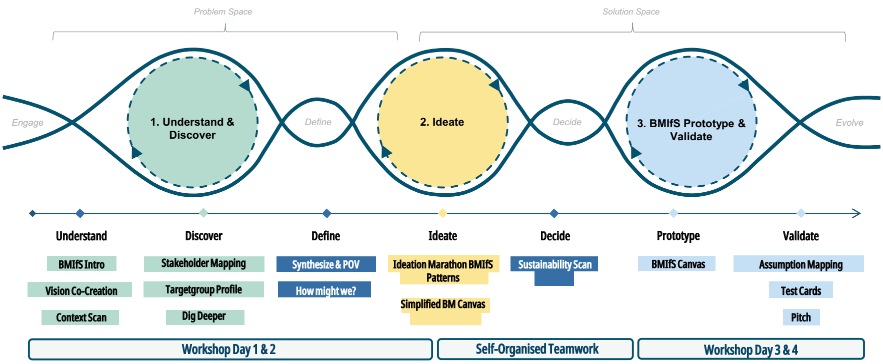

Fig. 19.1 The TT-BMI design sprint approach and activities (Wyss et al., 2023)

target group's needs in the greater socio-ecological context. For this activity, the student teams used BMIfS prompts such as the sustainable business model ideation and pattern cards (Hovgaard, n.d.; Lüdeke-Freund et al., 2019). Using the BMIfS evaluation funnel and the sustainability scan, inspired by Bocken and Short's (2021) sustainability criteria, the teams then selected a single promising idea to use in the sustainability challenge. This decision also required consideration of the ideas' desirability, feasibility, and viability (Brown, 2008). The teams then created solution sketches for interim presentations to the managers and other students.

The teams generated additional ideas between the first two and the final two workshops. They could ask questions or request feedback in online calls with the managers. At the final two workshops, the teams developed their ideas into BMIfS prototypes using the YY-BMI canvas for BMIfS. This canvas, which lists guiding questions for each of its building blocks, is a compilation and adaptation of other business model canvases such as the Business Model Canvas (Osterwalder & Pigneur, 2010), the Sustainable Business Canvas (Tiemann et al., 2016), and the Sustainable Business Model Canvas (CASE, 2017; Hovgaard, n.d.). The teams used assumption mapping to test the validity of their BMIfS prototypes' assumptions. Finally, the teams presented interactive and comprehensive pitches for their BMIfS prototypes to the managers and other students.

Uncovering Business Opportunities Opened by a Climate-Neutral Car

The Uncovering Business Opportunities Opened by a Climate-Neutral Car initiative was a co-creation sustainability challenge for students at Halmstad University and managers at the Swedish SME, Polestar. The students were participants in a large, co-creation multi-disciplinary workshop where they presented their business model prototypes to the managers, students from other programs, and university faculty members. The goal of the challenge, which is integrated with the current engineering curriculum, was to co-create business model prototypes by building on the multiple competencies of the students from the different engineering programs at the university.

Polestar's most ambitious project—Project 0 Polestar, announced in April 2021)—aims to produce a climate-neutral car by 2030 by the reduction of emissions throughout the supply and production chains (www.polestar.com).

Two questions were posed in the sustainability challenge: (1) How can Polestar create and capture true value from different stakeholders' point of view in the ownership phase of a climate-neutral car's lifecycle? and (2) How can Polestar increase the use of the car in the ownership phase while continuing to capture true value (i.e., sustainability) while maintaining recurrent revenue streams? The students were tasked with co-creating a business model for one of the following time horizons: 0–2 years with existing cars; 5 years with cars with small adjustments; and up to 10 years with new cars. The students were required to specify the context in which the cars would be used and how their business models would capture value.

In the fall of 2021, twenty-six engineering students in Master's degree programs at Halmstad University participated in the eight-week initiative. Five student teams used the backcasting method that involves mapping the trajectory of a company from the desirable future back to the present to test the feasibility of plans, policies, and projects (Broman & Robèrt, 2017). The students followed scientific principles in the challenge and received feedback from the Polestar managers.

In the first of several phases, the teams' focus was on creating awareness and establishing a bold, long-term Vision (A) for Polestar. The teams studied sustainability reports and literature, entrepreneurial learning, and business modeling for sustainability. In the second phase, the teams established the Baseline (B) for the world and for Polestar by identifying relevant micro, meso, and macro trends and their relationships with the context-relevant SDGs proposed by the United Nations. In the third phase, the teams created, presented, and tested Creative Solutions (C), and refined different business model prototypes using Upward and Jones's (2015) Flourishing Business Canvas, and the Future-Fit Business Benchmark tool used for evaluation and refinement of their business model prototypes (Kendall & Willard, 2015). In the fourth phase, the teams created Devise a Plan (D) they could use to communicate their ideas to the Polestar managers and other stakeholders. During this phase, the teams were trained in how to pitch their business model to different stakeholders and how to create an action plan/impact statement for their business model. The Polestar managers discussed the students' sustainable business model innovations in all phases of the challenge. Figure 19.2 illustrates the eight-week Project 0 Polestar initiative.

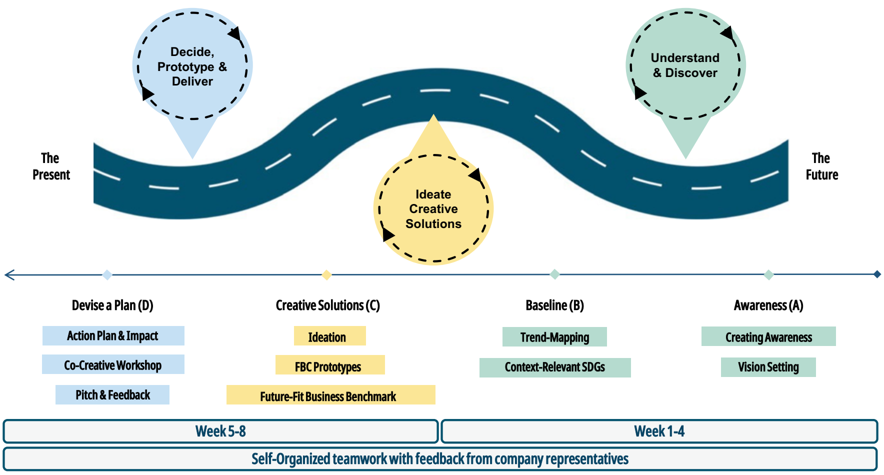

Fig. 19.2 Approach to true value co-creation in BMIfS at "Uncovering Business Opportunities Opened by a Climate-Neutral Car" (The third and fourth Author's Own)

Reflections on Designing Inter-Organizational Value Co-Creation in BMIfS Initiatives with Universities and SMEs

In this section, we identify the main causes of the challenges to true value co-creation in BMIfS that the university students and the SME managers encountered in the Polestar initiative and the TT-BMI initiative. We also propose seven tentative principles to refer to when designing co-creation BMIfS initiatives that can bridge the knowledge-doing gap—that is, the gap between information and action. We argue that considering these principles during inter-organizational collaborations will foster more fruitful value co-creation initiatives.

Causes of the Co-Creation Challenges: Educational Approaches

Despite the increased use of innovative approaches in education aimed at "wicked," complex challenges (e.g., Dyllick, 2015; Muff, 2013), traditional educational approaches persist in higher education. The economic pressure to reduce costs and to conserve resources (e.g., via lecture format, large class size, and low lecturer compensation), combined with a reluctance to change curricula and pedagogic methods, often impedes the transition to more innovative educational approaches.

Universities must engage in persuasive communications with SMEs when they make their pitch for value co-creation initiatives in BMIfS. University personnel, however, may lack the motivation or even competence to initiate and maintain such communications. Most educational institutions are organized according to the traditional assembly-line concept of educators, controllers, and inspectors.

Co-creation initiatives in BMIfS are also challenging for students and educators. Students are more committed to projects when they are responsible for student-led instruction. Educators take on untested and unfamiliar workloads when they relinquish the comfort and custom of lecture-based instruction. Educators need to coordinate interdisciplinary student teams and develop networks of experts who can provide coaching and other assistance. Building and maintaining these networks are especially challenging tasks when new initiatives are undertaken at a time when traditional, lecture-based formats—with fixed course schedules and standardized grading criteria—remain firmly in place.

Faculty members and students engaged in co-creation in BMIfS initiatives also need systemic competencies. Such competencies are seldom taught in traditional university programs that focus on compartmentalization. Integrating the approaches and supportive tools needed for the systemic perspective in co-creation initiatives in BMIfS present challenges. However, a broader systemic perspective is necessary that integrates external stakeholders' needs and that addresses environmental issues (Breuer et al., 2018). Yet this perspective is rarely presented in educational settings. The use of sustainability-oriented business modeling tools is still limited (Wyss et al., 2021a, 2021b).

In conclusion, the challenges caused by educational approaches used in true value co-creation in BMIfS can seem quite discouraging because they are numerous and complex. Yet, if universities enthusiastically promote a more flexible and experimental educational approach, these challenges may be overcome.

Causes of the Co-Creation Challenges: SME Approaches

The SME focus on fast problem-solving, near-future outcomes, and quick returns on investment can conflict with the essence of inter-organizational collaboration, especially with the university's mission of knowledge advancement. This goal inconsistency can be problematic for value co-creation initiatives. SMEs may lack the resources, time, and interest needed to participate fully in such initiatives. Universities that lack established relationships with candidate SMEs may know little about the SMEs' reputation, results, and trustworthiness. SMEs may be reluctant to provide this and further information to the universities and students. SMEs may even have expectations of the collaboration that are outside the scope of the agreed-upon collaboration terms (e.g., requests for business consulting).

The universities' acquiring and onboarding process with SMEs is thus complex and not without risk. For their part, SMEs may assume university students lack the expertise, knowledge, and time needed to contribute meaningfully to proposed initiatives. Additionally, SMEs may not have a clear understanding about who has the main responsibility for the initiative or about the resources they are expected to commit to it. SMEs may worry that the collaboration may disrupt and/or cannibalize their well-functioning activities, leading to reactive risk management and a short-term focus that hinders tackling complex and dynamic sustainability challenges. As a result, during initiatives the students' innovative and transformative capabilities are often undeveloped or, at best, only minor, incremental improvement activities are initiated.

In conclusion, while many university students are eager to participate in co-creation initiatives, some SMEs are hesitant for a variety of reasons. This hesitancy poses challenges for university programs that seek collaborative business partners. This broken link in the true value co-creation in BMIfS between students and SMEs requires more analysis if solutions are to be identified.

Tentative Principles for Leveraging True Value Co-Creation in BMIfS with Universities and SMEs

Building on value co-creation theory (Vargo et al., 2017; Vargo & Lusch, 2008, 2016), in this section, we develop a set of tentative principles applicable to the design of value co-creation in BMIfS initiatives such as the YY-BMI and the Project

0 Polestar initiatives described in this article. While co-creation theory acknowledges that value co-creation occurs in systems, it does not identify specific principles for value co-creation in BMIfS. Additionally, the value co-creation literature primarily focuses on traditional stakeholders, such as customers and companies (e.g., Srivastava et al., 2024), while overlooking other important stakeholders in the system (e.g., universities and SMEs). Following Thomas and Ambrosini (2021) and Lin and Lekhawipat (2023), we respond to recent calls (e.g., Vargo et al., 2017) for an examination of the use of value co-creation by diverse stakeholders.

We label our tentative design principles as the 7C principles that bridge the knowledge-doing gap in the true value co-creation in BMIfS initiatives. These principles are Confirmation, Confidence, Creativity, Credibility, Communication, Capability to Co-create, and Capacity to Address the Systems-Citizenship Gap. Success with value co-creation initiatives in BMIfS requires that these principles create value for all parties (e.g., universities and their students, SMEs and their managers). Furthermore, these initiatives should have flexible, systemic design-based formats that are organized around a specific BMIfS challenge (i.e., the boundary object). Figure 19.3 illustrates the 7 C principles for true value co-creation in BMIfS initiatives.

Confirmation This principle refers to "the unique, hard-to-imitate competitive resource that unleashes and leverages relational capabilities" (Milton, 2008, p. 1065) in true value co-creation in BMIfS. Prior research suggests successful collaboration in BMIfS between universities and companies requires aligning their identities (Hamann & Faccer, 2017; Parola et al., 2022). Our research unravels the alignment forms. To students, confirmation means applying and communicating their knowledge, presenting and receiving feedback on their ideas, and building relationships with stakeholders that could lead to future employment. To SMEs managers, confirmation allows to experiment safely with innovative approaches and ideas and build relationships with other stakeholders. These opportunities allow to reduce the

Fig. 19.3 Tentative principles for designing true value in co-creation BMIfS initiatives (The Authors' Own)

uncertainty associated with new projects. Overall, the Confirmation principle allows to leverage and strengthen the relationships between stakeholders.

Confidence This principle refers to "the assuredness in oneself and in one's capabilities" (Norman & Hyland, 2003, p. 264). Our initiatives align with Bartunek and Ren's (2022) description of two types of meaningful events that shape students' learning: learning that provides student practice and learning that provides student insights. Support for university students and SME managers requires that universities create a setting where the parties can connect (Brodie et al., 2019). This safe space for dialogue should help the parties express their individuality as they learn from others' ideas and experiences (Bartunek & Ren, 2022) and increase their self-confidence rather than provoke closure and dissociation from the learning experience. The Confidence principle fosters reward systems for participants, push boundaries, and challenge established norms.

Creativity This principle refers to "the ability to turn new and imaginative ideas into reality" (Caeiro-Rodríguez et al., 2021, p. 29236). Creativity means addressing challenges, listening to unbiased ideas, and acquiring new knowledge. Usually, corporate innovation prioritizes companies' interests, which hampers creativity (Sharma et al., 2022). Addressing "wicked" problems requires that all stakeholders embrace creativity (Micheli et al., 2019) and use their resources to achieve creative outcomes (Carmeli & Schaubroeck, 2007).

Creative work that benefits SMEs can occur outside their business silos by involving new stakeholders, such as students and other SMEs. Students can also produce creative ideas that they present to teachers and managers for validation. Thus, creative ideas co-emerge when stakeholders embrace different roles (i.e., university students as innovators; SME managers as validators). The Creativity principle requires patience to wait for the co-emergence of creative ideas.

Credibility This principle refers to the trust required among parties in true value co-creation in BMIfS. For example, a teacher is credible to students if the students think the teacher cares about their educational welfare (Cavanagh et al., 2018). For the students, acquiring credibility means they are trusted to work collaboratively with wicked problems and to receive constructive feedback. For the SME managers, acquiring credibility means they are trusted to work collaboratively on projects and to accept students as valuable resources. Collaborative activities are meaningful to students, especially when practical skills are used and opportunities for self-improvement are presented (Bartunek & Ren, 2022). In applying the Credibility principle, initiative designers may test learning approaches that are transparent, tolerant, and inclusive.

Communication This principle refers to the creation of and support for mutual understanding among stakeholders in true value co-creation in BMIfS. According to Ganapathy (2020), "robust academic-practitioner networks' are needed to tackle today's complexities." In such networks, communication is the glue that unites the seven principles of true value co-creation in BMIfS. Effective communication can reduce the tension among the parties by facilitating their proactive socialization (Parola et al., 2022). Engagement platforms for effective communication are essential for the exchange of knowledge and resources by stakeholders (Brodie et al., 2019; Thomas & Ambrosini, 2021) and for the alignment of goals and boundaries in BMIfS (Fehrer & Wieland, 2021; Vargo & Lusch, 2016). Embracing the Communication principle allow parties to engage more enthusiastically and cooperatively to align objectives, worldviews, and expectations.

Capability to Co-create This principle refers to the parties' aptitude for and commitment to true value co-creation in BMIfS. Recent research emphasizes that collaborating stakeholders should share their localized knowledge, relinquish their roles as "experts" with exclusive knowledge, and embrace the roles of participant, organizer, or knowledge partner (Sharma et al., 2022; Thomas & Ambrosini, 2021). For example, students rather than their instructors typically take the leadership role in unorthodox, co-creation projects with various expected outcomes. A potential problem with such projects is that one party may expect outcomes that the other party has not agreed to (Montonen et al., 2021).

In applying the Capability to co-create principle, initiative designers may promote innovation activities that the parties have jointly designed and adopted.

Capacity to Address the Systems-Citizenship Gap This principle refers to the capacity of people to think in systems and see interdependencies (c.f., Senge, 2006). The systems-citizenship gap results from the increase in globalization and digitalization that requires people to understand interdependence better and take greater responsibility for the earth and its resources. Universities, in particular, are expected to respond to this demand (Montonen et al., 2021; Sandhu et al., 2019) in their research on organizational phenomena and their selection of external research partners for collaboration projects.

In applying the Capacity to address the Systems-Citizenship Gap principle, initiative designers may advocate for more use of the tools, immersive activities, and frameworks needed to achieve a better understanding of the natural world and of the interdependence of all living things.

Discussion

Our study challenges popular approaches to value co-creation that often rely on advisory activities led by third parties such as outside consultants or university researchers (Senge et al., 2012). When consultants or researchers advise collaborations of diverse parties, the usual assumptions are that the parties have clearly defined roles, and that one party has the "best" expertise. These assumptions fragment the complex and dynamic sustainability challenge into piecemeal components suitable for linear problem-solving, often limiting the parties' interaction, knowledge exchange, and creativity.

We claim that an inter-organizational collaboration gap exists between universities and SMEs that can be overcome by emphasizing the advantages of true value co-creation in BMIfS initiatives that embrace a more systemic approach (Ganapathy, 2020). Such initiatives can benefit all stakeholders, including SMEs that lack sufficient resources to address "wicked" problems by themselves and universities that lag in their research and teaching efforts (Montonen et al., 2021; Sharma et al., 2022). This article enriches the business model literature (e.g., Foss & Saebi, 2017; Zott et al., 2011) by outlining the 7C principles that can guide inter-organizational collaboration in BMIfS. These principles are intended to stimulate discussion and evaluation.

Our study supports other research on true value co-creation that emphasizes the systemic nature of BMIfS (Fehrer & Wieland, 2021) and the importance of systemic interaction and alignment among organizations during BMIfS (Fehrer & Wieland, 2021; Snihur & Bocken, 2022) especially that diversity of organizations' goals and interests can result in tension and friction (Fehrer et al., 2020). This article contributes to recent discussions on the role of universities in driving change in the broader ecosystem (e.g., Sharma et al., 2022; Thomas & Ambrosini, 2021). In true value co-creation in BMIfS, universities shift their focus from case studies of SMEs in isolation, to co-creation of design initiatives (Gumusay & Reinecke, 2021). It emphasizes the importance of designing a true value co-creation environment where no organization is an expert, rather all organizations are knowledge partners.

Most of the business model innovation literature that conceptualizes value co-creation in BMIfS oversimplifies the process by focusing on companies' resources and activities while neglecting the linkage between companies' and other parties' resources and activities (Vargo & Lusch, 2008, 2016). True value co-creation in BMIfS is even more complex when the organizations' goals and needs conflict (Fehrer & Wieland, 2021). Therefore, it is imperative to radically re-think the design and process of value co-creation in BMIfS by paying close attention to the organizations, which expect BMIfS to create value for them, for partner organizations, and the overall system (Fehrer & Wieland, 2021).

Our research extends the work by Lundberg and Öberg (2021) and Perna et al. (2022) to shed light on the importance of meaningful classroom activities in inter-organizational collaboration, especially innovation and value co-creation between universities and SMEs. We argue that the classroom could be extended to a value co-creation setting wherein diverse organizations participate. In this setting, we demonstrate that students' and managers' learning experiences are mutually influential. Furthermore, we acknowledge that value co-creation settings pose significant challenges for universities and SMEs, outlining principles to overcome these challenges.

Conclusions

Our 7C principles, a novel framework for true value co-creation in BMIfS from an inter-organizational perspective, are the result of our experience with two value co-creation initiatives in two countries. We believe these principles could be generalizable to other initiatives of true value co-creation in BMIfS. Different settings with different stakeholders (e.g., NGOs managers and governments representatives) could further explore the relevance of the 7C principles and enrich them.

Future research should explore how organizations can leverage our 7C principles in new contexts (e.g., industries, regions) and by involving new organizations (e.g., NGOs and governmental agencies). Additionally, the research could explore strategies to increase SME participation in inter-organizational initiatives of true value co-creation with universities. A convincing business case for such work could overcome the SMEs' resistance to co-creation initiatives with external stakeholders.

Universities and SMEs have a crucial role in promoting sustainability. Working in joint projects, students and managers can co-create true value not only for their organizations but also for society (e.g., Hoveskog et al., 2018; Tell & Hoveskog, 2022). We hope our article inspires future collaboration between universities and SMEs in sustainability and other wicked problem projects.

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Chapter 20
Fostering Sustainable Development through IT Service-Learning: Insights from Rural South Africa

Rouxan Colin Fouché and Liezel Nel

Abstract Information Technology Service-Learning (ITSL) projects are essential for bridging digital literacy gaps in underserved communities such as Botshabelo, South Africa. Despite global technological advancements, many individuals in such areas lack basic computer skills crucial for employment and personal development. The ITSL project implemented in Botshabelo aimed to empower unemployed and computer-illiterate community members through practical training and fostering digital inclusion. This study investigates the lasting impacts of this initiative, exploring how participation has influenced participants' digital literacy levels, employment opportunities, and community engagement. Using a qualitative phenomenological approach, data was collected through semi-structured interviews 16 months after the project's conclusion. The findings, analysed through the lenses of digital divide theory, social capital theory, and asset-based community development, reveal significant improvements in digital literacy and self-confidence among participants, many of whom transitioned from unemployment to employment or career advancement. Additionally, some participants became digital literacy advocates within their community. These results underscore the transformative potential of ITSL programs in promoting sustainable development and economic growth in rural settings. The study concludes that service-learning initiatives can effectively enhance socio-economic opportunities and foster community collaboration, suggesting broader applications for similar projects in other underserved communities globally. This highlights the critical role of digital literacy in achieving broader sustainability goals.

Keywords Community engagement · Digital literacy · Rural communities · Service-learning · Sustainable development

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Introduction

In an era of rapid digital transformation, the global landscape has been reshaped, offering unprecedented opportunities for innovation, economic growth, and social progress. However, this digital revolution has also intensified existing inequalities, particularly in developing countries and rural areas. South Africa's socio-economic development and global competitiveness are severely limited by its lack of digital skills, as noted in the South African National Digital and Future Skills strategy (SA Department of Communications and Digital Technologies, 2020). The digital divide—the gap between those with the skills, knowledge, and resources to utilise digital tools and those without—remains a significant challenge. This is especially true in marginalised rural and peri-urban areas where communities face limited access to quality education and economic opportunities (Mojapelo, 2020; Lembani et al., 2020).

According to the South African National Digital and Future Skills strategy (NEMISA, 2017), bridging this digital divide requires creating digital opportunities across all sectors of society, particularly for disadvantaged communities. The responsibility to increase digital literacy extends beyond government initiatives to universities, which play a vital role in addressing digital inequalities through engaged scholarship and service-learning (Van Deursen et al., 2014; Mphidi, 2016; Mudau et al., 2023).

South African national policies emphasise community engagement as a key role for higher education institutions (HEIs). The Higher Education Amendment Act and subsequent policy developments reinforce the responsibility of HEIs to support socio-economic development through service-learning and engaged scholarship (SA Department of Education, 1997; Department of Higher Education and Training, 2016). The University of the Free State (UFS) embodies this commitment through initiatives addressing social and economic challenges in its surrounding community (Ramahlele, 2022).

At the UFS, the Information Technology Service-Learning (ITSL) project empowers unemployed, computer-illiterate community members through practical digital skills training over 10 weeks. This aligns with current national digital skills development frameworks (Ministry of Communication and Digital Technologies, 2020). Integrated into a second-year Computer Science module (CSIS2642), this initiative offers local communities free Microsoft Word and Excel training. In Botshabelo, the project partners with the loveLife Y-Center, where computer literacy training is provided. Due to limited computer availability [see Fig. 20.1], sessions are repeated to accommodate up to 80 participants per week for the project duration. Successful candidates receive certificates upon completing all practical assessments.

Despite the project's successes (Fouché & Nel 2024a, 2024b), the broader impact of the ITSL project on participants' long-term digital literacy, employment opportunities, and community engagement has not been systematically studied (Fouché & Nel 2024a, 2024b). This research study seeks to address this gap by investigating

Fig. 20.1 loveLife Y-Center computer lab in Botshabelo

the lasting impact of the ITSL project and exploring how participation in the initiative has influenced the digital literacy levels, employment opportunities, and community engagement of the project's beneficiaries.

Therefore, the primary objectives of this chapter are as follows:

- To evaluate the long-term impact of the ITSL project on participants' digital literacy, employment opportunities, and community engagement
- To analyse how community-based digital literacy initiatives contribute to creating sustainable and innovative business ecosystems in rural areas and
- To provide insights into the role of higher education institutions in fostering digital inclusion and economic empowerment through service-learning

The aim is to provide valuable insights for policymakers, educators, and business leaders seeking to address the digital divide and promote inclusive economic growth in developing regions. By examining the ITSL project through the lenses of digital divide theory, social capital theory, and asset-based community development, we hope to inform the design and implementation of future initiatives to enhance digital literacy, create employment opportunities, and catalyse community-driven sustainable innovation.

Literature Review and Theoretical Framework

This section explores the South African digital divide and the three key theories underpinning our study: digital divide theory, social capital theory, and asset-based community development (ABCD). This theoretical framework provides a comprehensive lens for analysing the ITSL project's impact in Botshabelo, South Africa.

The Digital Divide in South Africa: Context and Theory

The socio-economic landscape of South Africa, marked by persistent inequalities in income, education, and access to technology, has significantly shaped the country's digital divide. The legacy of apartheid continues to impact the distribution of resources, particularly affecting rural and historically disadvantaged communities, which experience limited access to digital infrastructure and educational opportunities (Oyewole, 2010). Research on South Africa's digital divide highlights poverty, low literacy levels, and inadequate infrastructure in rural areas as major barriers to achieving digital equity (Lembani et al., 2020; Van Dijk, 2020; Aruleba & Jere, 2022; Faloye & Ajayi, 2022; Maniram, 2023).

We draw upon Norris's (2001) conceptualisation of the digital divide as multidimensional, encompassing global, social, and democratic divides. Van Dijk's (2006, 2020) digital divide theory further refines this concept by distinguishing between four types of access, namely:

- Motivational access
- Material access (first-level digital divide)
- Skills access (second-level digital divide) and
- Usage access (third-level digital divide)

This theoretical framework helps explain the persistent digital inequalities in South Africa, particularly in rural areas such as Botshabelo [see Fig. 20.2], where the ITSL project primarily addresses skills access and usage access.

Despite numerous initiatives to bridge the digital divide, empirical research on their long-term impact remains limited. Most studies emphasise short-term

Fig. 20.2 loveLife Y-Center in Botshabelo, South Africa

outcomes, such as device distribution or Internet access, rather than assessing sustainable improvements in digital literacy, employment, or community development (McReynolds, 2019).

South Africa's digital divide is a complex issue shaped by historical and socio-economic factors. Van Dijk's digital divide theory offers a valuable perspective for evaluating initiatives such as the ITSL project in Botshabelo. Effective strategies must go beyond access to technology, focusing on how these efforts foster community development and social capital, particularly in digital literacy and engagement.

Community Engagement and Social Capital in the Context of Digital Literacy Initiatives

While digital divide theory helps us understand the barriers to digital inclusion, the concepts of community engagement and social capital provide insights into how initiatives such as the ITSL project can leverage and build community resources to address these barriers.

Service-Learning and Community Engagement

South African HEIs are increasingly involved in addressing the digital divide through service-learning and community engagement initiatives. These efforts are often framed within broader socio-economic development goals, with HEIs seeking to contribute to knowledge production and practical skills development within local communities. Service-learning is a powerful pedagogical tool, particularly in contexts where students can apply theoretical knowledge to real-world problems while benefiting the community (O'Brien, 2009).

Social Capital Theory

To understand the broader impact of these initiatives, we employ social capital theory, particularly as developed by Putnam (2000) and Lin (2001). This theory offers insights into how digital literacy projects might contribute to community development beyond individual skill acquisition. Key concepts include the following (Putnam, 2000; Lin, 2001):

- Bonding social capital (connections within homogeneous groups) and bridging social capital (connections between heterogeneous groups)
- Network theory of social capital, positing that resources are embedded in social networks and can be accessed or mobilised by individuals

These concepts illustrate how the ITSL project could potentially enhance participants' social capital by improving their access to resources within and beyond their community networks. While service-learning programs in HEIs promote digital literacy and employment skills, research on their community impact is limited. Existing literature primarily focuses on student benefits, often overlooking community perspectives (King et al., 2009). These programs may also struggle with deep community engagement, potentially misaligning with local needs and contexts (Mahlomaholo & Matobako, 2006).

Integrating social capital theory with digital divide theory offers a broader framework to assess the ITSL project's impact in Botshabelo. Beyond digital skills and access, building social capital through these initiatives could significantly influence community development and empowerment. This highlights the importance of community-based, asset-based approaches in enhancing the effectiveness and sustainability of digital literacy efforts.

Community-Based Interventions and Asset-Based Approaches

Building on the concepts of community engagement and social capital, we now examine how community-based and asset-based approaches can provide a framework for designing and implementing effective digital literacy initiatives.

Digital Literacy and Socio-Economic Development

Digital literacy is increasingly recognised as a key driver of socio-economic development in the twenty-first century, as it provides individuals with the skills necessary to participate in the digital economy and access employment opportunities (Van Laar et al., 2017). Community-based digital literacy programs have the potential to address both the first-level digital divide (access to technology) and the second-level divide (skills to effectively use technology), thus contributing to the overall socio-economic well-being of marginalised populations (Selwyn, 2004).

Asset-Based Community Development

To frame our understanding of how digital literacy initiatives can contribute to broader community development, we draw upon the ABCD approach developed by Kretzmann and McKnight (1993). This approach emphasises the following:

- Identifying and mobilising existing (but often unrecognised) community assets
- Community-driven development rather than top-down interventions and
- Relationship-driven processes that build and strengthen social capital

The ABCD approach aligns with the ITSL project's focus on recognising and developing human capital in Botshabelo, involving community members in learning, and building relationships within and beyond the community. This approach highlights the ITSL project's potential to improve digital skills while promoting broader community development. Despite the importance of community-based digital literacy programs, research on their long-term impact, especially in South Africa, is limited. Most studies focus on immediate outcomes such as ICT skills or employment, neglecting broader effects such as community cohesion or empowerment (McReynolds, 2019). This research gap underscores the importance of studying the ITSL project's long-term impact on sustainable community development.

Integration of Theoretical Perspectives and Future Directions

By integrating digital divide theory, social capital theory, and the ABCD approach, we form a comprehensive framework for analysing the ITSL project's impact in Botshabelo. These theories collectively illuminate how digital literacy initiatives can foster sustainable development in marginalised communities. Digital divide theory provides insights into the barriers the Botshabelo community faces regarding access to digital technology and skills. Social capital theory sheds light on how strengthening social networks and relationships can enhance the effectiveness of such initiatives. The ABCD approach emphasises leveraging existing community assets to drive development from within.

In the context of the ITSL project, these theories interconnect as follows:

- **Bridging the digital divide through community assets:** The ITSL project addresses gaps in digital access and skills (digital divide theory) by utilising the community's inherent strengths and resources (ABCD). By engaging local participants and facilities, the project builds upon what the community already possesses.
- **Enhancing social capital via digital literacy**: Improved digital skills empower participants to expand their social networks and access new resources (social capital theory). This expansion not only benefits individuals but also strengthens community ties, facilitating the sharing of knowledge and opportunities.
- **Fostering sustainable development**: Increased digital literacy, strengthened social networks, and mobilised community assets contribute to sustainable socio-economic growth in Botshabelo. The theories collectively explain how the ITSL project can lead to long-term community empowerment and resilience.

This integrated framework allows us to assess the multifaceted impact of the ITSL project, moving beyond individual skill acquisition to consider broader social and developmental outcomes. It provides a nuanced understanding of how digital literacy initiatives can catalyse positive change in underserved communities.

Methodology

Research Design and Approach

This study employed a qualitative phenomenological approach to assess the long-term impact of the ITSL project on participants' digital literacy, employment opportunities, and community engagement in Botshabelo, South Africa. The ITSL project, a collaboration between the University of the Free State (UFS) and the Botshabelo community, aimed to improve digital literacy among unemployed, computer-illiterate residents, addressing the area's digital divide.

Phenomenology was chosen to capture participants' lived experiences. Husserl's transcendental phenomenology helped the researchers remain objective by bracketing personal biases, allowing participants' voices to take center stage (Carpenter, 2011).

Sampling Decisions

The research population comprised 80 community members who had completed the ITSL project. A purposive and snowball sampling approach was adopted, consistent with phenomenological research, focusing not on generalisation but on gaining detailed insights into individual experiences (Carpenter, 2011; Mapp, 2008; Creswell & Poth, 2023). The purposive sampling ensured that participants selected for the study had directly experienced the ITSL project, aligning with the study's objective of understanding its impact on their lives. Subsequently, the snowball sampling method was employed, where referrals from loveLife employees and other participants helped identify additional individuals who could provide valuable insights into their experiences with the project (Cohen et al., 2017; Staller, 2021). The small sample size of 10 participants was preferred to facilitate an in-depth exploration of each participant's lived experience.

Data Collection

Semi-structured phenomenological interviews, conducted 16 months after the ITSL project ended, were used as the primary data collection method to provide rich insights into participants' experiences. The three-step interview process, comprising an introduction, exploration of the project's impact, and final reflections (Bearman, 2019), focused on key aspects of the ITSL project. It was piloted with five community members to refine the questions. The interviews, conducted by phone with participants in and outside the project area, lasted 20–30 minutes (Mapp, 2008; Ataro, 2020). Consent was obtained, and participants were encouraged to share their experiences in their own words.

Data Analysis

Colaizzi's (1978) descriptive phenomenological method was employed to analyse the interview transcripts. This seven-step process provided a structured approach to extracting themes from the participants' accounts (Shosha, 2012; Morrow et al., 2015). The data analysis focused on generating a deep understanding of the participants' experiences of long-term change, allowing the essence of their interactions with the ITSL project to be documented.

Reliability and Validity

Several strategies were employed to ensure the reliability and validity of the study's findings. First, interview questions were standardised across all interviews, following Bearman's (2019) structured guidelines to ensure data comparability. Second, bracketing techniques were used during the analysis to ensure that the participants' lived experiences were not distorted by the researchers' beliefs and experiences (Mapp, 2008; Shosha, 2012). Lastly, member checking was conducted, where participants reviewed and confirmed the accuracy of the interview transcripts, further enhancing the trustworthiness of the study's findings.

Findings: The Long-Term Impact of the ITSL Project

The discussion in this section is grouped according to the different themes identified during the analysis of the transcribed interview data. The 10 participants (P1 to P10) comprised four males and six females ranging from 21 to 26 years of age. Among the 10 participants interviewed, the ITSL project led to significant positive outcomes. Initially, 7 participants were unemployed, with 3 working as volunteers. Post-project, 5 participants secured formal employment, while 2 established themselves as digital service entrepreneurs. Additionally, 3 participants became digital literacy trainers in various capacities, and 1 pursued further computer literacy certification. These outcomes demonstrate the project's effectiveness in creating both employment and entrepreneurial opportunities while also developing a sustainable cycle of knowledge transfer within the community.

Throughout this section, we will interpret the findings through the lens of the digital divide theory (Norris, 2001; Van Dijk, 2006), social capital theory (Putnam, 2000; Lin, 2001), and community development theory, particularly the ABCD approach (Kretzmann & McKnight, 1993).

Lived Experience Prior to the ITSL Project

Before starting the ITSL project, seven participants were unemployed—either doing nothing or just helping with chores at home. While some of them could not find employment, P9 lost his job due to COVID-19:

> I was working at the cinema, but due to the COVID pandemic, they did restructuring and I lost my employment.

The three employed participants held positions as groundbreakers (volunteers) at loveLife. Four of the participants regarded themselves as school or university dropouts:

> My mother and father were worried that I would not become anything because I did not finish school. (P10)
>
> I was at TUT [Tshwane University of Technology] in Shoshanguve. So I had to drop out because of some reasons. I came back home. (P5)

These experiences highlight the social divide aspect of the digital divide as described by Norris (2001), where socio-economic factors contribute to disparities in access to digital resources and opportunities.

Reasons for Participating in the ITSL Project

The participants believed the project was an opportunity to improve their chances of gaining employment or promotion. P5 stated that computer literacy qualifications would be helpful when searching for employment:

> It is very important to have a computer literacy certificate because it will be easy for me to apply for work at the retail shops or other companies to capture their data.

Many participants were computer illiterate, and the project created an opportunity to become computer literate. P7 was afraid of using technology but knew she had to overcome it:

> My reason was very simple. Because I was scared of technology, I knew that I had to learn how to use it.

The involvement of the UFS in the project also motivated several participants to participate, as P2 explained:

> It was an advantage to be part of something from a well-known institution.

These motivations align with Van Dijk's (2006) concept of motivational access, the first step in overcoming the digital divide. The participants recognised the importance of digital skills in improving their life prospects, demonstrating a motivation to engage with digital technology.

Participant Actions After Completing the ITSL Project

After completing the project, several participants started teaching friends and family what they had learned during the project. The participants also started applying for employment or promotion:

> After I finished the project, I got promoted. Because the following year, I became the facilitator for basic computer skills. Going from being a participant to being the facilitator. (P1)
>
> I started looking for employment. My computer skills helped me type and create my CV and send it out online. (P8)

Seven of the 10 participants voiced concern regarding the lack of employment opportunities in the project's implementation area. P7 commented:

> It is difficult to find a job here because of the lack of employment opportunities in Botshabelo. We must look for jobs in other towns.

The actions participants took after the project demonstrated progress in both skills access and usage access, as defined by Van Dijk (2006, 2020). Participants not only gained digital skills but also applied them in practical contexts such as job searching and teaching others. This knowledge-sharing also exemplifies the building of bonding social capital (Putnam, 2000), strengthening community ties through shared learning.

Impact on the Participants' Lives

The ITSL project significantly improved participants' employability. P2 noted, "*UFS is one of the universities people always want to go to. And if you show up with their certificate, the employers become interested*". Several participants found employment or were promoted after the project:

> P3: "I got a job here at loveLife. I'm a Groundbreaker now".
>
> P5: "I got employed as an assistant teacher. While working at the primary school, they discovered I have computer literacy skills. And then I could teach young learners because they have computers, but they did not have someone to teach the kids".
>
> P8: "My life changed for the better because I got employed after completing the project. I am a general school assistant now".

P5's concern about the lack of a qualified computer literacy teacher at her school supports Mpehle's (2011) observation that, despite having computer labs, rural schools often lack proper training for teachers and lab managers. The UFS certification proved particularly valuable in the job market, with employers recognising the prestige associated with training from an established university. This institutional credibility enhanced participants' employability compared to uncertified training programs.

The project helped participants become self-sufficient and more responsible. P8 stated: "*Now I can do everything on my own because I am earning an income and can pay for everything, and I am very responsible now*".

Participants' self-worth and confidence improved. P6 expressed: "*I feel like I am worth something, and I have these skills now, and I can use them to help others*".

Some participants became entrepreneurs, like P3: "*I help others to create and type their CVs so that I can make extra money every month. I also help them to apply for employment by helping them apply online for a fee*". The ITSL project fostered valuable networking connections among participants, local businesses, and the university. These networks proved crucial for entrepreneurial success, as participants leveraged their connections to establish digital service businesses, find clients, and expand their customer base through word-of-mouth referrals.

All participants reported becoming computer literate and using computers regularly. P6 summarised: "*A computer is something that makes you feel very uncomfortable for the first time. But this computer literacy project made it easier, and I'm not scared anymore*".

The project motivated some to pursue further education. P4 shared: "*It encouraged me to complete another certificate in computer literacy. I think it has changed my life because it has encouraged me to want to study further*".

Participants became agents of change, educating others about computer literacy and assisting with job applications.

These outcomes demonstrate how the ITSL project contributed to bridging the digital divide by improving both skills and usage access (Van Dijk, 2006). The increased employability and entrepreneurship opportunities align with Lin's (2001) network theory of social capital, showing how digital skills can be leveraged to access resources embedded in social networks. Furthermore, the emergence of participants as digital literacy advocates within their community exemplifies the principles of ABCD (Kretzmann & McKnight, 1993), where community members become drivers of their own development.

Impact of the ITSL Project on Friends and Family of the Participants

Participants used the skills gained from the project to educate colleagues, friends, and family, improving their computer literacy. P2 shared: "*My mother, my siblings, I taught them out of the project syllabus after we finished at loveLife*".

Many helped family members with school assignments, reducing household financial strain as some participants began contributing financially or living independently. P1 explained: "*Because now I'm the provider for the household. I bring in money to buy food".*

Parents, initially concerned about their children's future, regained hope. P4 noted: "*My father and my mother lost hope, but after I attended the project, they now have hope that I will be something*".

Participants also assisted family and friends with job searches, typing CVs, and applying online. P6 observed growing interest in the ITSL project: "*People are* *asking when the UFS project is coming again because they want to register and get certificates from the university*".

The ripple effect on friends and family reflects the building of bonding and bridging social capital (Putnam, 2000). By sharing skills within their circles (bonding capital) and helping others access jobs (bridging capital), participants contributed to community development, aligning with the ABCD approach (Kretzmann, J.P., McKnight, 1993).

Sarah's Journey

In this sub-section, we would like to share the amazing journey of one project participant, Sarah,[1] who, as a direct result of the ITSL project, found her way out of poverty to becoming self-sufficient, being a provider for her family, and making a very important contribution to her community.

"Hi, I'm Sarah, a 24-year-old female. I worked as an unpaid volunteer at the loveLife facility in Botshabelo while attending high school and living with my family. When I heard about the ITSL project at the loveLife Youth Development Centre, I decided to register, believing it would be advantageous since a well-known institution organised it. I enjoyed the project immensely. It improved my computer literacy skills, and I was even able to help other participants who struggled. The MS Word and MS Excel videos and weekly assignments created by the service-learning students were particularly helpful in teaching me how to use these programs.

Participating in the project was an excellent decision. I'm very proud of the qualifications I received, as they helped me find employment. Immediately after completing the ITSL project, I became a facilitator in the computer labs at the loveLife facility in Botshabelo. I wanted to apply my new skills to teach others, and I even taught my mother and siblings what I had learned.

While at loveLife, I continued looking for other opportunities. I applied online, including my loveLife experience and ITSL certificates in my applications. Within a week, I was called for an interview. The employers were very interested when I showed up with the UFS certificates. This led to my appointment as a facilitator and data capturer [see Fig. 20.3*] in the USAID DREAMS program, an HIV/AIDS initiative implemented across 15 countries.*

My new role involves presenting information and education sessions at schools for girls [see Fig. 20.4*] and capturing data. They provided me with a new cellphone and a computer to work from home. This job required me to move to Welkom in the Free State, where I became self-sufficient. I'm no longer a burden on my family; instead, I now support them by sending money for food and electricity.*

I use computers daily in my workplace and help others write CVs and apply for jobs online. I've noticed many people in my community are unaware of online job opportunities, so I've been showing them how to access these.

[1] Sarah is a fictional name given to protect the identity of the participant.

Fig. 20.3 Sarah's USAID DREAMS project team

Fig. 20.4 Educational HIV/AIDS session being presented by Sarah

Looking back, I realise the importance of receiving certifications with training. I had previously attended a computer training session at loveLife without getting qualifications. It's crucial that certificates accompany training because employers want proof of computer literacy skills. Even if you learn the skills, without a certificate, it doesn't help much in securing employment. The ITSL project and my subsequent jobs have transformed my life, allowing me to become financially independent, support my family, and help others in my community".

Sarah's journey provides a compelling illustration of how the ITSL project aligns with ABCD principles, as proposed by Kretzmann and McKnight (1993):

- **Identifying and mobilising existing assets**: The ITSL project recognised the potential within community members like Sarah, who was initially an unpaid volunteer. The project mobilised her as a valuable community asset by providing her with digital skills.
- **Community-driven development:** Sarah's progression from project participant to facilitator at loveLife and then to a role in the USAID DREAMS program exemplifies how the skills gained through the project enabled community members to drive their own development.
- **Relationship-driven processes:** Sarah's story highlights the importance of relationships in community development. Her connections with the ITSL project, loveLife, and eventually USAID DREAMS illustrate how social networks can be leveraged for individual and community benefit.

Conclusion

The ITSL project implemented in Botshabelo, South Africa, demonstrates the transformative potential of targeted digital literacy initiatives in fostering sustainable development within rural communities. This study's findings reveal significant and lasting impacts on participants' lives, extending beyond mere skill acquisition to encompass broader socio-economic empowerment. Key outcomes of the ITSL project include the following:

- Enhanced digital literacy and self-confidence among participants.
- Improved employment prospects and career advancement opportunities
- Emergence of participants as digital literacy advocates within their communities
- Positive ripple effects on families and the wider community and
- Contribution to an emerging local digital business ecosystem

The success of the ITSL project underscores the critical role that HEIs can play in addressing the digital divide and promoting sustainable development. By bridging the gap between academic knowledge and practical community needs, service-learning initiatives such as this one can drive meaningful change in underserved areas.

Moreover, the study highlights the importance of long-term impact assessment in evaluating the efficacy of such interventions. The experiences shared by participants 16 months after the project's conclusion provide valuable insights into the sustained benefits of digital literacy training, offering a more nuanced understanding of how such initiatives contribute to individual and community development over time.

Notably, the ITSL project has contributed to the emergence of a local digital business ecosystem in Botshabelo. Participants have not only found employment but also become entrepreneurs, offering services such as CV writing and online job application assistance. This grassroots economic activity, rooted in newly acquired digital skills, suggests the potential for such projects to spark innovative, technology-driven micro-enterprises in rural areas. The ripple effect of knowledge sharing and skill transfer within the community further strengthens this emerging ecosystem, creating a self-reinforcing digital empowerment and economic opportunity cycle.

The ITSL project's success in Botshabelo offers a replicable model for other rural and marginalised communities facing similar digital exclusion challenges. It demonstrates how targeted educational interventions can align with the United Nations' Sustainable Development Goals (SDGs), particularly in areas such as quality education, decent work and economic growth, and reduced inequalities (United Nations, 2015).

In conclusion, the ITSL project is a strong example of how service-learning can tackle development challenges by empowering people with digital skills and fostering continuous learning. As the world becomes more digital, ensuring equitable access to digital literacy is essential for both development and social justice. This project's success in training community members and promoting entrepreneurship underscores its potential as a model for rural development in the digital age.

Limitations

The study's findings are based on a specific context: the ITSL project facilitated by the UFS in South Africa. The results may not be generalisable to other service-learning projects or communities with different socio-economic backgrounds, educational levels, or cultural contexts.

Future Research

Future research and practice should focus on scaling up successful models such as the ITSL project to reach more communities, integrating digital literacy into broader development programs for holistic empowerment, and fostering partnerships between academia, government, and the private sector to sustain and expand such initiatives. Additionally, investigating the long-term economic impact of digital literacy in rural economies is crucial. The ITSL project in Botshabelo has significant growth potential, with plans to expand to other communities, diversify skills, engage policymakers, and ensure sustainability through community ownership. Continuous research and innovation will support its scalability and adaptability to different contexts and evolving digital needs.

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Statement on Ethics Ethical clearance for this study was granted by the General/Human Research Ethics Committee of the University of the Free State (Ethical clearance number: UFS-HSD2020/1088/2508). Informed consent was secured from all participants, ensuring they understood the research objectives and their right to withdraw at any time. Confidentiality was upheld by anonymising interview transcripts. Due to the sensitive nature of the inquiry, care was taken to ensure participants felt comfortable sharing their experiences.

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Chapter 21
Preparing the Youth for the Workforce of Tomorrow: Investigating Virtual Reality (VR) in Higher Education Institutions (HEI)

Sunet Eybers, Bester Chimbo, Charlotte Lungile Hlengwa, Lario Malungana, and Tebatso Gina Moape

Abstract Innovative technologies and teaching approaches have become a necessity in our digital society. Higher Education Institutions cannot afford to be left behind as they are responsible for educating and exposing our youth to these technologies while transferring knowledge and skills in innovative ways. The objective of this study was to investigate what research has been published on the topic of virtual reality in higher education institutions whilst also considering how virtual reality was used in these environments. A systematic literature review was conducted, and it resulted in 193 articles. Nineteen subject areas were identified, of which general education, engineering, and medicine were the most prevalent. In each subject area, a short description of how virtual reality was used was included. The study identified the scope for future investigation into computer science and information technology, chemistry, construction, entrepreneurship, geography, healthcare, horticulture, library science, mathematics, and sustainability.

Keywords Education · Higher education institutions · Immersive · Virtual reality

Introduction

Virtual Reality refers to virtual environments displayed on a screen and requires no specialized equipment. In contrast, immersive virtual environments are environments where the users' senses are engaged, whereby users experience a sense of presence in a virtual world. While immersive virtual reality requires specialized

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equipment, such as a special headset, these environments are believed to have enormous benefits in domains such as immersive learning, industrial training, gaming, healthcare, travel and tourism, farming, mining, construction, development, hazardous environment training, to name a few (Jensen & Konradsen, 2018; Suh & Prophet, 2018).

Institutional environments often use virtual reality (VR) technologies in subjects like science, technology, engineering, and mathematics (STEM) (Safikhani et al., 2022). Lawson (2024) and Lee (2020) further highlighted the enormous potential of Immersive VR technologies used in STEM education, including opportunities to acquire programming skills (in objective-oriented programming and writing program code), computational thinking, innovation, invention, and project skills while working in virtual environments. Furthermore, immersive VR can foster an understanding of key theoretical constructs due to “experience” simulations of near-natural real-world environments and subsequently acquire skills impossible in HEI instructor-led environments. A good example is the study by Wang (2022), where student nurses got the opportunity to administer chemotherapy in a virtual environment. Through this immersive environment, the students acquired skills and exposure otherwise impossible to acquire through videos and instructions.

However, earlier research presented by Bricken (1991) identifies challenges such as fear of technology and lack of knowledge and skills when engaging with virtual reality technologies, the potential misuse of the technology, and fear of confusion (to name a few) (Safikhani et al., 2022).

Today’s youth are exposed to immersive virtual reality technologies at a very young age in our digital society. Therefore, more than just traditional methods of interacting with a computer is required to meet the user experience requirements of the digital society (Radianti et al., 2020). Generally, HEI, traditional teaching and learning methods, such as instructor or facilitator-led sessions, must be supplemented with technology, allowing students to learn through their experience with near-life environments. One such technology is immersive virtual environments, which can transform traditional educational environments to meet the ever-increasing demands for computer user experience improvements (Rogers, n.d.). This paper provides insights for HEI institutions to keep up with the user requirements and expose learners to these technologies as part of safe education environments.

Also, as mentioned above, immersive VR can foster the understanding of key theoretical constructs because they experience simulations of near-real-world environments and subsequently acquire skills not possible in HEI instructor-led environments. Therefore, without considering using these technologies as part of their teaching and learning strategies, HEIs might miss out on an opportunity to foster teaching and learning and provide quality education (per the institution’s overall strategic goal).

Based on the potential benefits and challenges associated with using immersive VR technologies in HEI, this research aims to investigate how immersive virtual reality environments can foster teaching and learning in HEI by considering two research questions, namely: (1) What academic research has been conducted over the past nine years on immersive VR in HEI environments? and (2) How does HEI use immersive VR for teaching and learning? The objective of the first question is to explore the current academic landscape of publications considering immersive VR in HEI. In contrast, the second research question investigates how HEI uses immersive VR.

The paper starts with an overview of previously published literature on Virtual Reality and the various technologies and scenarios in which this technology can be used, followed by a description of the Research Approach. The Research Analysis and Discussion section describes the analysis and discusses the findings of the systematic literature review, after which the paper concludes.

Virtual Reality

The versatility of Virtual Reality technologies is evident in their use in diverse industries and sectors, including automotive, healthcare, retail, travel and tourism, architecture, real estate, interior design, mining, recruitment, and learning and development. For example, VR is employed in customer interaction, vehicle design, engineering, staff training, and sales in the automotive sector (Lawson et al., 2015). Early design and vehicle engineering reviews conducted using VR provide significant cost reductions compared to physical prototypes and create collaboration platforms for engineers across geographical areas (de Clerk et al., 2019; Schwarz et al., 2020).

Generally, specific VR technologies are used in various industries. For example, the *HTC Vive* is a head-mounted display used by leading car manufacturing companies to provide engineers and designers with a real-time platform to work on a car model remotely or an engine assembly (Win et al., 2021). In tourism, *VR Expeditions 2.0* is a tool geared for tourists to travel the world in the comfort of their own homes. It provides a “try before you fly” experience that allows travelers to glimpse their destination before any purchase, improving and managing expectations in the traveler experience. Communication, sales, public speaking, and active listening skills are all soft skills that demand staff development (Dubiel et al., n.d.). Virtual reality language learning platforms like VirtualSpeech and MondlyVR support speech proficiency while reducing public speaking anxiety (Shafiee Rad, 2023); and also provide staff development training, blending e-learning, online simulations, and practices (Dubiel et al., n.d.). The same is true in healthcare, where medical personnel such as surgeons undertake surgical training virtually by interacting with medical devices to perform medical procedures and assessments on virtual patients. In driver training, TeenDrive365, another leading vehicle manufacturer, is enabled with realistic 3D graphics, animations, noises, and full simulations of road traffic for a holistic driving experience (TeenDrive365, 2025).

In HEI environments, the simulation of near-real-world environments for teaching and learning across various subjects allows for dynamic interaction whereby learners can engage in a “safe” environment, including where specialized training is required, with no unintended consequences (Chen et al., 2023). VR environments are subdivided into two distinct categories, depending on the user's immersion level, including non-immersive and immersive VR. Non-immersive VR requires less-specialized equipment since users interact with the environment using a keyboard, mouse, game console, or touchscreen (Chen et al., 2023). An example is a VR desktop, where the three-dimensional virtual environment is displayed on a desktop, whereby the user engages with the environment without becoming immersed (or part of) (Bicalho et al., 2023). Immersive VR environments, on the other hand, require specialized equipment, systems, and technologies, for example, Cave Automatic Virtual Environment (CAVE) (projecting 3D images in an enclosed space); and Head-Mounted Display (HMD) (also known as VR goggles, worn as a helmet on the head) (Bicalho et al., 2023; Chen et al., 2023).

Popular HMD brands of immersive VR technologies include Oculus Rift and HTC Vive (Bicalho et al., 2023). More advanced immersive technologies exist where a combination of HMDs, bodysuits, and data gloves is used. Although a study by Smutny (2023) found that the majority of VR applications were free, expensive applications were the majority and ranged from $20.00 to $22.99. The study, unfortunately, did not consider additional maintenance and upgrade costs. Examples of cost-effective, free technologies typically suitable for developing countries were mobile VR, in the form of downloadable applications. Another popular example includes Google Cardboard, which was successfully used by Malinchi (2017) to engage in a virtual library environment. The application allows users to use a cost-effective cardboard viewer in VR. The cardboard viewer can be hand-made and designed to fit around a smartphone, acting as VR goggles. Despite the many technologies available, Radianti (2021) highlighted important considerations users consider before selection, such as "price, equipment, functionality, and availability." Costs seemed to be a huge consideration, as most of the VR applications used for educational purposes, irrespective of the application area, were freeware (Radianti, 2021).

Research Approach

A systematic literature review was conducted to explore the current landscape of Immersive Virtual Reality in HEI. The review focused on the Scopus database as the primary source of extensively published literature during the last nine years (2014 to 2024). Harzing's Publish or Perish (Harzing, 2007) was used to ensure the quality of articles returned. This freeware tool assists with academically published literature searches by considering filters such as year, author affiliation, publication name, title words, and/or keywords. The tool furthermore allows searches in PubMed, Semantic Scholar, Scopus, Google Scholar, or by considering cross-references. The searchers are based on the metadata of academically published articles, with information supplied, such as the number of citations per article, with a ranking number according to the citations. Other valuable data includes the name of the publication outlet and the type of article, for example, reviews, conference proceedings, journal articles, or book chapters.

The final list of academic publications was derived after following a rigorous approach to ensuring quality, as specified by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach by Page et al. (2021). The articles' metadata (including article abstracts) were used to classify and discuss key findings according to the subject areas.

Systematic Literature Review Process

The PRISMA (2020) approach was structured for conducting systematic literature reviews and dictates a four-phase approach.

Phase 1—Article identification: The following keywords were searched in the Scopus database, using Harzing's Publish or Perish: "virtual reality" and/or "immersive" and "higher education," with a year restriction of 2014–2024. The top 200 articles were returned based on the highest number of citations. The highest citation number was 1391, and the lowest was 0. Scopus was included to avoid duplicates, as other academic databases often contain the same articles. A backward search was conducted where applicable.

Phase 2—Screening: Five lines were removed from the 200 articles from phase one, as they referred to the same conference proceeding document, whilst two articles were not in English. No duplicate articles were identified.

Phase 3—Eligibility: The remaining 193 articles were evaluated for eligibility by considering the author keywords and article abstracts. All the articles focused on the main search keywords and seemed relevant.

Phase 4—Final research article pool: The final research pool comprised 193 articles published in peer-reviewed academic outlets.

Research Analysis and Discussion

Most articles were published in 2023, namely 47, followed by 2024 (33) and 2022 (30). Although not academically supported by evidence, a reason for the substantial number of publications in 2023 might be due to the post-pandemic digital transformation. In 2018, a significant decrease in the number of publications was experienced. This finding is similar to the finding by Rashid's (2021), who identified a similar trend in the bibliometric study in 2021 (Fig. 21.1).

Most of the publications appeared in Journals (115), followed by Conferences (69) and Book Chapters (9).

When evaluating the conference publications, most of the publications appeared in the ACM International Conference Proceeding Series (8), Lecture Notes in Computer Science (7), Education Sciences (7), and Sustainability (Switzerland) (6).

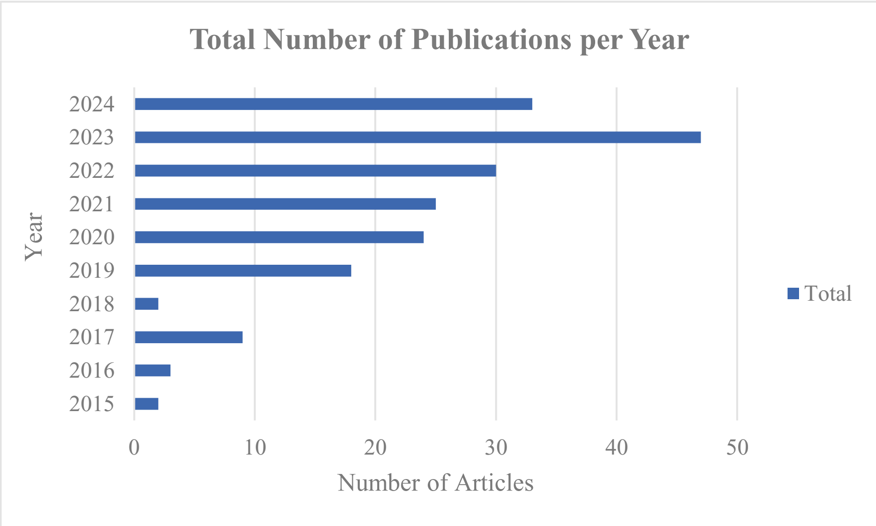

Fig. 21.1 Total number of publications per year

The following outlets contained four publications each: Interactive Learning Environments, Communications in Computer and Information Science, Education and Information Technologies, Lecture Notes in Networks and Systems, and Electronics (Switzerland).

Papers were classified according to the subject area on which the papers focused. Nineteen (19) subject areas were identified, of which the General Education subject area was the most prevalent. Table 21.1 summarizes all the subject areas, indicating the number of articles (Fig. 21.2).

A study by Radianti (2021) investigated the current availability of VR applications for educational purposes. Included in the study was a summary of the application areas, which are referred to as subject areas in this study. The study identified 24 areas in 2020, whilst 23 areas were identified in 2021.

Whilst no provision was made for the study by Radianti (2021) to include a general category focusing on general aspects of Education, the areas where VR was applied and listed according to the highest rank included Nature (15.8%); Space (14.5%); Art (10.7%); Medicine (10.3%); History (9.8%); Game (6.8%); Architecture (6.0%), etc. Although no provision was made for Nature and Space as separate categories, it can be classified as part of this study's STEM category, which was identified as a subject area that returned the third highest number of articles, corresponding with the study by Radianti (2021). Other similarities in the findings included the Medical category, ranked nr 4 by Radianti (2021) and ranked nr 2 in this study; and Architecture ranked nr 7 by Radianti (2021) and nr 5 in this study. Whilst the utilization of VR in language studies was ranked higher by this study, namely, nr 6, the study by Radianti (2021) ranked it third from the bottom. Surprisingly, neither study found evidence of publications focusing on using VR in Computer Science and Information Technology, as these disciplines are knowledgeable and at the forefront of technology.

Table 21.1 Summary of articles per subject area

#	Subject area		Number of articles	%	Reference(s)
1	General education		119	62	(Janßen, 2016; Calvet, 2019; Papanastasiou, 2019; Wohlgenannt, 2019; Detyna, 2020; Kalkofen, 2020; Lee, 2020; Natale, 2020; Radianti et al., 2020; Young, 2020; Fromm, 2021; Pellas, 2021; Radianti, 2021; Rashid, 2021; Villalba, 2021; Bernardo, 2022; Coban, 2022; AbuKhousa, 2023; Betts, 2023; Evens, 2023)[a]
2	Engineering (including mining, mechanical, and electrical engineering)		15	8	(Laseinde, 2016; Kamińska, 2017a, 2017b; Maffei, 2019; Violante, 2019; Kalkofen, 2020; Soeiro, 2020; Jalil, 2022; Lara-Prieto, 2022; Marks, 2022; Albarracin-Acero, 2024; Azofeifa, 2024; Ghazali, 2024; Solmaz, 2024; Wong, 2024)
3	Medical		14	7	(Buń, 2015; Dubovi, 2017; Irwin, 2019; Birbara, 2020; Mariscal, 2020; Botha, 2021; Lucena-Anton, 2022; Pickering, 2022; Ranieri, 2022; Kiegaldie, 2023; Kumar, 2023; Lee, 2023; Aasekjær, 2024; Ewais, 2024)
4	STEM		9	5	(Pellas, 2020; Garduño, 2021; Li, Zhang and Luo, 2021; Miller, 2021; Pande, 2021; AlGerafi, 2023; Majewska, 2023; Lawson, 2024; Lee, 2024)
5	Architecture		7	4	(Sanchez-Sepulveda, 2019; Jenek, 2021; Ummihusna, 2022a, 2022b; Hajirasouli, 2023; Shanti, 2023; Andalib, 2024)
6	Language		6	3	(Berns, 2018; Soto, 2020; DeWitt, 2022; Nicolaidou, 2023; Qiu, 2023; Yuan, 2023)
7	Arts		5	2	(Vicent, 2015; González-Zamar, 2020; Hutson, 2022; Queiroz, 2022; Jiawei, 2023)
8	Science		4	2	(Bennie, 2019; S. M. Reeves, 2021b; Lui, 2023; Rakhmonov, 2023)
9	Biology		4	2	(Rai, 2019; L. E. Reeves, 2021a; Xue, 2023; Wallgrün, 2024)
10	Computer Science and Information Technology		2	1	(Bujdoso, 2017; Alfalah, 2018)
11	Other category	Chemistry	1	4	(Ramirez, 2020)
12		Construction	1		(Jong, 2022)
13		Entrepreneurial	1		(Grivokostopoulou, 2019)
14		Geography	1		(Jochecová, 2022)
15		Healthcare	1		(Schiza, 2023)
16		Horticulture	1		(Kee, 2022)
17		Librarian	1		(Suen, 2020)
18		Mathematics	1		(Miyazawa, 2020)
19		Sustainability	1		(Paszkiewicz, 2021)

[a]Only the top 20 highest-cited papers are included due to page restrictions

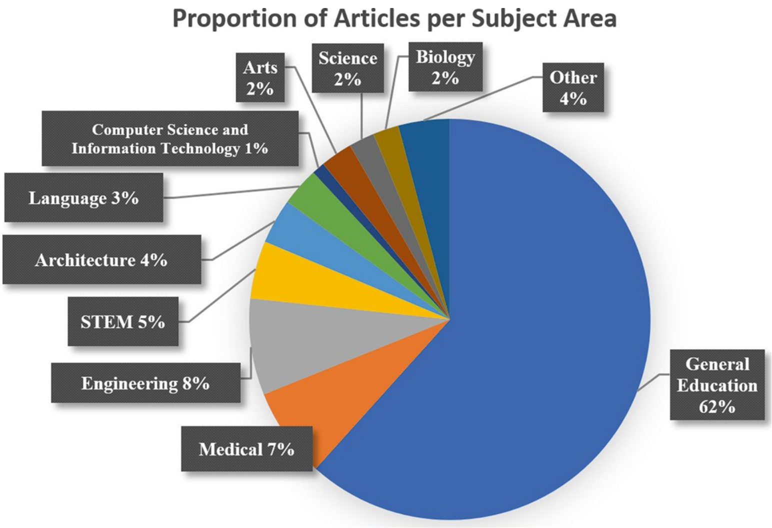

Fig. 21.2 Proportion of articles by subject area

General Education

The General Education subject focus area dealt with general educational approaches, not specifically focusing on a particular area or discipline, such as the application, benefits, challenges, and good practice of VR adoption for academic purposes (Calvet, 2019). As rightfully indicated by Adnan (2020), VR is not just a trend but has become essential to teaching and learning in the Education 4.0 era. This era focuses on adopting and utilizing advanced technologies as part of the Fourth Industrial Revolution, which fosters innovation, interconnectivity, and automation. A study by Buń (2015) underscored the utilization of VR technologies to promote the acquisition of necessary digital skills such as creative thinking, problem-solving, decision-making, and collaboration (Bernardo, 2022), as well as knowledge (Bernardo, 2022; Lee, 2020). It is imperative to meet the demands of the Education 4.0 era.

The highest cited article, namely a study by Radianti et al. (2020) was included in the General Education category. Generally speaking, the articles in this category consider the utilization of VR in presenting learning content, and instructional design elements to be considered (Fromm, 2021; Pellas, 2021; Wohlgenannt, 2019; Young, 2020), and the inclusion of learning theories when VR is adopted in learning environments (Radianti et al., 2020). The immersive nature of VR directly contributes to students' motivation and increased engagement, whilst facilitating learning (Detyna, 2020; Natale, 2020), as well as a sense of presence and positive student emotions (Lønne, 2023). However, a study by Coban (2022) found that the level of education, education field, and combination of computer-based and traditional sources influence the effect of immersive VR technologies on teaching and learning. Not surprisingly, then, research by AbuKhousa (2023) proposed an "architecture to develop a metaverse-intensive learning experience (MiLEx) platform."

Other interesting findings were the investigation into the influence of user experience on task performance in virtual learning environments Botha (2021); the ability of Virtual Reality to increase empathetic capability Villalba (2021); and the effectiveness of learning retention and spatial skills in learning environments (Betts, 2023). A bibliometric study by Rashid (2021) highlighted the interdisciplinary nature of VR, which is not focused on the domain of Computer Science or Information Technology but rather on the application to other subject areas such as Medical, Engineering, and STEM. This is in line with the findings of this paper, where 19 subject areas were identified.

Finally, there was a strong focus on utilizing 360-degree videos, also referred to as surround video, which allows for creating videos that record images in all directions (Adnan, 2020; Berns, 2018, 2020; Chinello, 2019; Evens, 2023; Lie, 2023; Mendoza, 2023; Natale, 2020; Ranieri, 2022). A study by Evens (2023) suggested design guidelines focusing on 360-degree environments.

Engineering

Research conducted by Marks (2022) reported enhanced learning outcomes in the engineering faculty. A study by Kamińska (2017a, 2017b) used a customized prototype to foster VR-supported teaching and learning in a mechanical and electrical engineering learning environment, which showed potential to improve the quality of engineering education. This is similar to research by Ghazali (2024) and Albarracin-Acero (2024) the authors also used an in-house developed environment to teach electronic engineering subjects.

In a study conducted by Violante (2019), the author proposed using 360-degree videos, a popular approach across many domains, for engineering education. This is supported by Kalkofen (2020) using the same 360-degree video approach in mining engineering education. This allowed students to experience real mining environments without actual field trips and exposure to potentially dangerous situations.

Research investigating the use of VR in engineering subjects has been examined by many authors (Azofeifa, 2024; Jalil, 2022; Lara-Prieto, 2022; Laseinde, 2016; Solmaz, 2024), with a specific focus on VR to teach mechatronics (Kamińska, 2017a, 2017b); production engineering subjects (Maffei, 2019); construction engineering (Soeiro, 2020); VR in electronic engineering (Albarracin-Acero, 2024); and experiments to investigate the effectiveness of VR environments on mechanical engineering education (Wong, 2024).

Medical

Five articles in the medical subject area focused on Nursing Education (Botha, 2021; Dubovi, 2017; Irwin, 2019; Kiegaldie, 2023; Lee, 2023), covering topics such as non-invasive simulators to acquire skills in medication administration and managing conditions. Other focus areas included Anatomy (Aasekjær, 2024; Birbara, 2020), medical first aid training (Mariscal, 2020), neuroscience (Pickering, 2022), ultrasound (Buń, 2015), physiotherapy (Lucena-Anton, 2022), and molecular biology (Ewais, 2024). Research by Kumar (2023) investigated medical students' "desire to learn" when using VR technology.

Science, Technology, Engineering, and Mathematics (STEM)

A study by Pellas (2021) evaluated the suitability and efficacy of teaching practices, whilst the authors found that very little literature considered measuring learning performance in VR educational environments. However, Pande (2021) studied the long-term effect of VR technology and found an increased level of student performance (similar to findings by Miller (2021)), enjoyment, and benefits. Furthermore, AlGerafi (2023) and Lee (2024) found that collaborative, virtual learning environments contribute to the learning experience of students as well as overall learning effectiveness, engagement, and motivation (AlGerafi, 2023; Garduño, 2021). Majewska (2023) indicated that students perceived VR technology to assist them with acquiring knowledge and skills, but like the findings by Pellas (2021), an increase in learning performance could not be confirmed. In a study by Lawson (2024) the authors explored various studies on immersive virtual reality and found that control variables or criteria are often lacking in comparison studies with traditional learning methods. Finally, a study by Li et al. (2021) found numerous challenges when using VR/AR/MR technologies in educational environments.

Architecture

Research focusing on VR in architecture education is vast, including a systematic literature review that found that VR was mainly used in architecture design subjects Ummihusna (2022a), whilst Hajirasouli (2023) proposed an "immersive pedagogical framework" to expose students to a more engaging interactive learning environment in architecture courses. A study by Sanchez-Sepulveda (2019) investigated virtual gamification strategies in urban design, which provided for an agile, collaborative educational environment. VR technology was explored as an experiential learning approach in architecture design courses Ummihusna (2022b) whilst Shanti (2023) discovered that VR was used to teach students the history of architecture. Finally, Andalib (2024) reported on using VR in landscape architecture education, whilst Jenek (2021) explored how VR can be used in virtual design environments.

Language

Virtual Reality has been used in language education by many scholars, including Qiu (2023) who investigated the use of VR/AR in language learning and the improvement of English as a communicative, additional language (Soto, 2020). It is noted in the study that VR also seemed to be a popular approach in foreign language education. Berns (2018) included a study by Nicolaidou (2023) exploring the use of VR versus mobile applications in foreign language learning, the use of 360-degree videos in foreign language learning, and improving competence in Mandarin as a foreign language (DeWitt, 2022).

Arts

Research by Jiawei (2023) investigated VR in art education and art history (Hutson, 2022), whilst González-Zamar (2020) investigated the consequences thereof, and Vicent (2015) focused on assessments in a 3D arts course. Queiroz (2022) used a bespoke VR application in textiles and fashion design education.

Science

The Science subject area category only covered aspects related to Science, in contrast to the much wider STEM category, where Science, Technology, Engineering, and Mathematics were included.

In a study by Lui (2023), the authors adopted a theory-based learning approach using VR as part of science education design. Studies conducted by Reeves (2021a, 2021b) and Rakhmonov (2023) used virtual laboratories in teaching and learning, in particular, undergraduate chemistry (Reeves, 2021a, 2021b) and Rakhmonov (2023) specialized sciences education. Research by Bennie (2019) focused on VR in teaching enzyme catalysis.

Biology

In a study by Reeves (2021a, 2021b) the authors explore the use of VR in bioscience education whilst Wallgrün (2024) used VR to prepare biology students for fieldwork. VR was used in a virtual lab simulation based on gamification in biology classrooms. In the meantime, Rai (2019), and Xue (2023) also used virtual laboratories to teach food microbiology.

Computer Science and Information Technology

Research focusing on using VR in education in the Computer Science and Information Technology subject area was in the minority. A study by Alfalah (2018) investigated the use of VR as a teaching aid in IT curriculum whilst Bujdoso (2017) focused research on using VR in teaching a system development module.

Conclusion

The study explored the current landscape of academically published articles on Virtual Reality (including immersive technologies) used in education to understand the extent of research and how these technologies were used. This is important as understanding current research can be used to expand and perform future research to prepare the youth for the world of work. The study identified 19 subject areas in which VR technologies were used, with the most popular subject areas being General Education, Engineering, and Medicine. The most popular method identified in the research article pool was 360-degree videos.

In the Education subject area, most studies focused on the benefits, challenges, applications, increased engagement, and motivation, making it challenging to identify how VR technologies were used in this environment. In the medical subject area, non-invasive simulators seem to be a popular method for acquiring skills across various medical areas. The Engineering subject area used prototypes to address challenges associated with field visits. Research in the STEM subject area predominantly focused on increased learning performance, which seemed inconclusive. The Architecture subject area focused on the design aspects of the discipline, allowing students to acquire knowledge and skills in a virtual environment. The Language subject area focused on teaching foreign languages, whilst the Science area used virtual lab simulations. Finally, VR was used as a Computer Science and Information Technology teaching aid.

The study's findings underscored the importance of using VR technology across disciplines and subject areas. Still, they highlighted the scope for future investigation in Computer Science and Information Technology, Chemistry, Construction, Entrepreneurial, Geography, Healthcare, Horticulture, Library Science, Mathematics, and Sustainability.

Despite the limitation of only considering the top 200 most cited papers and the top 20 highest-cited papers in the General Education category, we believe the paper's findings significantly contribute to understanding the current academic landscape of VR in education. The authors suggest that future work should focus on an in-depth analysis of one subject area at a time. We further believe that VR technologies will in the future play a key role in educational environments, as the youth already extensively use these technologies for recreational purposes.

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Chapter 22
Transforming Education with AI: Sustainable Curriculum Development Approaches

Havisha Vaghjee

Abstract The integration of Artificial Intelligence (AI) in designing curricula has been a key tool in developing sustainability in education worldwide. As instructors and policymakers work toward adopting inclusiveness and diversification in classrooms, the application of AI-powered analytics is an effective tool in developing personalized student experiences around each student's individual needs. This is not only an added value in student engagement but is an assistance in providing academic success by considering varied student modes of learning and capabilities. Using AI to analyze vast amounts of teaching and learning-related data helps education stakeholders determine areas to be improved upon, emerging trends, and preexisting gaps to empower better curricula development. The use of such data helps ensure educational content is topical, relevant, and efficient in addressing changing requirements in this modern era. In addition, the collaboration between educators and artificial intelligence tools allows for better creativity and an innovative environment, which enhances the learning experience and promotes critical thinking and problem-solving skills. For this research work, a systematic literature review approach will be used to understand the application of artificial intelligence in developing curriculum, while looking into the AI-related innovative tools that can be used in teaching and learning, the benefits to be gained, and the challenges encountered. Undeniably artificial intelligence has a lot of promise for education, however, the ethical challenges associated with its adoption and use need to be addressed. An ethically responsible approach has to be maintained in handling confidential data, thus improving equity and transparency in using algorithms. A balance between the benefits gained from AI and an ethical approach will enable the creation of a viable and resilient learning environment. This study looks into the implications of using AI for curriculum development and its influence on teaching

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and learning. An overview of the present applications, benefits, and ethical considerations of artificial intelligence in education will contribute to the discourse on how to foster more inclusive, innovative, and effective learning environments.

Keywords Artificial intelligence · Sustainable curriculum · Higher education · Digital transformation · Educational technology

Introduction

Education in the digital age presents both opportunities and challenges. Artificial Intelligence (AI) has been a key driver in content development, delivery, and assessment. Through the years, AI has moved from data processing and automation to educational innovation particularly in curriculum development (Nedungadi et al., 2024). The traditional approach to curriculum development has been heavily dependent on pedagogical theory and content. However adaptive and personalized learning requires curriculum changes to meet evolving technologies and societal needs (Joshi, 2023; Moleka, 2023). Using AI in curriculum development not only addresses students' learning needs but also provides a framework to keep education content up to date (Ahmed et al., 2024).

The promise of AI lies in its ability to process large amounts of data to identify patterns and recommend actions that can improve learning outcomes (Baker & Inventado, 2014). For instance, AI-driven analytics can identify learning gaps, monitor student performance in real-time, and recommend adjustments that can shape the learning experience of individual students according to their needs. This is crucial in tertiary contexts where the diversification of learners justifies the responsive and inclusive design of courses (Yadav, 2025). Researchers such as Luckin et al. (2016) and Fadel et al. (2019) agree that AI can transform teaching and learning through evidence-based insights that can help design courses more efficiently and dynamically.

Sustainable curriculum development ensures education content is relevant in a rapidly changing technological world. Traditional curriculum development and revisions rely on periodic updates which often lag behind emerging trends. However, AI integrated approach allows continuous testing and repeated refinement and hence long-term curriculum validity. Moreover, collaboration between educators and AI tools creates a learning environment through creativity, critical thinking, and problem-solving skills needed in the twenty-first century (Kasztelnik, 2024).

Literature Review

AI has advanced significantly in recent years with applications ranging from intelligent tutoring systems to predictive analytics. In education, most uses of AI revolve around facilitating better learner experience, automated administration, and informed decisions through data-driven decisions, for instance, by identifying at-risk students or optimizing curriculum content through predictive analytics. Among the most influential uses of AI in education are:

- Machine Learning (ML): ML algorithms are used to process educational data to identify patterns to inform the design of curricula. As an example, ML can be used to predict student performance and recommend personalized pathways of learning.
- Natural Language Processing (NLP): NLP allows AI systems to understand and generate human language, and to support the design of intelligent tutoring systems and automated testing tools.
- Data mining: Data mining is employed to translate large amounts of data into meaningful information to support instructors in identifying trends and gaps in student learning.

Artificial Intelligence in Education

Traditionally, AI was integrated into education through the development of computer-assisted instruction and rule-based systems. The early works by Woolf (2010) laid the foundation for the development of intelligent tutoring systems (ITS) and adaptive learning environments. Initially, these systems only attempted to offer personalized assistance and feedback to learners in an attempt to speed up performance in learning through personalized instructional practices.

Over time, advancements in machine learning, natural language processing, and big data analytics have expanded the potential of artificial intelligence in teaching. Research has shown that AI can support various aspects of teaching and learning (Ahmed et al., 2024; Kasztelnik, 2024; Williamson, 2017). Adaptive learning systems, for instance, now employ algorithms that dynamically change content following student performance measurements (Holmes et al., 2019). However such changes must be cautiously managed so as not to oversimplify critical subject matter. Similarly, AI analytics can sort through vast amounts of instructional content to determine trends to guide curriculum development. All these advancements have created a paradigm change in teaching practice where AI is not only considered to be an instructional aid but is increasingly regarded as a tool for educational reform (Asy'ari & Sharov, 2024).

Sustainable Curriculum Development

Sustainable curriculum design is an evolving process through which course programs are developed, refined, and planned to remain viable in the long term. Traditional ways to design course curricula have otherwise been through a static, cyclical process done at periodical intervals. However, these traditional models fail to keep pace with emerging trends in technology and shifts in society. Researchers such as Mishra and Koehler (2006) have recommended embracing more flexible models whereby technology is integrated in designing course curricula.

The design of the curriculum in line with the theory of sustainability is not just about revising content in line with trends but ensuring the curriculum is future-proof (Aggarwal, 2023; Marisa et al., 2024; Rane et al., 2023). This has to be a systemic change considering feedback, input from diverse stakeholders, and ongoing evaluation. In this case, AI has no limits. AI can give instant feedback on student performance and learning trends that can be used to adjust content in the curriculum. This helps develop a living curriculum that responds to internal and external factors and thus the principles of sustainability.

Artificial Intelligence in Curriculum Design

The connection between sustainable curriculum design and AI has been leading to increasing research interest. Several studies have explored how AI-driven analytics can inform curriculum design by identifying gaps in learning, monitoring progress, and providing recommendations about pedagogical adjustments. One such research by Zawacki-Richter et al. (2019) has indicated much promise in AI-assisted evidence-based curriculum development where data is used to iteratively shape programs in better ways.

Despite these achievements, the literature reveals that most of these issues continue to be overlooked. Most of the present models only concentrate on functional aspects of artificial intelligence—such as computerized testing and dynamic learning—without paying attention to in-depth ways in which these can be implemented in the overall context of designing courses. Furthermore, issues related to ethics—such as transparency in algorithms and privacy in data—are regularly referred to but barely investigated in-depth. Usage of AI technologies may result in homogenizing the curriculum across institutions and potentially suppress cultural and institutional uniqueness. Additionally, as algorithms rely on content from the web, copyright and intellectual property concern may arise, hence leading to risks of plagiarism and ownership. All these indicate toward the development of a holistic framework that will not only use artificial intelligence in designing curriculum but one that address both sustainability and ethical issues.

Ethical Considerations in AI-Driven Education

The ethical challenges encountered with the use of AI in education arise with the collection of data and analysis of them for further usage. Since AI systems significantly depend upon vast amounts of data to perform optimally, data privacy, confidentiality, and problems related to bias gain increased significance. Holmes et al. (2019) have stressed the importance of ensuring ethical standards when using AI in educational contexts. Ensuring transparency in algorithms and reducing potential biases in AI systems is essential to guarantee fairness and equity in student outcomes (Tanveer et al., 2020). Furthermore, having clear policies and informed consent are needed to protect student's information and maintain trust between educators and learners.

Literature on developing sustainable curricula highlights both revolutionary potential and immense challenges in integrating these. On the one hand, AI offers leading-edge capacity in personalized instruction, dynamic adaptation to evolving student populations in real-time, and informed decision-making through data (Blessing Ngozi Iweuno et al., 2024). On the other hand, traditional ways of designing curricula fall short in adapting to exponential change in technology, and core ethical issues have to be resolved to enable responsible uses of AI.

Research Gap

Despite extensive growth in both domains of instructional design and artificial intelligence applications, the gap between these two is notable. This gap in research can be researched in several key areas:

Integration of Pedagogical and Technological Innovations

Much of the research done in applying artificial intelligence to instruction concentrates on intelligent tutoring systems or automated grading. While these studies indicate the applied value of artificial intelligence, they tend not to discuss the overall pedagogical implications. Additionally, there is a lack of integrated frameworks that incorporate the technological potential of artificial intelligence with innovative methods in designing courses (Kamalov et al., 2023). Such models should be developed to ensure benefits with the use of artificial intelligence beyond administrative effectiveness but one which fundamentally enhances the learning process.

Long-Term Sustainability vs. Short-Term Pilots

The majority of AI applications in education are conducted in the format of short-term pilot projects that yield encouraging results in the short term but accomplish nothing toward long-term sustainability issues. The rate of technological advancement requires a curriculum that not only needs to evolve at periodic intervals but also needs to be built to be inherently adaptive and resilient. Contemporary research seldom, if ever, explores how the pilot projects might be integrated into long-term, scalable systems that can adapt to evolving educational needs.

Ethical and Equitable Implementation

While existing literature recognizes ethical issues related to data privacy, transparency, and algorithmic bias, there is a large gap in the literature that provides specific strategies on how to resolve these issues concerning sustainable curricula development. The need for an efficient approach that exploits the potential of artificial intelligence while mitigating ethical hazards is evident. Studies on how to integrate ethical considerations into AI-based curricula development and implementation are urgently needed.

Global and Contextual Factors

The majority of research in this field has occurred in technologically advanced areas, with relatively little attention to the possibility of differences in AI adoption between different types of educational institutions. Global education systems display considerable diversity in their resources, cultural norms, and policy environments. There is a need for studies investigating how sustainable curriculum models can be adapted across various global contexts so that the advantages of AI can be accessed and equitably distributed in a variety of educational settings (Ejjami, 2024; Marisa et al., 2024).

Overall, while there has been considerable research on the operational applications of artificial intelligence in the education sector and on sustainable curriculum development separately, their intersection remains insufficiently researched. There is an urgent necessity for a comprehensive, ethically responsible, and globally sensitive strategy leveraging AI to facilitate resilient and responsive curriculum development. Bridging these gaps will not only contribute to theoretical insight into the role of AI in educational settings but also offer policy-relevant and educator-focused recommendations for policymakers and educators across the globe.

Research Objectives and Research Questions

Research Objectives

1. To study the recent trends in AI technologies in education and their application in curriculum development.
2. To explore the benefits of AI-driven analytics in creating personalized learning experiences to meet various learning styles and needs.
3. To determine and examine the ethical issues related to the application of AI in education, specifically regarding data privacy, equity, and algorithm transparency.
4. To recommend ways for the responsible and ethical inclusion of AI in curricula, in a way that promotes inclusivity and innovation.

Research Questions

1. In what ways can artificial intelligence be incorporated into curriculum design to develop inclusive and sustainable education systems?
2. What are the pros and cons of using AI-based analytics to create personalized learning experiences?
3. What steps can be taken to address the ethical issues related to the application of AI in education to ensure equitable and responsible application?

Methodology

A systematic literature review (SLR) process is used in this research to investigate studies conducted on the use of artificial intelligence (AI) in developing curricula. SLR is employed because of its methodological rigor and capacity to present an extensive synthesis of work to date. The process entails the following steps:

- Identification of Research Questions: The research questions and objectives above direct the process of literature review and analysis.
- Search Strategy: A systematic review of academic databases (e.g., Scopus, Web of Science, PubMed, and Google Scholar) using keywords like "Artificial Intelligence," "Curriculum Development," "Personalized Learning," "Inclusive Education," and "Ethical AI."
- Inclusion and Exclusion Criteria: Peer reviewed studies are included based on relevance to the research questions and year of publication (published within the last five years). Exclusion criteria include papers not in English language and research that is not particularly about AI in education.
- Data Extraction and Synthesis: Data is extracted from the chosen studies and synthesized under themes like AI educational technologies, benefits of AI analytics, ethical concerns, and strategies for responsible application of artificial intelligence.
- Analysis and Interpretation: The synthesized data is examined for patterns, trends, and gaps within the existing literature. The findings are interpreted with the research questions and objectives.

Discussion

Transformative Potential of AI in Curriculum Development

Using AI for curriculum development has the potential to transform higher education. By harnessing the capabilities of AI analytics, instructors can design curricula that can be dynamic, responsive, and adaptable to every student's needs. For instance, personalized learning pathways through an AI system allow content to be dynamically altered in real-time to fit each student to his or her style of learning (Chiu & Chai, 2020; Strielkowski et al., 2024). This not only provides greater engagement, but also improved academic performance.

Artificial Intelligence helps in the development of evidence-based curriculum through comprehensive student performance and learning patterns. With educational institutions increasingly relying on data-driven decision and creation, AI-powered tools can detect gaps in the curriculum and suggest targeted interventions. This continuous process helps in achieving a dynamic curriculum design that evolves constantly and ensuring relevance and sustainability over time.

Traditional curriculum models have been concerned somewhat more with uniformity at the expense of considering the alignment of economic indicators, learning styles, and contextual factors affecting student performance. Artificial intelligence challenges this traditional practice by fully exploiting its capability to handle multimodal inputs—ranging from grades to participation levels to socio-emotional indicators—on which the adaptive learning system relies (Strielkowski et al., 2024). For instance, natural language processing (NLP) programs allow to grade student essays not only in grammatical correctness but in intellectual substance automatically filling in gaps in areas where misconception lies (Nedungadi et al., 2024). Computer vision systems monitor in-class performance, in turn, feeding instructors participation patterns otherwise undetectable. Such tools allow curricula to adjust in response in real-time, adapting difficulty in content and presentation following continuous loops. A student not making an algebraic point can be supplied with specially targeted problems sets and accompaniment visuals while his or her peer comfortable with the content material is advanced to applied projects integrating geometry with data science. This adjustability is not isolating in this context; in fact, it offers an organized support system where differentiated instruction is offset by collaborative learning sessions.

However, there is the risk of overuse of AI potentially diminishing the students' critical thinking and reflective capabilities. Emphasis should be laid on maintaining active engagement and cognitive challenge in the learning process.

Advantages of AI-Driven Analytics in Curriculum Design

Data-Driven Curriculum Optimization

AI's analytical capabilities are extended beyond classrooms to system evaluation of courses through the aggregation of student performance statistics by institutions. Application to aggregate statistics for student performance by institutions using machine learning models identifies regional gaps in accessing education or gaps in core competencies in key subjects. STEM performance statistics in underserved institutions can expose shortfalls in experience in applied problems in engineering to trigger recommendations by AI systems to include corresponding project-based courses to match regional requirements in industry (Evangeline & Moorthy, 2025; Yadav, 2025). Such recommendations by data support increased relevancy in courses while meeting requirements in sustainability. In Hong Kong, a secondary school course enhanced in artificial intelligence and sustainability education included frameworks to empower students to solve environmental issues through an integrative perspective while relating technological solutions to regional socio-economic contexts. Such frameworks suggest the potential to integrate academic concepts with real-world applications, fostering both technical proficiency and student engagement.

Personalized Experience and Social Engagement in AI-Enhanced Learning

The quest for personalized learning is commonly misunderstood to be independent, isolated learning. However, work is organized around three-dimensional design orchestrating full-group, small-group, and personalized teaching. Artificial Intelligence builds upon this design with the potential to have instructors design core curricula to full classes with pathways to independent explorations through branching. Within full-group settings, cues created by AI like interactive tests of number series trigger group-wide investigation through various entry points based on skill levels. Small-group discussion following workshops uses anticipatory analysis to match students who have equal problems or interests to each other to in effect support peer-directed problem-solving with guidance by instructors. Adaptive systems at an individual level have personalized recommendations and feedback to resources to support autonomy while in turn facilitating pathways to social learning (Chiu & Chai, 2020; Rane et al., 2023). This tiered methodology precludes breakdowns in classrooms while ensuring social cohesion to support diverse needs.

Equity through Culturally Responsive Artificial Intelligence

The most consequential social value in personalized AI is to redress systemic injustices. Learning algorithms trained by diverse sources around the globe can spot cultural bias in the material used to design examples, case studies, and testing benchmarks. Accordingly, examples, case studies, and testing benchmarks have to change. As an example, an AI scanning an American syllabus in American history can spot an overrepresentation in Eurocentric histories and recommend additional material to present nonmainstream interpretations. However, achieving full equity is contingent upon continued diligence in redressing algorithmic bias. This emphasis by the European AI Alliance upon fairness-aware algorithms is an imperative call to have representative training sets and regular tests to spot bias. Used ethically, artificial intelligence not only offers personalized pathways to learning but enables equal provision to advanced teaching tools—from tutorial chatbots in multiple languages to augmented reality training in low-bandwidth environments (Holmes et al., 2019; Moleka, 2023).

Bridging Technological and Pedagogical Dimensions

One of this research's key contributions can be to construct an integrated framework that balances technological development with sound pedagogical principles. Curriculum design toward sustainability has to be circular in process where not only is AI used in an administrative capacity but is used in instructional design as an integral component (Yadav, 2025; Zawacki-Richter et al., 2019). In bringing policymakers, data scientists, and instructors together in collaborative work, the framework can support an environment in which artificial intelligence is used to reinforce traditional teaching methods while fostering new pedagogical approaches.

There is a need to bring together technological and pedagogical approaches. Artificial intelligence can process and analyze unimaginable amounts of data. However, the responsibility remains for the instructors to contextualize these outcomes in pedagogical approaches and meet students' needs. Hence such a framework will encourage an interactive dialogue between instructors and technologists to prevent AI-assisted projects from being executed in isolation but instead being integrated within a broader educational strategy.

Ethical Challenges in AI-Driven Curriculum Design

Algorithmic Transparency and Academic Integrity

Transparency in most AI systems poses significant ethical challenges, especially when algorithms are used for curricular decisions (Asy'ari & Sharov, 2024). Instructors should critically evaluate recommendations by AI in support of pedagogy and not unquestioningly follow automated recommendations. The emphasis of the AI4T project (*AI for Teachers*, n.d.) on explainable AI highlights the significance of systems that can express decisions in language that can be understood by instructors. For example, an AI employed in designing courses should specify why it favors certain results over others to lead instructors to change parameters in alignment with professional judgment.

Data Sovereignty and Student Privacy

Where curricula increasingly leverage behavioral and biometric data, robust data governance frameworks become crucial. The European Commission's Digital Education Action Plan is in favor of decentralized storing through secure accesses to prevent misuse. All institutions making use of AI tools have to work following legislations including GDPR, in an environment to obtain informed consent not just in collecting data but in certain applications to fit in with the curriculum. Aside from this, learners ought to have ownership of their learning analytics, including opting out of non-essential tracking with no academic penalty.

Collaborative Synergy: Educators and AI Systems

Improving Pedagogical Expertise

Contrary to the fears of AI replacing instructors, effective implementation positions AI as a partner supplementing human expertise (Ahmed et al., 2024; Galdames, 2024; Nedungadi et al., 2024). AI handles routine work—quiz marking, resource management, and attendance tracking—freeing up educators to focus on mentoring and creative teaching. AI is a brainstorming partner in curriculum development, generating new lesson ideas that instructors flesh out based on classroom dynamics. For instance, an AI can recommend a gamified module on climate science, which can be adapted by instructors to reflect local environmental case studies.

Professional Development for AI Literacy

Sustainable integration relies upon instructors who have AI literacy capabilities. Institutional initiatives should promote continuous professional development in machine learning programs to empower instructors to comprehend the potential and limitations of AI tools. Training programs can be directed toward interpreting learning analytics dashboards, adjusting algorithmic parameters, or identifying signs of algorithmic bias. With such dual competence, pedagogical mastery and technical literacy, these institutions empower instructors to lead rather than be led by change through AI.

Institutional and Policy Implications

Successful integration of AI in curriculum development extends beyond classroom practices; it requires significant institutional support and policy reform (Galdames, 2024; Indumathy & Mujra, 2025; Kamalov et al., 2023). Institutions must invest in infrastructure to support these innovations—that is, broadband link to the Internet, secure systems to process vast amounts of data, and state-of-the-art AI software. Policymakers must establish systems to ensure proper uses of AI, including strict rules regarding data privacy, transparency in algorithms, and avoidance of bias.

Findings Arising from First Implementations

As of now, pilot projects indicate that institutions that have implemented AI-driven curriculum models have achieved increased student engagement and academic performance. Educators have reported that being able to monitor live student performance enables them to identify learning gaps earlier and hence to respond by adjusting their instructional practices (Asy'ari & Sharov, 2024; Kamalov et al., 2023; Mariyono, 2024). Although these early findings are optimistic, further research is necessary to confirm the stability over time of these models in diverse educational settings.

It has been proven through research that developing innovation in education is an interdisciplinary, collaborative process. This is achieved through engaging various stakeholders—educators, curriculum developers, AI experts and policymakers—so that a shared understanding is built to comprehend the complexities and potential of using AI in curriculum development. This collaborative process not only establishes theoretical foundations strongly but also provides solid foundations for implications in practice per modern educational contexts.

Future Research Directions

Based on these data and observations learned in this chapter, the following are the major directions for future work that are recommended:

Longitudinal Impact Studies

Future research should conduct longitudinal investigations examining the long-term impacts of AI-driven curriculum design. Long-term observation of instructional practice development, student participation, and student performance through repeated cycles of academic work will shed light on scalability and resilience in AI-powered curricula.

Comparative Analysis Across Diverse Contexts

Given the global nature of higher education, comparative studies are needed. Research to explore how AI-driven curriculum models perform across different cultural, economic, and regulatory environments is required. Such comparative works help to identify best practices that are universally acceptable as well as strategies that are locally situated.

Developments in Pedagogical Innovations

Further research is necessary to analyze ways in which AI can be employed to aid in innovative pedagogy. This means analyzing blended models in which conventional teaching in classrooms is supplemented by AI-powered adaptive learning systems. Future research should focus on leveraging AI to encourage increased critical thinking, creativity, and problem-solving skills among students.

Policy Implementation and Ethical Frameworks

The implications of adopting AI continue to be an area of active research priority. Future work should be directed toward building solid foundations in the area of ethical frameworks and policy recommendations in response to data privacy, transparency in algorithms, and equitable access. In particular, comparative studies between deploying these frameworks in various institutional contexts can prove to be most helpful.

Technological Advances and Emerging Trends

As AI technologies continue to evolve, long-term studies are necessary to track emergent trends and how they can affect curriculum development. Joint research between institutions of higher learning and technology developers can test new AI technologies, determining their feasibility for actual learning environments. The research would also have to include implications of such technological innovations on pedagogical approaches in addition to the structure of learning institutions.

Broadening the Theoretical Foundation

Future research can draw on systems theory, organizational change theories, and online pedagogy to create more sophisticated models that can address the complex issues of AI integration. Strengthening the theoretical underpinning will make real-world applications not just innovative but also sustainable against the backdrop of the fast pace of technological evolution.

Conclusion

The use of Artificial Intelligence in curriculum design is a game changer for tertiary education. In this study, the case for an integrated model of sustainable curriculum development using AI to create personalized, evidence-based, and adaptive educational programs has been presented. An adaptable framework that combines technological innovation with sound pedagogical practice is required. It acknowledges the necessity of ongoing conversation between technologists and educators so that AI-based solutions are both ethically and sustainably implemented. Although initial empirical evidence affirms the promise of such frameworks, further research—especially longitudinal research and comparative research—is required to validate their effectiveness across a wide range of educational contexts.

Along with outlining the disruptive possibility of AI, this research also tackles underlying ethical issues and policy dilemmas. By calling for a balanced strategy that optimizes the benefits of AI while making data privacy paramount and algorithmic transparency desirable, the framework will offer a roadmap for the responsible adoption of AI in education. Finally, findings offered in this study are intended to inform more inclusive, innovative and dynamic learning environments, and by doing so, contribute to the larger discussion of how education might be reconfigured in the digital age.

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Chapter 23
Aligning Innovation Outcomes through Design Thinking within Business Management Studies

Sean Kruger and Dawid Alwyn Jacobus Bornman

Abstract In response to the evolving demands of the Fourth Industrial Revolution (4IR), business education must equip students with future-orientated skills such as innovation, technological literacy, and entrepreneurial thinking. This study explores the utilisation of design thinking (DT) into undergraduate business management education as a means of cultivating these competencies. The study reports on a micro-level case within an African business management degree programme, where second-year students employed the Hasso Plattner Institute's DT process in a practical group project. A comparative analysis of two successive student cohorts was used to assess the impact of DT. Findings show that the 2024 cohort outperformed the 2023 cohort in innovation, prototyping with 4IR technology, and entrepreneurship, suggesting enhanced competency in digital business models and market viability. Sustainability scores remained stable across cohorts showing a consistent emphasis on ethical business practices. Regression analysis confirmed that both innovation and prototyping constructs were significant predictors of entrepreneurial success. The findings suggest that integrating real-world calls for innovation and prototyping with 4IR technology in business management studies, guided by DT principles enhances student competencies in entrepreneurial thinking and innovation. The study contributes to the growing body of literature on experiential, interdisciplinary learning in business education and provides evidence for curriculum innovation that aligns with the future of work.

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Introduction

Globally, unemployment patterns are shifting as rapid technological advancements reshape job roles and the associated skills required. By 2025, it is expected that automation and artificial intelligence (AI) will displace 85 million jobs while concurrently creating 97 million new roles requiring advanced digital and analytical skills (World Economic Forum, 2025). In response, business education must evolve to equip students with future-proof capabilities, ensuring they remain competitive in an increasingly automated and technology-driven workforce (Harvard Business Review Analytics Services, 2019).

While existing research highlights the significance of problem-solving and innovation in business education (Schlimbach et al., 2024), there remains a lack of empirical studies that examine how design thinking (DT) can systematically develop Fourth Industrial Revolution (4IR)-oriented skills in university students (Fleaca et al., 2023). Prior studies have established that critical thinking and analytical reasoning are core competencies in the international undergraduate business curriculum (Lombardi et al., 2021; Matthee & Turpin, 2019). However, there is still limited understanding of how structured methodologies like DT can enhance students' ability to navigate uncertainty, leverage digital tools, and align technological innovations with sustainable business models. Furthermore, although many industries have successfully incorporated rapid prototyping, Internet of Things (IoT), and AI-driven decision-making into their operational strategies (Bakator et al., 2024; Pacher et al., 2023), business education has trailed in embedding these skills in an experiential learning format.

To address this, our study examines the role of DT in fostering future work skills within business management studies, focusing on key dimensions such as innovation, prototyping (through 4IR technology adoption), sustainability, and entrepreneurship. The research is positioned within an African higher education setting, where second-year business management students engaged in a project-based learning initiative that required them to adopt 4IR technologies to prototype solutions into entrepreneurial ventures. These ventures were calls for innovation with associated funding, making them applicable and relevant.

To do so, a comparative micro-level case study design is used, focusing on two successive cohorts of business students (2023 and 2024) at a leading South African university. Students in the 2024 cohort were introduced to an enhanced DT framework and workshop that emphasised 4IR-driven prototyping and business model innovation, while the 2023 cohort followed a less technology-centric approach, with no dedicated DT workshop. By comparing these two cohorts, this research identifies the impact of structured DT training on students' ability to innovate, prototype, and develop sustainable, strategically aligned solutions.

The remainder of this paper is organised as follows. The next section provides a brief background followed by the methodology section that details the comparative case study approach and data collection techniques. This is followed by the findings and discussion. The paper concludes with implications for business education, recommendations for curriculum development, and directions for future research.

Background

DT is a structured approach to problem-solving that prioritises user needs, iterative learning, and cross-disciplinary collaboration. It follows a series of phases, including empathising with users, defining problems, ideating solutions, prototyping concepts, and testing iterations. The methodology integrates analytical reasoning with creative exploration to develop user-centred solutions that align with technological advancements. Various models outline different stages, with institutions like the Hasso Plattner Institute advocating a five-step process for structured innovation (Avsec, 2021). In the context of 4IR demands, skills needed now and into the future of work includes problem-solving, adaptability, and interdisciplinary collaboration; all of which DT cultivates (Marita Turpin et al., 2023; World Economic Forum, 2025).

4IR's rapid pace of change and global competition are forcing businesses to innovate continuously. The ever-digitised economy's development means that organisations are forced to improve with innovation. Traditional problem-solving approaches are often insufficient for the complex, interdisciplinary challenges posed by emerging 4IR technologies. Consequently, organisations are turning to DT and other innovative methodologies to generate human-centred solutions (Bartoloni et al., 2021; Coskun-Setirek & Tanrikulu, 2021). DT, with its emphasis on empathy, ideation, and iterative prototyping, is increasingly recognised as a key tool towards 4IR readiness. For example, educational institutions have begun integrating DT into their curricula to prepare future workers for the digital economy (Matthee & Turpin, 2019). Such efforts show that fostering an innovative mindset and creative problem-solving abilities is crucial for businesses navigating 4IR. Moreover, innovation in the 4IR context often involves open and collaborative approaches (Zheng & Zhang, 2023).

However, adopting 4IR technologies presents both opportunities and challenges for businesses. The introduction of innovations like IoT systems, AI-driven platforms, or advanced robotics requires organisations to experiment and learn quickly. Prototyping, building preliminary models or pilot implementations of new technology solutions, has become a critical practice in the 4IR era (Sean Kruger & Steyn, 2024). Nevertheless, effectively adopting 4IR technologies also demands overcoming resource and skill barriers. Consequently, many businesses want to leverage 4IR innovations for their potential benefits, but lack of capital, expertise, or technical talent can pose severe challenges (Nel-Sanders & Thomas, 2022). Therefore, prototyping and the adoption of 4IR technologies have become integral to the iterative development of new products and services, in business and business education.

Another integral aspect that has emerged in the 4IR landscape, is that of sustainability as organisations and societies seek to harness new technologies to achieve environmental and social goals (Bakator et al., 2024). The agendas of digital transformation and sustainable development can be mutually supportive. A growing body of research explores how 4IR technologies can enable cleaner production, efficient resource use, and circular economy models (Khan et al., 2022). One empirical study found that successful adoption has a positive effect on sustainable production practices, which in turn enhances circular economy capabilities in manufacturing (Chari et al., 2022). In practical terms, digitisation tools can help organisations reduce waste, save energy, and design more sustainable supply chains. Proficiency then in integrating 4IR solutions with sustainability objectives is becoming a critical business skill.

Finally, entrepreneurship as a skill in the 4IR era and future of work enables humans to navigate digital transformation movements and scale business models. Startups and enterprises that harness automation, IoT, and AI can quickly adapt to market shifts, creating innovative solutions with global impact. The digital economy enables entrepreneurs to access new funding opportunities, such as venture capital and blockchain-based crowdfunding, while digital platforms facilitate market entry and customer engagement (Fossen & Sorgner, 2021). In regions like Africa, technology entrepreneurship is thriving, with startups leveraging 4IR tools to solve local challenges in fintech, healthcare, and agriculture. Entrepreneurial success in 4IR requires not only technical proficiency but also strategic thinking, resilience, and the ability to navigate an evolving digital landscape, making it a crucial skill for sustainable economic growth and innovation (Si et al., 2023).

Methodology

This study employs a comparative micro-level case study design, focusing on two successive cohorts (2023 and 2024) in a South African business management programme. The institutions department where this was offered is one of the top three in the country, as rated in several higher education rankings according to Times Higher Education (2025). A case study approach was used as it allows for an in-depth exploration of the contextual application of DT in entrepreneurship education, particularly its impact on future skills.

By examining two cohort cases, the research identifies the influence of structured DT implementation in 2024 compared to a more conventional approach in 2023. The DT module was embedded as a compulsory, curriculum-integrated component of the core business management course, meaning that all students in both cohorts participated as part of their degree requirements, rather than through elective enrolment or self-selection. This approach strengthens the comparability between cohorts and reduces potential bias linked to voluntary participation. Each cohort's group projects serve as embedded units of analysis, for the validity of findings through cross-case comparison (Yin, 2018). For 2023, there were 47 groups (282 students) and 2024 had 53 (318 students).

Quantitative methods were used to assess performance scores and statistical trends, while qualitative data of the artefact's comments captured reflections. The research methodology aligns with prior studies on DT in education, which highlight its role in fostering problem-solving, collaboration, and technological proficiency in students (Matthee & Turpin, 2019; Ojan & Lara-Navarra, 2023). Primary data collected included student group project outputs from both cohorts, comprising business venture reports, slide presentations, business model canvases, prototype documentation, and supplementary materials such as feedback reports and discussion points (Sabri et al., 2023). The comparative analysis of these artefacts provided understanding into the extent to which DT influenced students' problem-solving approaches, prototyping skills, and business strategy development. The presence of user research, iterative prototypes, and creative market solutions in the 2024 cohort was examined against the 2023 cohort to determine the impact of DT.

Quantitative performance metrics were derived from group project scores, where innovation, prototyping, sustainability, and entrepreneurial applications were assessed from their pretentions. These were extracted from official course assessment records and a pitch presentation. Each project was evaluated based on predefined rubrics measuring innovation, prototyping (through 4IR technology adoption), sustainability, and entrepreneurship. Each team consisted of six members, and scores were aggregated per team to facilitate statistical comparison across cohorts. These sub-scores allowed for an examination of specific competencies. These performance metrics were documented on the university's preferred Learning Management System (LMS) (Donevska-Todorova, 2024).

To analyse the quantitative data, statistical techniques were used to compare cohort performance. Descriptive statistics were computed to assess mean, median, and standard deviation values for skill scores across cohorts. One-way ANOVA tests determined whether mean differences in scores were statistically significant, while correlation analysis explored relationships between different skill areas. Multiple regression analysis was conducted to evaluate the impact of DT exposure on entrepreneurial success while controlling for potential confounding variables, such as prior academic performance. Effect sizes, including Cohen's d, were computed to quantify the magnitude of differences between cohorts (Bartoloni et al., 2021).

For context, in 2023, DT processes focused on innovation through technological advancements and novel business models. The 2024 approach expanded the scope by clustering projects into three key sectors including renewable energy, the gig economy, and agriculture allowing for a broader application of DT across diverse industries. This clustering enabled interdisciplinary collaboration and sector-specific problem-solving, ensuring that solutions needed to be tailored to distinct industry challenges. This selection reflects South Africa's economic landscape, where agriculture remains a cornerstone of the economy (Stats SA, 2024), the renewable energy sector is rapidly expanding (South African National Energy Association, 2023), and the gig economy is experiencing significant growth (Turpin & Van Belle, 2021). By focusing on these sectors, the DT projects facilitated interdisciplinary collaboration and sector-specific problem-solving, ensuring that solutions were tailored to address distinct industry challenges pertinent to South Africa's development priorities.

Findings

2024 cohort's mean scores in innovation and prototyping were higher than 2023, suggesting more creative problem-solving and greater adoption of 4IR technologies in their projects on average. For example, innovation averaged 73 in 2024 vs 70 in 2023, and prototyping (use of IoT, AI, and wireframes) averaged 81 vs 71. Entrepreneurship outcomes (business viability) also trended higher in 2024 (mean 77 vs 72). In contrast, sustainability scores were similar across the two cohorts (2024: mean = 76; 2023: mean = 74), indicating a consistent emphasis on environmentally and socially conscious practices within the course structure. However, while sustainability often aligns with ethical considerations, it does not necessarily capture the full breadth of ethical business conduct. As such, these results should be interpreted as reflecting students' engagement with sustainability-oriented objectives, such as environmental responsibility and social impact, rather than a comprehensive measure of ethical business practice. Median scores closely mirrored the means in each case, suggesting roughly symmetric score distributions across both cohorts.

ANOVA

One-way ANOVA tests (cohort as the factor) were conducted for each skill category to determine if the 2024 cohort's improvements were statistically significant. (i) Innovation: the 2024 cohort's innovation scores were slightly higher on average where it was statistically significant although modest ($p \approx 0.05$). This suggests a measurable improvement in creative problem-solving and novel business ideas in 2024 over 2023, in line with a growing emphasis on innovation in the curriculum. (ii) Prototyping with 4IR technology: there was a significant cohort effect on prototyping scores ($p < 0.001$). The 2024 students scored markedly higher, on average, in leveraging IoT, AI, digital tools, and rapid prototyping, indicating a stronger uptake of 4IR technology adoption in the later cohort. This aligns with the expectation that curricula are increasingly integrating advanced prototyping and tech skills year-over-year. (iii) Sustainability: no significant difference was found between 2023 and 2024 sustainability scores ($p > 0.10$). This could imply that sustainability was a consistently emphasised aspect of the programme in both years, resulting in comparable competency levels. (iv) Entrepreneurship: the 2024 cohort showed higher entrepreneurship scores assessing business viability, market need, and financial planning with their solution. This improvement was statistically significant

($p < 0.05$). The data indicate 2024 projects were somewhat more refined in market assessment and financial sustainability. However, the effect was not as large as for prototyping suggesting that while 2024 made gains in venture viability, the difference from 2023 was moderate in significance (Saunders et al., 2019).

Correlation Analysis: Relationships between Skill Areas

The correlations between the four skill areas were then assessed to see how they interrelate within the student projects. In both cohorts, it was found that the skill dimensions are positively correlated where teams that excelled in one area tended to do well in others. (i) Innovation to sustainability has a moderate positive correlation (approximately $r = 0.5$). In both 2023 and 2024, projects that scored high on innovation (very creative or novel ideas) often also addressed sustainability well. This suggests that many innovative solutions were developed with sustainable or ethical considerations in mind such as novel business models that also solve environmental problems. (ii) Innovation to prototyping had a strong positive correlation ($r = 0.7$). Teams with high innovation scores generally also performed well in prototyping. This makes sense as highly creative projects typically leveraged advanced technology and prototyping to bring those ideas to the fore. In 2024 especially, the integration of novel 4IR technologies went along with innovative thinking. (iii) Prototyping to entrepreneurship also had a strong positive correlation ($r = 0.6$–0.7). Projects that effectively utilised 4IR technologies and rapid prototyping tended to have stronger entrepreneurship scores (better business models and viability). This implies that the ability to build and demonstrate a functional prototype or use modern tech tools bolstered the business case and market potential of the project. Finally (iv) sustainability to entrepreneurship had moderate positive correlation ($r = 0.4$–0.5). Teams that emphasised sustainable practices often had slightly better entrepreneurship outcomes as well, although this link was weaker than the tech-innovation links. It suggests that while many student ventures aimed to be ethical and eco-friendly, those considerations were somewhat independent of purely market viability in the project scores.

All pairwise correlations were positive and significant ($p < 0.01$), indicating projects excelled across multiple dimensions. The *innovation*, *prototyping*, and *entrepreneurship* triad was strongly interlinked where highly innovative ideas with strong prototypes were inclined to yield better entrepreneurship scores. *Sustainability* correlated positively as well, but less so, possibly reflecting that some teams focused on technology and market factors more, while others prioritised ethical impact.

Impact of Innovation and Prototyping on Entrepreneurship through Regression

To examine the contributions of innovation and prototyping to entrepreneurial success, a multiple regression analysis was conducted with *entrepreneurship score* as the *dependent* variable and *innovation and prototyping* scores as *independent* variables. This analysis aimed to quantify the extent to which these competencies influence entrepreneurial outcomes, specifically business viability, and to assess their relative impact.

Innovation and prototyping emerged as significantly positive predictors of entrepreneurial success. In a combined model, pooling data from both cohorts to enhance statistical power, these predictors collectively explained a substantial proportion of variance in entrepreneurship scores (adjusted $R^2 \approx 0.55–0.65$). This suggests that more than half of the variability in business viability could be attributed to differences in innovation and prototyping levels. Prototyping demonstrated a slightly stronger effect than innovation, as indicated by a higher β coefficient. Even when controlling for innovation, prototyping remained a significant predictor ($p < 0.01$). This finding suggests that projects integrating functional prototypes or 4IR technologies were more likely to achieve higher viability scores. The presence of a tangible proof-of-concept, such as an IoT device or AI demonstration, enhanced credibility and market appeal, thereby strengthening the business case for student ventures. Innovation was also a significant predictor of entrepreneurial success, even when controlling for prototyping ($p < 0.01$). Projects characterised by greater novelty and creativity achieved higher entrepreneurship scores, highlighting the importance of originality and problem-solving in venture success. A strong value proposition that effectively addressed a clear market need contributed to improved business viability. Multicollinearity diagnostics confirmed that, while innovation and prototyping were correlated, variance inflation factors remained within acceptable limits. This indicates that both predictors made distinct and meaningful contributions to the regression model.

Effect Sizes for Cohort Differences

To quantify the magnitude of differences between the 2023 and 2024 cohorts, Cohen's *d* was calculated for each skill area. Cohen's *d* measures effect size in standard deviation units, representing the difference in means divided by the pooled standard deviation. This allows for an assessment of the practical significance of differences between the two groups. For innovation, Cohen's *d* was approximately 0.3, indicating a small effect favouring the 2024 cohort. This suggests that, on average, the 2024 group demonstrated slightly higher innovation levels; however, the difference was not substantial, as the distributions of the two cohorts overlapped considerably. In prototyping (4IR technology adoption), Cohen's *d* was approximately 0.8, representing a large effect. This indicates a significant improvement in the 2024 cohort's prototyping skills, with scores approximately 0.8 standard deviations higher than in 2023. This suggests a notable advancement in 4IR technology adoption and rapid prototyping capabilities from one year to the next. Part of this was the access to IoT kits and associated training in the makerspace. For sustainability, Cohen's *d* was approximately 0.1, signifying a negligible to small effect. This suggests that sustainability awareness remained largely consistent between 2023 and 2024. Finally, in entrepreneurship, Cohen's *d* was approximately 0.5, reflecting a moderate effect. This suggests meaningful growth in students' ability to develop viable, needs-driven, and financially sound business plans.

2024 Clusters

ANOVA results when comparing clustered differences for the 2024 cohort indicate that there are no statistically significant differences between the three clusters across all evaluated criteria. The p-values for all categories are above the common significance threshold of 0.05, suggesting that performance variations across the clusters are not strong enough to be attributed to differences in understanding or approach within each sector.

Discussion

The findings of this study highlight the critical role of DT in fostering future work skills, particularly in relation to innovation, prototyping with 4IR technologies, entrepreneurship and sustainability. By comparing two successive cohorts, structured exposure to DT principles enhances students' ability to engage in creative problem-solving, integrate emerging technologies, and develop market-ready entrepreneurial solutions.

An observation from the study is the marked improvement in prototyping and 4IR technology adoption among the 2024 cohort. This aligns with prior research suggesting that hands-on, iterative design processes facilitate deeper engagement with technological tools (Irie et al., 2019; Sharma, 2021). The statistically significant difference in prototyping scores between the two cohorts suggests that embedding structured DT methodologies into business education enhances students' technical competencies. In particular, the integration of IoT-based solutions, AI applications, and wireframe tools in student projects demonstrates the growing emphasis on digital literacy as an entrepreneurial asset. This aligns with the (World Economic Forum, 2025) that notes that digital transformation is reshaping the business landscape, necessitating a reconfiguration of educational strategies to ensure graduates are proficient in emerging technologies. Figures 23.1 and 23.2 provide top performers and their prototypes.

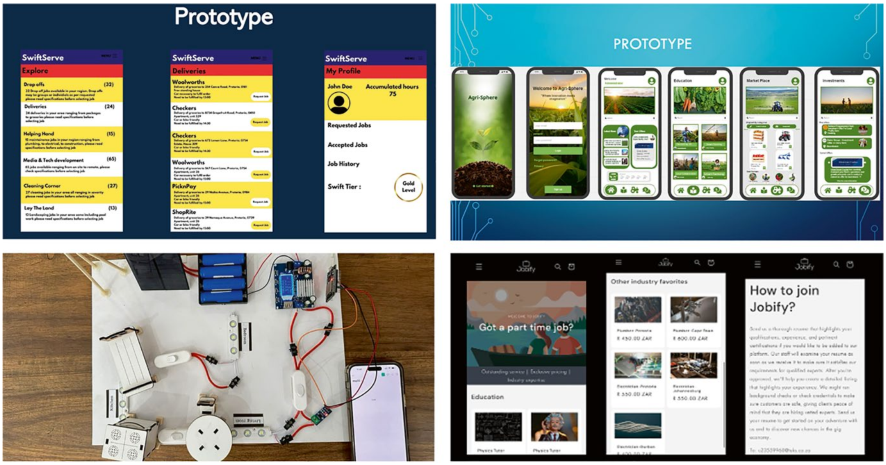

Fig. 23.1 Snapshots of group prototypes 2024

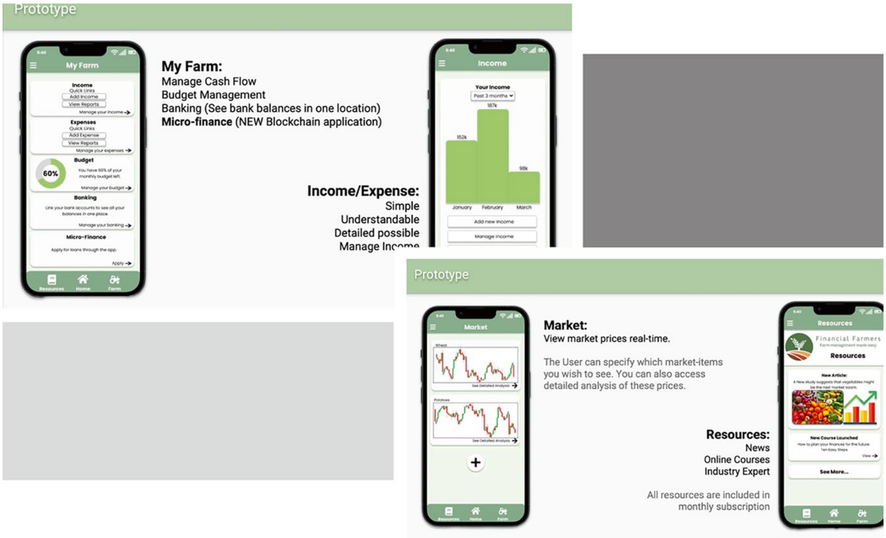

Fig. 23.2 Snapshots of group prototypes 2023

The analysis indicates a moderate improvement in entrepreneurial skills, with the 2024 cohort demonstrating greater competency in identifying viable business opportunities and developing financially sustainable models. The correlation between prototyping proficiency and entrepreneurship scores suggests that students who effectively leveraged 4IR technologies in their projects also exhibited stronger market readiness. This supports previous findings that experiential learning approaches, such as DT, cultivate an entrepreneurial mindset by emphasising iterative development, risk-taking, and user-driven innovation (Avsec, 2021; Matthee & Turpin, 2019). Furthermore, the study emphasises the importance of strategic business alignment, as students who engaged deeply with prototyping and iterative development were better positioned to articulate business strategies (Carlsson et al., 2021; Cheng et al., 2024).

Sustainability scores remained consistent across both cohorts, indicating that while students are increasingly proficient in technological integration and entrepreneurial thinking, their ability to conceptualise and implement sustainable business practices remains a challenge. This aligns with research suggesting that sustainability competencies require a more explicit and structured pedagogical approach and future green talent development (S Kruger, 2025; Zhu et al., 2024). Future iterations of the course may benefit from linking sustainability principles to prototyping and business model development, ensuring students conceptualise ecological and social impacts alongside technological feasibility.

A theoretical implication of these findings is the interplay between DT and digital entrepreneurship. The results suggest that structured exposure to human-centred design methodologies enhances students' capacity for technological innovation, reinforcing the notion that creativity and technical proficiency are mutually reinforcing (Fossen & Sorgner, 2021). Consequently, the study contributes to the growing body of literature advocating for interdisciplinary approaches to business education, where design methodologies and technological fluency are integrated into entrepreneurial training (Si et al., 2023). Moreover, the strong correlation between innovation and prototyping scores supports the argument that business students should be trained not only in conceptualising ideas but also in executing and refining them through iterative experimentation (Marita Turpin et al., 2023).

The practical implications of this study highlight the need for higher education institutions to update business curricula to highlight experiential and technology-integrated learning. Universities should establish (or leverage existing) innovation hubs, makerspaces, and partnerships with industry to provide students with access to emerging technologies such as IoT, AI, and automation. Incorporating project-based assessments that emphasise iterative development rather than traditional examinations can better align with the demands of 4IR (Del Vecchio et al., 2023; Kruger & Steyn, 2024; Riepina et al., 2023). Moreover, from a pedagogical perspective, these findings advocate for the continued expansion of experiential and technology-driven learning models within business education. The statistically significant increase in prototyping competencies in the 2024 cohort demonstrates that business students benefit from direct engagement with 4IR tools, supporting calls for greater emphasis on digital literacy within entrepreneurship curricula (Kruger & Steyn, 2020).

Conclusion

This study set out to explore how structured DT interventions, when embedded within a business management curriculum, can contribute to developing critical future work skills in the context of the 4IR. By examining the comparative outcomes of two student cohorts engaged in project-based learning, this research provides empirical evidence of the value of DT as a pedagogical tool for enhancing innovation, entrepreneurship, technological prototyping, and sustainability.

The findings make several contributions to current literature and practice. First, they demonstrate that structured DT exposure, particularly when aligned with access to 4IR prototyping tools, significantly strengthens students' ability to generate creative, viable, and tech-enabled business models. Second, the strong correlation between prototyping and entrepreneurship outcomes highlights the importance of experiential learning and tangible innovation processes in business education. Third, the consistent sustainability scores across cohorts suggest that while ethical considerations are present, more intentional integration is needed to ensure that sustainability is not treated as a peripheral outcome but as a core design consideration. Therefore, this study provides a contribution to research on innovation and entrepreneurship education by showing that DT not only fosters future-focused skillsets but also bridges the gap between abstract business theory and real-world, actionable solutions. It contributes to existing knowledge by providing evidence from a South African higher education context, an often underrepresented setting in global pedagogical research, demonstrating that locally grounded, technology-integrated learning models can have globally relevant impact.

As higher education institutions seek to prepare students for careers that do not yet exist, the results of this study provide a case for embedding design-led, interdisciplinary, and technology-enabled learning experiences into core business education.

Limitations

While the study provides evidence of the benefits of DT, several limitations must be acknowledged. First, the findings are context-specific to a single institution and may not be universally generalisable. The relatively small sample size, while appropriate for a micro-level case study, limits the broader applicability of the results. Additionally, while the study controlled for cohort effects, external factors such as broader economic conditions and technological advancements may have influenced student performance. Third, the introduction of a formalised DT module in 2024 raises the possibility of a novelty effect. It is conceivable that students and tutors approached the newly structured DT activities with heightened enthusiasm and motivation, which could have influenced engagement levels and outcomes. However, this effect is likely tempered by the fact that the same lecturers facilitated both cohorts, and the DT sessions were limited in number and duration, reducing the extent to which novelty alone could explain performance improvements. Future research could expand this study by incorporating multiple institutions or longitudinal tracking of student progress post-graduation to assess the long-term impact of DT training on entrepreneurial success.

Future Studies

Future studies should explore strategies to better integrate sustainability with technological and business innovation, ensuring that graduates are not only equipped to thrive in 4IR industries but also contribute to ethical and responsible business practices. As technological disruptions continue to redefine economic landscapes, the integration of DT, digital literacy, and sustainable entrepreneurship will be essential in cultivating a future ready workforce that is innovative, agile, and socially responsible.

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Chapter 24
Sustainable Learning Architectures for Corporate Universities as Platforms for Intrapreneurship and Change in an International Context

Rolf-Dieter Reineke and Oliver Gottschall

Abstract Corporate Universities (CUs) have become integral to strategic corporate development, fostering talent, innovation, and organizational change. This study explores the evolving role of CUs as platforms for sustainable learning, intrapreneurship, and transformation in an international context. Drawing on case studies from Europe and Asia, alongside secondary empirical data and literature reviews, the research identifies core archetypes of CUs as well as best practices for their implementation.

We observe the emergence of several key global trends shaping CUs, including the rise of digital learning platforms, AI-driven adaptive education, and a growing emphasis on sustainability. We also examine the synergy between CUs and internal consulting units, demonstrating how organizations leverage CUs to drive strategic initiatives, talent development, and cross-border knowledge sharing. This also includes the exploration of the integration of sustainability principles within CU structures, with examples from leading corporations that have embedded environmental, social, and governance (ESG) factors into their learning models.

From the case studies and our own practical experience, we highlight several challenges in CU implementation, including cultural adaptability, internal resistance, and the balance between corporate control and academic independence. Our typology of CUs follows the different development stages of a typical CU, from initial competency-based learning models to advanced strategic transformation platforms that integrate internal consulting and innovation hubs.

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Our findings suggest that successful CUs require strong executive commitment, a well-defined consulting ecosystem, and flexible organizational structures. Emerging trends indicate a shift toward network-based learning ecosystems, where CUs collaborate with universities, think tanks, and external experts to enhance their impact. Finally, we provide a set of recommendations for practitioners on structuring effective CUs that align with corporate strategy and foster long-term sustainable learning.

Keywords Corporate University · Corporate learning architecture · Internal consulting · Intrapreneurship · Network-based learning ecosystem

Introduction and Context

Increasing complexity and rapid changes in the global business environment have necessitated that companies develop their own analytical and consulting capabilities while also redefining their training strategies. This has resulted in several parallel initiatives, particularly the expansion of internal consulting units and corporate universities (CUs). While internal consulting units provide specialized, in-depth knowledge tailored to company-specific challenges, corporate universities have become key instruments for strategic corporate development. Consequently, numbers of CUs have been increasing constantly over the past two decades. Hirst (2015) estimated that there were more than 8000 Corporate Universities globally. However, their effectiveness and integration into corporate strategies vary significantly across different regions and industries.

One of the most well-known examples of a successful corporate university was General Electric's (GE) Crotonville campus, established under the leadership of Jack Welch. For decades, this institution had become a cornerstone for GE's leadership development and change management, before GE decided to spin-off and sell the center in early 2024 (cf. Carey, 2024). However, the corporate landscape across the globe has yet to fully embrace such a comprehensive model, with corporate universities often serving more as knowledge-sharing hubs rather than catalysts for strategic transformation.

Corporate universities have evolved significantly over the last few decades, moving from a primarily training-focused role to becoming strategic partners in business transformation. The shift from traditional training models to experiential and problem-based learning has been influenced by advancements in cognitive science, digital technology, and organizational behavior studies. The increased use of digital learning platforms, artificial intelligence, and data-driven insights has allowed CUs to provide more personalized and efficient learning experiences.

In countries such as the United States, China, and India, corporate universities have expanded beyond internal training providers and now engage in industry-wide knowledge-sharing initiatives. For instance, Huawei University in China collaborates with global academic institutions to foster technological advancements, while McDonald's Hamburger University has developed standardized training programs to ensure consistency in service quality across its global franchises.

The effectiveness of corporate universities varies across cultures and economic environments, requiring multinational corporations to tailor their corporate education strategies to accommodate diverse learning styles, regulatory environments, and workforce expectations.

While Western corporate universities tend to focus on leadership development and innovation management, Asian corporate universities often emphasize hierarchical knowledge transfer and discipline-specific expertise. For example, Toyota's corporate academy integrates Kaizen principles into leadership training, reinforcing the company's commitment to continuous improvement. These findings are in line with Hofstede's findings: in cultures with high power distance, it might be more difficult to establish organizational concepts that require cross-departmental and cross-hierarchical collaboration (Hofstede, 2020).

In emerging economies, corporate universities often serve as national workforce development engines, addressing skill gaps and fostering economic growth. Infosys' Global Education Centre in India, for example, provides industry-relevant training not just for employees but also for students and professionals outside the company.

Main trends and benefits for the set-up of Corporate Universities are more or less universal (cf. Fig. 24.1):

- The "employability" of employees at other employers is becoming an important image factor in the competition for the best young talent. Renowned corporate universities, which also contribute to corporate development through practical project work, may make an important contribution to this, depending on the positioning of the CU.
- The potentially negative aspects of the decentralization of organizational and management structures become more pronounced, as decentralization can potentially lead to silos within the organization. Consequently, the communication of a common value base and identification in the sense of "corporate citizenship" requires a forum (Meister 1998, p. 10). Corporate universities are one solution in the search for unifying elements.
- Traditional personnel and further training work are being put to the test. It has been shown that the gap between theory and practice can hardly be closed in off-the-job training. This so-called transfer gap is far less pronounced in on-the-job training, which is linked to actual collaboration on internal consultancy projects.

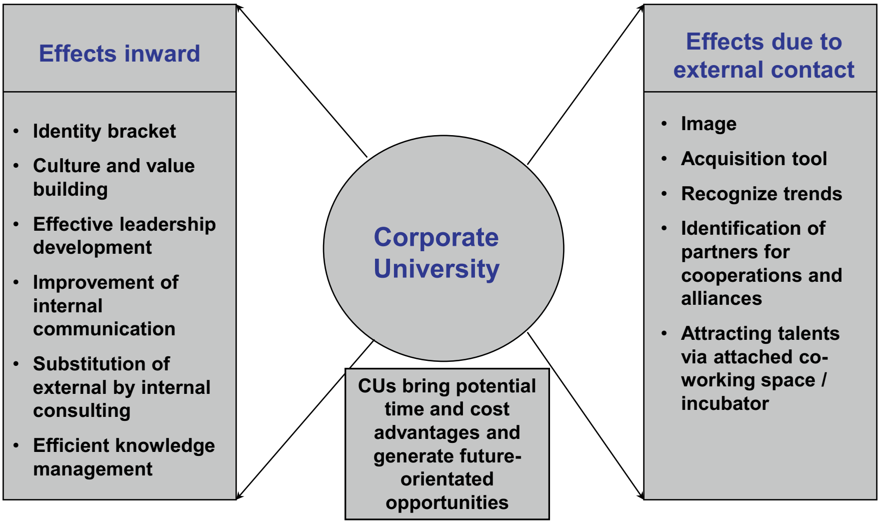

Fig. 24.1 Potential benefit categories of corporate universities. Source: Modified and extended based on Reineke (2000, p. 197)

- The opportunity to combine knowledge transfer, which can also include the acquisition of academic degrees with practical counseling work, offers an attractive personnel development concept that can contribute to the retention of management and management trainees.
- Pooling the capacities of various innovation and consulting oriented units enables the processing of project tasks and the realization of corresponding concepts on a global scale.

Review of Recent Literature on Sustainable Learning Architectures for Corporate Universities in an International Context

Definition of Corporate University

The term "Corporate University" has been defined in a number of different ways and from different angles across academic and popular literature. Hirst, for example, provides a basic and high-level definition, where CUs are "educational structures based in private and public, commercial and non-commercial organizations to help implement—through Learning and Development—the organization's strategies." (Hirst, 2015).

Tylor (2012) defines a Corporate University by segregating it from training departments on one hand, and traditional universities on the other hand: "A training department is tactical or operational, whereas a corporate university is positioned at a strategic level. A good training program helps you do your job better. A corporate university helps the organization achieve its mission" (…); "Traditional universities conduct scientific research and grant degrees in a variety of disciplines. Corporate universities focus primarily—though not exclusively—on on-the-job skills, company-specific proprietary knowledge and branding, and certification." (Tylor, 2012).

Noteworthy is also the close relationship between Corporate University and (Internal) Management Consulting in companies. Several companies have established both CUs and internal consulting units to foster employee development and address internal challenges. Notable examples include Siemens, Google, IBM, and Novo Nordisk, where a close integration between corporate university and inhouse consulting units can be noticed.

Consequently, we would like to define the term Corporate University[1] as follows:

> Corporate Universities (also referred to as "Corporate Academies") are architectures for individual learning and organizational development within a company, which offer a strategy-based platform for internal consulting, practice-oriented learning, and intrapreneurship.

Role and Relevance of Corporate Universities

Muench (2003), although acknowledging that personnel development efforts nowadays target a wide variety of participants within an organization, sees the main target group of Corporate Universities still in the leadership personnel of an organization. (Muench, 2003, p. 69). As such, corporate training and development efforts such as the ones conducted within a CU pursue four main goals: (1) "Adjustment" of knowledge and skills to an ever-changing work environment; (2) "Innovation," particularly with regard to preparing the organization for latest developments or giving specific impulses for innovation efforts; (3) "Career Progression," that is, providing guidance and support to leaders to prepare them for their next career steps; and (4) "Leadership Competencies," that is, the specific development of leaders' core competencies (Muench, 2003, p. 70).

[1] Our use of the term "Corporate University" here needs to be contrasted to the very different context and meaning of the term Capitalist University as used, for example, by Barkan (2013), Donoghue (2008), Giroux (2011), Heller (2016), and others. Barkan states that "universities have always been corporations" and who sees the term Corporate University in one line with "neoliberal university, the military–industrial–academic complex, knowledge factories, academic capitalism, diploma mills, and the commodification or commercialization of higher education" (Barkan, 2013, p. 140)

Kolo et al. (2013) studied 23 companies that had set up CUs and identified four main clusters of CUs depending on the institution's role as (1) Strategy Platform; (2) Leadership Accelerator; (3) Training Center; and (4) Learning Network (cf. Fig. 24.2) (Kolo et al., 2013, p. 7). It is noteworthy that the breadth of the target audience widens from (1) to (4), with CUs setup as strategy platforms mainly focusing on senior executives and top management, while CUs setup as learning networks are usually open to leaders and employees across all levels (Kolo et al., 2013, p. 8). Exhibit 1 illustrates the relationship between the role of the CUs and their target audiences.

Corporate Universities and Sustainable Learning Architectures

Recent studies (cf. Graham et al., 2015; Hays & Reinders, 2020) propagate the integration of sustainable practices into the design and operation of learning curricula. Graham et al. define the term sustainable learning as "learning that lasts," whereas "sustainable learning is evident when students feel good and confident about the knowledge, skills, attitudes and values that they have acquired, and can apply them effectively and build upon them as they continue to learn across the life span" (Graham et al., 2015, p. vii).

With this definition in mind, the authors propose to define "Sustainable Learning Architecture" as formal learning structures within a corporation that focus on

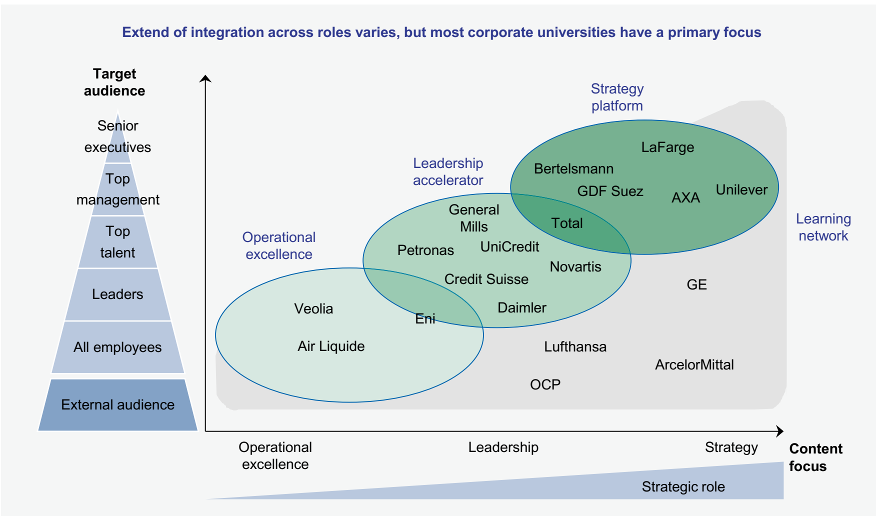

Fig. 24.2 Roles of Corporate Universities according to BCG. Source: Kolo et al. (2013, p. 7)

sustainable learning and exist for at least 5 years from the time of their establishment. This is not to say that CUs with a shorter life span cannot contribute to the strategic and organizational development of a company. However, the long-lasting effects of a CU establishment may be considered sustainable only once it passed the test of time.

Hays and Reinders highlight the role of “corporate training centres” in “striving to promote innovation, effectiveness, development, empowerment and well-being through learning” (Hays & Reinders, 2020, p. 34). This includes the incorporation of modular course designs, which allows for the continuous updating of content, ensuring relevance in a rapidly changing global business environment (CreativesOnCall, 2025).

Intrapreneurship Within Corporate Universities

Intrapreneurship, defined as entrepreneurial behavior within an organization, is crucial for fostering innovation and driving change. Corporate Universities play a significant role in nurturing intrapreneurial skills by providing employees with the necessary tools, knowledge, and environments to develop innovative solutions.

Gregán et al. (2024) highlight the role of intrapreneurs in driving entrepreneurial transformation within universities. The study underscores the importance of intrapreneurial individuals in advancing organizational change and innovation. The authors conducted a bibliographic analysis, revealing a growing interest in the subject, albeit with a limited number of publications and authors. This analysis provides insights into the development of intrapreneurship literature and its impact on organizational transformation.

Furthermore, a study by Provasnek et al. (2017) presents a conceptual model exploring the potentials and limitations of corporate intrapreneurship in a sustainability context. Based on their research on corporate entrepreneurship and sustainable corporate development, the authors propose a position matrix and typology to analyze sustainability and entrepreneurship plans of leading corporations. The findings define the sustainable corporate entrepreneurship process, highlighting the importance of gradual adjustments to factors such as resources and organizational structures to foster intrapreneurship.

Corporate Universities as Platforms for Organizational Change

Corporate universities are instrumental in facilitating organizational change by aligning learning initiatives with strategic goals (cf. Kolo et al., 2013, p. 2). They provide a structured environment where employees can acquire new skills and knowledge, enabling the organization to adapt to market dynamics and technological advancements.

The integration of sustainability into business education is a growing trend among corporate universities. Business schools are increasingly incorporating sustainability into their curricula, driven by strong climate policies and societal focus on environmental responsibility. For instance, European business schools like the Stockholm School of Economics and Aalto University School of Business have integrated sustainability deeply into their programs, cultivating multidisciplinary approaches to tackle global sustainability challenges. This trend reflects the role of corporate universities in promoting responsible business practices and preparing future leaders to address complex global issues (cf. Kolo et al., 2013, p. 16).

Additionally, the Financial Times' Responsible Business Education awards highlight business schools' efforts in addressing sustainability, disease, discrimination, and poverty alongside profit. These awards recognize significant contributions in various fields, including ESG guidelines, responsible fashion, and healthcare improvements, showcasing the impact of corporate universities in fostering organizational change through education (Financial Times, 2024).

International Perspectives on Corporate Universities

The globalization of business operations necessitates that corporate universities adopt an international perspective in their curricula and operations. This includes understanding diverse cultural contexts, regulatory environments, and market dynamics.

A study by Gregán et al. (2024) highlights the importance of international collaboration and knowledge exchange in advancing intrapreneurial practices within what is referred to as "entrepreneurial universities" (Gregán et al., 2024, p. 1). The study also identifies key countries and organizations contributing to this field, underscoring the global nature of intrapreneurship research.

An example of such global collaboration on knowledge development is the Center for Advanced Sustainable Management (CASM) based in Germany. CASM is embedded within CBS International Business School, which is part of Stuttgart-based Klett Gruppe, an international publisher of educational literature with presence in 17 countries (Center for Advanced Sustainable Management, 2025). CBS has developed strong relationships with key companies in the field of sustainable management, which it calls "practice partners." These include global companies such as Amazon, Accenture, Coca Cola, DHL, Eurowings, Mitsubishi Chemical Group, and many others. The network also includes chambers of commerce, ministries of economics, NGOs, think tanks, and thought leaders at local and international levels. These collaborations aim to make sustainability the new standard in business practice and education, highlighting the role of corporate universities in driving global sustainability initiatives (CBS International Business School, 2025).

The Corporate University vs. the Traditional University[2]

Walton and Martin (2004) investigate the differences between CUs and traditional universities. They find that there is a clear demarcation between the two: While traditional universities are mostly associated with the terms "university," "research," and "knowledge," CUs are mostly linked to "learning" and "development" (Walton & Martin, 2004, p. 14). They conclude that "corporate universities and traditional universities have different aims, objectives and values. There is little evidence of convergence of outlook between entities coming from different roots and traditions" (Walton & Martin, 2004, p. 17).

Recent Trends

In her 2002 study, Riley (2002) had pointed out that "Corporate universities (CUs) represent the fastest growing segment of the adult education market" (Riley, 2002, p. 2). More than 10 years later, that trend was still continuing: Kolo et al. highlighted that between 1997 and 2007, the number of CUs had been growing from 1000 to 2000 in such institutions in the US, and by 2011 there were "more than 4000 companies with formal corporate universities" (Kolo et al., 2013, p. 4). By 2015, Hirst estimated that about 8000 Corporate Universities had been set up worldwide; 4000 of which were located in the US (Hirst, 2015).

Most recently, Deloitte's Hardy-Vallée (2024) still sees a rapid evolution of CUs, identifying 11 emerging trends:

1. **Emphasis on Reskilling**, especially in an environment of rapid technological change
2. **Personalized and Adaptive Learning**, leveraging AI for personalized and adaptive individual learning experiences
3. **Focus on Leadership Development**, emphasizing "strategic thinking, decision-making, communication, and change management" (Hardy-Vallée, 2024)
4. **Integration of Virtual and Augmented Reality** in order to create more immersive learning experiences
5. **External Partnerships** through collaboration with outside industry experts and academic institutions
6. **Emphasize on Learning Outcomes** by measuring and evaluating learning programs
7. **Commitment to Diversity, Equity, and Inclusion (DEI)**, making programs more accessible and inclusive for all employees

[2] Our definition of the term "Traditional University" explicitly includes practice-based universities and universities of applied sciences such as the Polytechnic in the UK or the Fachhochschule in Germany, Austria, and Switzerland.

8. **Micro-learning/On-Demand Learning** to provide more flexibility to learners and allow employees to access content “anytime, anywhere”
9. **Integration of Sustainability/ESG/CSR** into the curriculum
10. **Lifelong Learning & Knowledge Management**
11. **Empowering Organizational Development** through focus on strategy, business knowledge, and culture transformation.

    (Hardy-Vallée, 2024)

Critical Evaluation

In academic literature, one can find an increasing number of publications that take a rather critical stance towards the growing trend of CUs. Taylor (2015) refers to Corporate Universities as “pseudo-university” and criticizes that the nature and benefits of CUs are little researched and understood:

> Despite an increase in attention to both human resource development at work and the governance of established state-accredited universities, neither educationalists nor management researchers have explored the nature and meaning of CUs in any depth. The field is thus left open to “insider accounts” relating the positive effects of CUs in developmental terms and in relation to business benefits, justifying the appropriation of higher education terminology and symbolism along the way; or to consultants with an interest in portraying CU initiatives as positive and worthwhile, retelling and retailing success stories. (Taylor, 2015, pp. 3–4)

Other critics question the maturity of the CU concept overall, and especially the necessity of the use of academic terminology by corporates, implying that—in their opinion—corporates with regard to their training programs might pretend to be at a standard that is beyond their actual area of competence: “There is also evidence that CUs are still ‘feeling their way’ in terms of projecting what they stand for. The question remains as to why corporations feel the need to use academic terminology to justify their learning initiatives.” (Walton & Martin, 2004, p. 17).

Expected Research Outcomes

Corporate Universities have regained the interest of both corporate and academics alike as the corporate training programs return to a “new normal” after the COVID pandemic. This renewed enthusiasm can be witnessed by the number of publications about the topic in recent months (e.g., Hardy-Vallée, 2024; Shakina et al., 2024; Zinschenko et al., 2024).

Within this context, the authors consider it timely to revisit the different approaches companies take in setting up their Corporate Universities. Consequently, our research pursues four main objectives:

1. Identify, segregate, and describe the different archetypes of corporate universities as observed in real-life applications and case examples
2. Describe suitable approaches and set-ups for the different types of CUs, with the aim to provide guidance to practitioners with regard to which approach fits to their respective corporate situation
3. Identify and explain success factors that need to be in place to ensure CUs generate the desired impact to the respective organization
4. Recommend concrete good practices for the creation and operation of CUs in an international context

With these objectives in mind, the authors aim to provide valuable insights for a broad group of "stakeholders" involved in the topic of corporate universities, including academic researchers, practitioners, HR professionals, as well as senior executives in corporations involved in setting up new learning architectures for their companies or looking for ways to increase the effectiveness of their existing learning systems and training structure.

Research Methodology

Research Design

This study adopts an exploratory research design, utilizing a case study approach combined with secondary data analysis. Given the relatively limited academic literature on the intersection of Corporate Universities and internal consulting units, an exploratory approach allows for a deeper understanding of the phenomenon by integrating multiple sources of evidence.

Data Collection and Triangulation

To ensure a comprehensive and robust analysis, we employ a triangulation strategy—using an approach very common in ethnographic research—as proposed by Frame 1987 and 1991 (referred to in: Gill & Johnson, 2002, p. 133; Kievelitz & Reineke, 1991, p. 308; Gottschall, 2018, p. 68). The triangulation utilizes three key data sources (cf. Fig. 24.3):

1. Existing Literature: Review of academic and practitioner literature on Corporate Universities, internal consulting, intrapreneurship and their potential synergies. This includes peer-reviewed journal articles, books, and industry reports that provide theoretical and empirical foundations for the study.
2. Secondary Data from External Empirical Studies: Analysis of existing empirical studies and industry reports that offer insights into Corporate Universities and

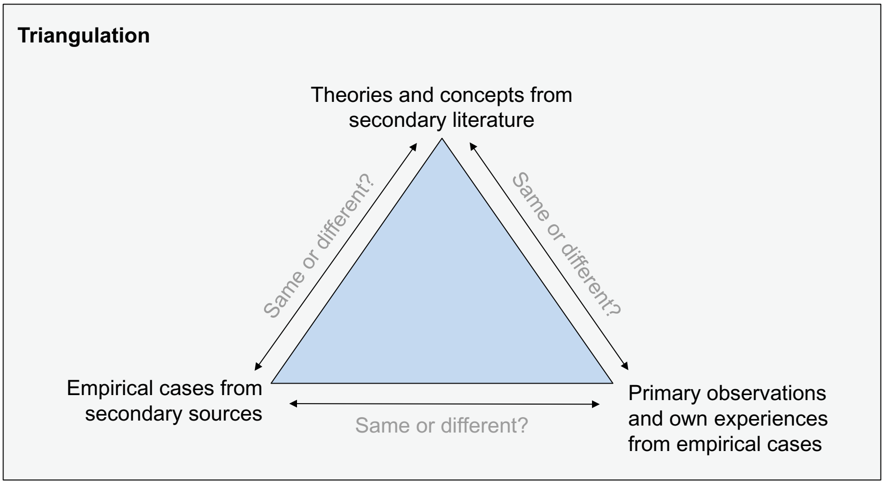

Fig. 24.3 Triangulation of Methodologies: Methodological Pluralism. Source: Modified and extended based on Gill and Johnson (2002), Gottschall (2018)

internal consulting functions plus entrepreneurial hubs across various organizations. These sources help contextualize our findings within broader industry trends and practices.

3. Primary Data from Case Studies and Practitioner Experience: Being practitioners and (former) management consultants themselves, the authors draw on case studies of selected organizations that have both Corporate Universities and internal consulting units. The case study data is complemented by their own professional experiences as consultants and practitioners in Corporate Universities in Europe and Asia, providing an emic (insider) perspective on how these functions interact and contribute to organizational learning and strategic goals.

Data Analysis

The data is analyzed thematically, identifying key patterns, relationships, and emerging insights across the three data sources. The authors compare findings from the literature with secondary and primary data to validate and refine their interpretations. This triangulation approach enhances the reliability and validity of the conclusions by cross-verifying information from multiple perspectives.

Limitations

As an exploratory study, the findings are not intended to be generalized (or generalizable) across all organizations. Instead, they offer valuable insights into a relatively under-researched area, serving as a foundation for future empirical research. Additionally, while the practitioner experience provides unique insights, it may introduce subjectivity; however, this is mitigated through systematic analysis and triangulation with external data sources.

Archetypes of Corporate Universities

The Corporate University in Relation to Other Initiatives for Corporate Development

In response to the dynamic developments in the corporate environment, several initiatives have been launched in large companies, but these have hardly been integrated into one coordinated approach. Instead, several of the following corporate units exist and work in parallel:

- Corporate University or Corporate Academy
- Department for group and corporate development
- Innovation/R&D center
- Function-specific or division-specific internal advisory units, located at different hierarchical levels
- Training and further education departments

While the Corporate University is usually a genuine start-up, internal consulting companies often emerge from existing organizational units (organizational department, HR department, IT department). In addition, internal incubators emerged in an attempt to foster innovation and to attract talent. An integrated and effective generation and application of knowledge does not tend to result from this coexistence. Instead, there is often an unhealthy tendency toward internal and external demarcation. The internal competition for in-house clients often leads to situations in which the outsider wonders whether everyone involved realizes where “the enemy” is: outside in the market or within the company itself?

This raises the question of how and under what conditions the aforementioned analysis, consulting, innovation, and change capacities can be bundled in order to create added value for strategic corporate development and what understanding of the role such a unit must have. The Corporate University appears particularly suitable as a crystallization point for these units, especially as over time it tends to mature and fulfill an increasing number of roles and functions for corporate development.

Typology of the Corporate University Based on Its Stage of Development

Corporate Universities can be characterized based on their "maturity," as they typically go through the following stages of development (cf. Fig. 24.4):

1. **Individual skills focus**: A Corporate University can rewrite its history as a relatively young or newly established unit. They may also emerge from existing functional units (e.g., organizational or HR department). However, these units are usually too preloaded in terms of methods, functions, and personnel to be able to credibly take a holistic project view vis-à-vis internal clients and may just focus on the development of individual skills.

2. **Strategic and organizational change**: Corporate Universities that live up to the claim of being a platform for strategic corporate development are usually located high up in the organization. The targeted deployment of consultants can therefore be controlled directly by the company management. At the same time, this prevents the undesirable development that employees of some internal consulting units complain about. This is almost never a problem of capacity utilization, but rather the more or less hidden deployment of consultants in line tasks in project form in order to cushion staff shortages according to the concept of "body leasing." The internal consulting unit then atrophies into a personnel reserve. If the innovation function is attached, eventually including an incubator, this solution may ensure that the innovation process is running in line with the strategic intent of the corporation. This type of Corporate University operates basically within the boundaries of the own organization.

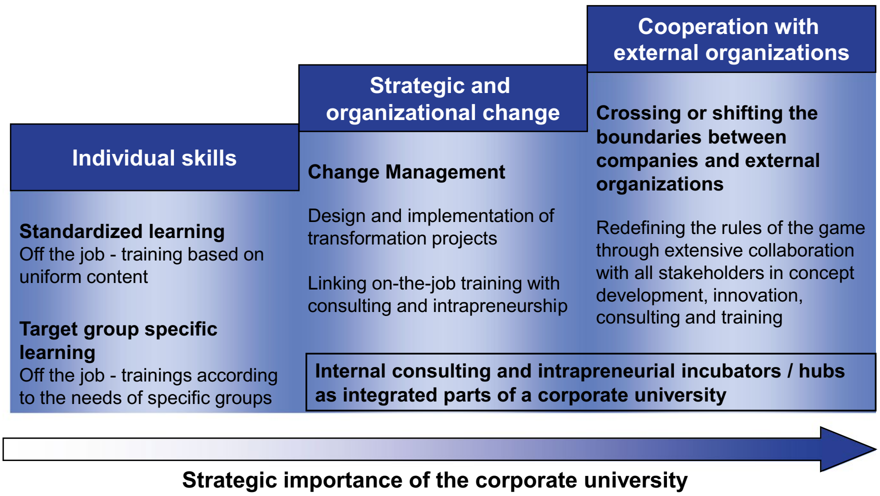

Fig. 24.4 Basic types of corporate universities. Source: Modified and extended based on Reineke (2000, p. 193)

Case A

A major European airport operator with shareholdings and management contracts intended to develop international leadership and change management skills at their home base but also abroad. A series of trainings have been designed for the airport managers. Whenever possible participants from different locations came to together at one of the participating airports. The intercultural implications immediately became evident; the individual knowledge exchange was facilitated.

Source: Own project work

Multinational companies are increasingly embedding cross-cultural competencies into CU curricula. Research by Hofstede (2020) and Trompenaars (1993) indicate that organizations that invest in global leadership programs yield higher expatriate success rates and better cross-border collaboration. Language barriers remain a challenge. Companies like Huawei and Toyota incorporate multilingual e-learning platforms and AI-driven translation tools to foster inclusivity and efficiency in their global corporate universities.

Case B

Siemens Global Learning Campus, Siemens' Learning Campus, operates across multiple continents and integrates local business challenges into training programs. With cultural intelligence training and leadership courses adapted to different regions, Siemens ensures that its global workforce remains aligned with the company's strategic goals while respect-ing cultural diversity.

Source: Siemens AG (2023).

3. **Cooperation with External Organizations**: Corporate Universities May Serve as a Learning and Meeting Place for all Social Groups and Stakeholders with Whom the Company Has a Relationship. They Also Organize Access to the Latest Knowledge, which Is Then Available for Consulting Tasks or the Innovation Function. This Also Includes Input from External Parties, which Can Be Fed in "just in time." Conversely, the Experience Gained from Project Work Can Be Fed Directly into the Company's Own Knowledge Pool and, if Necessary, into the Corporate Environment as Part of Maintaining External Relationships. This Type of Corporate Universities Has all the Functions as Described under "Type 2"; However, it Is Going Further by Including the Relationship to Relevant External Stakeholders in the Portfolio of Activities

Case C

Role portfolio of the Corporate University in a diversified multinational corporation:

- *Design and implementation of company-wide strategic change initiatives, identification and management of learning barriers, acting as a "Cultural Mediator," and ensuring continuity in enterprise-wide initiatives (*e.g.*, in areas such as Mergers and Acquisitions, Post-Merger Integration, Information Technologies, and Innovation).*
- *Conceptual development and execution of cross-company initiatives related to Corporate Identity, Corporate Design, Corporate Communication, and Corporate Ethics.*
- *Provision of internal consulting services.*
- *Enterprise-wide training and education programs, with a particular focus on top management development.*
- *Just-in-time training to support internal projects, incorporating intensive use of videoconferencing and distance education systems.*
- *Coaching for individuals and groups, including needs assessment and facilitation.*
- *Internal corporate think tank for developing a specific "Intellectual Capital," detecting and processing weak signals as an early warning system.*
- *Central hub for research and innovation, serving as a "Knowledge Navigator" for knowledge dissemination.*
- *Development of intelligent knowledge management systems, creating a knowledge base for change initiatives and an "Organizational Memory".*
- *Learning and knowledge control, specifically related to change management knowledge.*
- *Center for intercultural learning.*
- *Event planning and execution.*
- *Provision of platforms for dialogue with stakeholders and relevant social groups.*
- *A central, open meeting hub within the company that also serves as an attraction point for key industry sectors.*

Source: Own project work.

Unlike traditional training departments, advanced Corporate Universities are instrumental in internal consulting and knowledge management. They act as innovation hubs, fostering collaboration between internal and external experts to drive business transformation.

Case D

IBM Corporate University: IBM's Corporate University collaborates with external universities (MIT, Stanford) and tech startups to develop AI-driven business solutions. By leveraging real-world business scenarios, IBM integrates learning with innovation, enabling rapid upskilling of its workforce.

Source: IBM (2024)

Companies such as Airbus and Tata Consultancy Services use their CUs for strategic change management. By embedding internal consulting practices, they accelerate digital transformation and enterprise-wide agility (Forbes, 2022).

Digital Transformation is further driving the development of corporate universities. The adoption of digital platforms, AI, and data analytics has redefined corporate learning. AI-driven learning platforms analyze employee learning patterns and recommend customized content. Some companies employ adaptive learning technologies that optimize engagement and effectiveness. Deloitte and Accenture use gamification techniques and virtual reality (VR) simulations to enhance leadership training and customer service education. Studies suggest that immersive learning methods lead to a 70% increase in retention rates compared to traditional training methods (KPMG, 2022).

Suitable Set-Ups and Good Practices for Different Types of Corporate Universities

Set-Ups Based on Type of CU

Different types of Corporate Universities require different organizational set-ups.

Type 1: In this early stage, the lead is typically by the HR Department, with a decentralized steering of Corporate Universities as a management function in the line organization. This is based on a set of agreed HR development methods with clearly defined processes with a global reach.

Case E

A multinational supplier of the automotive industry started by developing a competency-model tailor-made to the needed future skill-sets for the company. Then a number of practice-learning concepts have been identified that are perceived to support the development of those competencies (Communities of Practice, Best Practice Round Tables, Peer Coaching, Assignment of

*Competency-Specific Tasks and Action Projects, Corporate Volunteering, Cross-Company Learning Groups, Competency-specific Coaching/Mentoring, On-the-job co-learning of specific competencies with the superior). The implementation of the variations of practice learning has been based on a manual, with detailed description on the processes and applications and decision-making tools for managers to help to select in view of the competencies to be developed. In addition, training companies in the target regions of the company have been pre-selected. These should be employed on an as needs basis for the training of practical, purely content related skills (*e.g.*, local accounting standards).*

Source: Own project work

By fostering a culture of "Communities of Practice," often implemented within consulting units through specialized Centers of Excellence (CoE) or Centers of Competence (CoC), the learning and development component can be further enhanced. These CoEs/CoCs typically do not require separate infrastructure but are instead adopted voluntarily as additional roles by employees.

Type 2: This more advanced version of a Corporate University requires usually some infrastructure. Bigger companies may have a designated appealing building for that purpose, with outlets in the main foreign destinations it covers. In the following example (cf. Fig. 24.5), some key staff is permanently employed (incl. Head Corporate University), others part-time. Internal consultants or intrapreneurs in an attached incubator work full-time (as a rule), but for a defined timeframe.

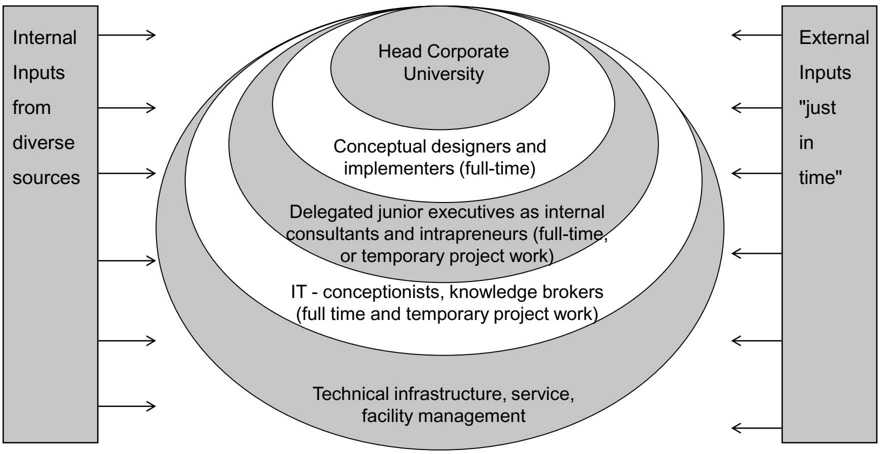

Fig. 24.5 The set-up of a corporate university in a diversified MNC. Source: Modified and extended based on Reineke (2000, p. 190)

For organizations with many branches or for SMEs that join forces for development purposes, the sharing on such an entity is a meaningful option.

Type 3: In this type, the external cooperation and network type of activities can simply be added to the set-up that has been described for Type 2. However, if the aim is more to develop external partnerships, other, more virtual concepts with ad-hoc settings can be considered. Then a "tent"-type of organization may be more effective rather than a solid "palace." The relevance of this Type 3 may vary across industries and depends on the strategy of the corporation. In times of "co-opetition" it may be one way to cope with increasingly blurred company borders.

Some companies have chosen to commercialize their internal consulting and training units by offering services externally. This can be strategically beneficial for knowledge generation, as it allows them to gain insights from other industries and organizations. Examples include Porsche Consulting and Lufthansa Consulting.

Case F

A group of leading companies in the aerospace industry in Europe agreed on a network type of Corporate University. The aim was not only to develop the individual skills of the participants, but also to prepare for the establishment of strategic alliances. Once a joint curriculum has been found, the hosting companies changed for each module. Trainings, workshops, and team-building activities have been conducted at different locations in Europe. After some initial hesitation, participants understood the underlying logic of "co-opetition," where cooperation and competition are co-existing at the same time, leading to blurred company boundaries.

Source: Own project work

Organizational Anchoring of Corporate Universities

One of the challenges in large corporations is that knowledge dissemination and initiatives from within may have a more difficult standing than outside knowledge and advice.[3] In order to ensure the appropriate acceptance from within the organization, the Corporate University needs a high degree of independence. Structuring according to priorities, which is determined by the philosophy of the "platform of strategic change," requires a high degree of integration into the company organization. Structurally, the Corporate University is usually a separate unit; in some cases, corporates have even established separate legal structures for their CUs, for example, CP All PLC's Panyapiwat Institute of Management (PIM) in Thailand (cf. Panyapiwat Institute of Management, 2025), although recent research suggests several potential shortcomings of such a setup (cf. Andriushchenko et al., 2022, p. 662).

[3] The authors have experienced this phenomenon of "the prophet in his own land" on multiple occasions during their work as external consultants to major international corporations.

A direct link between the director and the managing director or CEO, or at least a member of the top management, recognizes the importance of the institution. However, the perception of the Corporate University in the company units as an instrument of power and influence of the company headquarters is fatal. As soon as the internal consultants are perceived as "spies" of the company management, this unit can no longer be expected to contribute value.

The head of the CU is supported by a small number of employees who are available full-time as specialized conceptionists in the fields of consulting, training, knowledge management, and CU-related public relations activities. Delegated junior managers work as internal consultants and change agents, ideally also on a full-time basis for a specific period or as part of a specific project. To create the appropriate incentives for this, CU work must be seen as an honor and be a central element in the promotion of junior staff and management development within the company. A 50% time off for project tasks can be used as a supplement but is problematic. As the tasks within the line function are usually not reduced accordingly, the resulting conflict of time and objectives is usually decided in favor of the line function. The project work is therefore jeopardized in terms of adherence to deadlines and quality, and the learning success for the consultant deployed is questionable.

In the case of internationally active companies, the question of the inclusion of foreign subsidiaries also arises. Experience suggests that even in companies with a high degree of internationalization, change initiatives often do not cross the borders of the home country. Concepts that are hotly debated at headquarters are not recognized abroad, let alone adapted in an interculturally appropriate form. A Corporate University can also contribute to the international development and realization of change initiatives; it can even become a catalyst for the internationalization strategy. The starting point for such activities is the headquarters of the Corporate University, which is usually located in the home country. Loose forms of coordination via local contacts, virtual forms of organization with international project teams and finally the gradual expansion of own CU branches abroad are possible forms.

The network concept is the predominant cooperation principle: no fixed and long-term alliances with external universities and service providers, instead the best external and internal inputs are brought together in a timely and project-specific manner. Partners are all individuals or groups who can contribute to the further development of the company on the basis of the win-win philosophy. In the context of the further education function of a Corporate University, cooperation with other companies serves, among other things, to balance capacity; but is also a deliberate element of seminar programs in order to facilitate an exchange of ideas. Project-based practice- or action learning methods, together with micro-training units on an as needed basis, are usually a good match in this type of learning environment. The same basic idea can also be applied to the cooperation and exchange of internal consultants operating out of the Corporate University. This applies to external consultants as well as internal consultants from friendly companies.

In a Corporate University committed to the network concept, it will be difficult to integrate those consulting units that explicitly offer themselves within the company as an alternative to external consulting firms. Such units in large companies now sometimes have several hundred employees. One has to ask oneself whether this is really expedient in times when the product range and business processes are focussed on core competencies. In addition, the experience background of external consultants from a multitude of other projects and sectors is not taken into account. Even the occasional involvement of internal consultants in other companies' projects cannot compensate for this.

A widespread criticism of the CU concept, namely the tendency to navel-gazing, is best countered by an open, network-based Corporate University. The potential conflicts between internal and external consultants due to different corporate cultures, incentive systems, and a latent competitive situation are the lesser of two evils. In addition, some consultant roles, such as the "bearer of bad news" in the context of cost-cutting programs, can be easier assumed by external consultants, as they are not subjected to internal politics and not risking unfavorable performance evaluation and career progression as a result of their insights and recommendations. With an intelligent division of roles between internal and external consultants, greater consulting effectiveness can be achieved than when internal or external management consultants acted alone. However, mutual dependencies that arise, for example, when a large external management consultancy takes over the complete training of an internal consultancy unit should be avoided—partly because the external consultant may not have the in-depth knowledge and understanding of the organizational attributes such as its corporate culture that is usually required for successful operation of an internal consultancy, and also because it may make the company and its internal consultancy unit fully reliant on the external consultant in the early stages of its operations.

The result is a complex set of roles that must be carefully managed. However, this is good preparation for managers at a time when "co-opetition" is one of the realities of business life.

Challenges with Different Organizational Set-Ups

Problems arise if multiple internal consulting units exist at different organizational levels and are not fully integrated into the CU. For example: A company with separate consulting units for Change Management, Organizational Development, and IT, but only the Change Management unit was assigned to the CU. This often leads to unhealthy internal competition or, worse, "consulting metastasis"—where consulting teams expand their scope continuously, recruit new staff, or collaborate with external consultants, rather than working together effectively. To avoid inefficiencies, clear rules and incentives for collaboration must be defined, and forums for personal interaction among consultants (e.g., within the CU) should be established.

Another issue might arise in consequence to the lack of a unified consulting philosophy: In some cases, companies attempt to merge traditional management consultants with organizational development (OE) specialists within a single internal consulting unit. While the concept is logical—as change management and technical consulting are two sides of the same coin—experience shows that significant challenges arise. Long internal alignment processes and ideological conflicts between different consulting backgrounds often delay effectiveness. The situation worsens when previously independent consulting units are merged under the CU, often leading to all the symptoms of a post-merger syndrome.

This fragmentation can result in internal competition and a lack of cohesive strategy. For instance, a study by The Boston Consulting Group highlights that many organizations develop custom case studies reflecting their industry challenges, yet these are often not integrated across the company, leading to redundant efforts (Kolo et al., 2013).

For multinational companies, an additional challenge arises: how to integrate foreign subsidiaries into CU initiatives. Research on international change management has shown that even in highly globalized companies, change initiatives often do not extend beyond the headquarters' home country. Concepts that are intensively discussed at corporate headquarters frequently go unnoticed abroad and are neither adopted nor adapted in local markets. The acceptance of the overall concept of a CU does not only very across regions and national cultures. As CUs have been sometimes established and sometimes not by corporations in various parts of the world, it seems that the corporate culture, the strategy and the related leadership styles have an even bigger influence on the acceptance than the geographic location.

A Corporate University can act as a driver for the international development and implementation of change initiatives. In fact, it can become a catalyst for a company's internationalization strategy. Typically, the headquarters of the CU is located in the home country. However, various approaches exist to extend CU influence globally:

- Loose coordination via local contacts.
- Virtual organizations with international project teams.
- Gradual expansion through local CU branches abroad.

For example, Motorola University has launched regional campuses in the Americas, Europe, and Asia. These international branches typically cover multiple countries or entire regions, ensuring a more globally integrated learning and development approach. The CU influences operational business units through a balanced mix of demand-driven and supply-driven elements. The latter applies, for example, when strategic initiatives are initiated by top management. (cf. Wiggenhorn, 1990).

Corporate Universities, Internal Consulting and Intrapreneurial Activities: Synergies and Challenges

Corporate Universities and Internal Consulting

Several factors have driven the establishment of internal consulting units and their integration with corporate universities (cf. Reineke, 2002):

1. **Industry-Specific Expertise:** Internal Consulting Units Understand the Nuances of their Respective Industries Better than External Consultants, Eliminating the Need for Long Onboarding Periods and Ensuring Faster Problem Resolution

> **Case G**
> *Siemens Advanta Consulting (SMC) has played a crucial role in driving innovation and transformation within Siemens, leveraging in-house expertise to execute strategic initiatives more effectively than external firms.*
> Source: Siemens (n.d.)

2. **Change Management and Agility:** Companies Facing Constant Market Fluctuations Require Rapid, Adaptive Responses. Corporate Universities and Internal Consulting Units Work Together to Cultivate Agile Leadership and Workforce Readiness

> **Case H**
> *Google's re: Work initiative focuses on integrating data-driven HR practices in-to leadership development, ensuring that decision-making aligns with the company's evolving business model.*
> Source: Google re (n.d.)

3. **Confidentiality and Intellectual Property Protection:** Internal consulting minimizes the risk of exposing sensitive information to external parties. This has become particularly relevant in industries such as finance and pharmaceuticals, but also in more industrial settings where proprietary knowledge can be a key differentiator.

Case I

A Southeast Asian National Oil and Gas Company (NOC) has fully integrated its Talent/Leadership Academy and its Internal Consulting Unit. In a "field-and-forum" learning setting, participants in the multi-year leadership building program receive formal classroom training, followed by hands-on consulting project experience in one of the company's business units. With this approach, the company manages to build and retain valuable proprietary knowledge, while reducing the reliance on external consultants, leading to both cost savings and protection of the company's Intellectual Property.

Source: Own project work.

4. **Bridging the Theory–Practice Gap:** Traditional training methods often fail to translate theoretical knowledge into actionable insights. On-the-job learning through internal consultancy projects significantly reduces this "transfer gap." This is also supported by Empirical Evidence: A study conducted by Harvard Business Review (2021) found that companies employing experiential learning within internal consulting projects experienced a 35% increase in employee retention and a 20% improvement in leadership effectiveness.

Case J

The Food Business Unit of Betagro, a Thailand-based global agro-food company, anchored its talent development program with its Business Strategy team, its de-facto *internal consulting unit. Linking the training content to actual internal project work significantly improved participant experience (as shown in participants' rating of the program) and led to high retention rates of this critical employee group.*

Source: Own practitioner experience.

Even with the obvious advantages of linking a Corporate University and management consultancy, success factors must be in place to realize such a concept with the desired effect. The relationship with top management, organizational integration, the personnel concept and the cooperation concept for collaboration with external service providers and stakeholders appear to be particularly relevant.

Corporate Universities and Intrapreneurial Activities

The attachment of entrepreneurial or intrapreneurial hubs or incubators to CUs is driven by the following considerations:

- Many young high potentials don't like to work in a hierarchical context. Such talents may be attracted and retained only if they can set up something on their own, thereby nurtured by the Corporate University.
- The hub might be faster in making meaningful contributions based on new technologies as compared to try traditional ways to organize the innovation function.
- Together with the internal consulting function, the intrapreneurial hub can realize synergies from within the Corporate University, also across borders.

Case K
A medium-sized company in Switzerland used the show room and training building for their customers and added the internally focused Corporate University function to the image of that place. The starting point have been internal projects in the area of innovation, marketing, and sales that have been selected by the Steering Committee in view of the strategic direction of the company. The on-the-job training was backed up by external coaching and short training/workshop modules that have been provided "just-in-time" in close alignment with the project contents and the competency development goals of the participants. This approach allowed employees to learn in a practical environment while delivering immediate value to their company. In addition, they received a higher education title at the end. Steering of the academy program was provided by an internal Project Management Unit (PMU).
Source: Own project work

Success Factors for Corporate Universities in an International Context

Corporate Universities (CUs) serve as strategic instruments for talent development, leadership cultivation, and organizational transformation. Their effectiveness, however, depends on several key success factors:

1. **Strategic Commitment from Top Management**

A robust Corporate University requires unwavering support and clear goal setting from senior leadership. The goals need to be strongly aligned with the strategic objectives of the company. Research highlights that successful corporate universities have strong executive involvement. For instance, former GE CEO Jack Welch reportedly spent at least one day per week at the company's Corporate University, illustrating top management's role in embedding learning into corporate culture by directing strategic change initiatives run by the CU-based project teams (Davis & Davis, 2018). Ideally, the Corporate University enjoys true commitment from the whole top management and is also well-founded in the middle management that broadly communicates the value of the academy. Two negative perceptions from operational business units can critically impact the acceptance of a Corporate University:

1. The impression that the CU is merely a “plaything” of top management, serving as a platform for intellectual indulgence rather than adding real value.
2. The perception of the CU as a power and influence tool of corporate headquarters. If CU employees and project teams are viewed as “spies” of senior management, the unit’s ability to make an independent value contribution is lost.

2. **Structural Integration and Autonomy**

Corporate academies must strike a balance between autonomy and integration within the company. A study by Garavan et al. (2021) found that independent corporate universities linked to top management have higher strategic alignment and impact. However, excessive control by headquarters may lead to resistance from subsidiaries, especially in multinational enterprises (MNEs). For a Corporate University to gain credibility within the organization (the classic “prophet in his own land” dilemma), it requires a high degree of independence. This includes organizational independence and financial independence, which is a critical challenge.

3. **Talent Development**

CUs function as incubators for future leaders. Delegating junior managers as internal consultants or intrapreneurs fosters organizational learning while enhancing their leadership competencies. However, if project tasks do not have dedicated time allocation, conflicts arise between line functions and CU commitments (Bersin, 2020). The quality standards of internal consulting units must be high, as it is not possible to switch to alternative clients if projects fail. After all, the success of the project also helps to secure the future of the company. In the case of talents that are attached to an intrapreneurial hub, a well-developed “exit-strategy” is a key success factor: should a successful development project that passed the early stages be integrated in the organization, set up as a legal entity by the parent company or sold? And how can talents be retained?

4. **Cost Center Vs. Profit Center Approach**

Managing Corporate Universities as profit centers can undermine their strategic purpose by incentivizing short-term profitability over long-term capability building. Instead, a cost-center model with clear internal service valuation ensures alignment with business objectives. Corporate Universities often fund themselves partially through internal and sometimes external consulting and training services. Initial investment costs are typically covered by central budgets.

5. **International and Intercultural Adaptation**

A critical challenge for global corporations is ensuring that learning initiatives resonate across cultural and regional contexts. Research indicates that many change management programs remain confined to headquarters, failing to gain traction in foreign subsidiaries (Schuler et al., 2022). Corporate Universities can act as conduits for internationalization strategies by leveraging:

- **Virtual Learning Platforms:** Siemens' Global Learning Campus integrates digital learning to bridge geographical gaps.
- **Localized Curriculum Development:** Unilever's Leadership Academy tailors training programs to regional business environments.
- **Cross-border Knowledge Sharing:** McKinsey's learning network fosters inter-regional collaboration through knowledge hubs.

6. **Network-Based Learning Ecosystems**

Rather than relying on fixed alliances with academic institutions, modern CUs adopt flexible partnerships with universities, think tanks, and industry experts. Google's Corporate University, for instance, collaborates with external specialists to create agile learning modules (Westerman et al., 2020). Similarly, Deutsche Telekom integrates knowledge exchange with external consultants to drive innovation (Deloitte, 2021).

7. **Managing Internal and External Consultant Roles**

A well-structured CU blends internal expertise with external insights. While internal consultants ensure alignment with corporate strategy, external consultants contribute industry best practices. Research by Tannenbaum et al. (2023) indicates that a hybrid approach enhances advisory effectiveness, particularly when external consultants handle sensitive roles, such as cost-cutting initiatives.

8. **Mitigating Risks of Insularity**

Corporate universities often face the criticism of fostering insular thinking. To counter this, leading firms adopt open learning networks. IBM's corporate learning integrates peer learning from industry consortia, while Accenture Academy facilitates knowledge-sharing forums among global consultants (CEB, 2022).

Empirical evidence underscores the effectiveness of Corporate Universities, once the success factors mentioned above are met. Key performance indicators (KPIs) such as employee retention, leadership pipeline growth, and business performance improvements help evaluate their impact. Amazon's corporate university, for example, tracks employee career progression post-training, demonstrating a direct correlation between upskilling initiatives and career advancement (Harvard Business Review, 2023). While CUs require substantial investment, companies may get a significant ROI through reduced hiring costs, higher productivity, and enhanced innovation.

Conclusion

The synergy between corporate universities, internal consulting units, and intrapreneurial hubs presents a significant opportunity for organizations to develop strategic capabilities, drive innovation, and enhance leadership development. However, the success of these initiatives depends on alignment with corporate goals, cultural adaptability, and integration of digital learning technologies. As global markets continue to evolve, companies must remain agile in refining their internal consulting and corporate education strategies to sustain competitive advantage.

Corporate Universities play a pivotal role in fostering organizational capability, but their success hinges on strategic alignment, international adaptability, and a balanced ecosystem of key stakeholders. Empirical evidence suggests that a network-based, globally integrated approach enhances their impact.

Recent restructuring efforts such as the spin-off and sale of GE's Crotonville Corporate University (cf. Carey, 2024) suggest that the landscape of corporate learning architecture is changing and that current structures may need to reform themselves in order to remain relevant in the context of a rapidly evolving external environment. This may become particularly relevant in periods of economic recession and financial decline, during which corporate training and education efforts become subject of particular scrutiny by corporate boards and executives. Therefore, corporates could benefit from academic support in this area. Particularly, further research should focus on empirical assessments of corporate universities' impact on business performance and employee career progression across different industries and cultural contexts. Also, the role of AI-driven learning personalization and the relationship between Corporate Universities and sustainable leadership development deserves further study.

The more fundamental question as to what extent companies should "educate" their employees (vs. just focus on efficient task performance) may also deserve further investigation in future research efforts.

Given technological advancements and changes in the corporate work environment, the area of personal development in corporations can be expected to rapidly change in the years to come, and the authors expect this to remain a subject of high relevance and interest for both academic researchers and corporate practitioners in the years to come.

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The book was inadvertently published with an incorrect copyright year. The initially published version has been corrected, and the copyright year is now updated to "2025".

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