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Resources and research challenges

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Improving the quality of business process descriptions of public administrations

Quality of
business
process
descriptions

Resources and research challenges

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Abstract

Purpose – Business processes (BPs) of public administrations (PAs) are often described in the form of written procedures or operational manuals. These business process descriptions are expected to be properly understood and applied by civil servants, who have to provide legally compliant service provisions to the citizens. However, process descriptions in the PA are sometimes hard to read, ambiguous, or vague, leading to false interpretations or even incorrect execution of the processes. The purpose of this paper is to focus on improving the descriptions of BPs to be used in PAs.

Design/methodology/approach – To this end, the authors present an in-depth domain analysis, including a literature review and interviews with PA stakeholders belonging to different realities. From this analysis, the authors identified a set of 52 typical defects of process descriptions.

Findings – The authors provide a set of guidelines and a template to constrain the definition of these documents and to mitigate the identified defects. Furthermore, the authors outline research challenges in the field of quality assessment of textual process descriptions for the PA.

Research limitations/implications – This paper addresses the needs of any PA officer who has to write an official procedure or operational manual, and should be studied by researchers who wish to provide automatic strategies to check the quality of these documents.

Originality/value – Text quality issues have been addressed in various fields (e.g. requirements engineering), but not in the area of BP descriptions of PAs. The contribution consists in the study of the quality issues that occur and create problems in the practice of this particular domain. Based on this insight, we provide directions for research that will find solutions to mitigate the issues.

Keywords Public administration, Quality assurance, Business process management, Natural language processing, Ambiguity, Language quality assessment

Paper type Viewpoint

1. Introduction

Public administrations (PAs) are responsible for providing services to citizens in accordance with the law. To do this, they define procedures, i.e. business processes (BPs), which civil servants have to follow and that will result in a legally compliant service provision. Civil servants have to learn how to execute these BPs (Di Ciccio *et al.*, 2015); learning can be realised via oral instructions, expert guidance, or it can be based on studying documentation, i.e. codified knowledge of how to execute the BPs.

When studying this problem, there are two important observations to be made.

First, although graphical notations exist to capture knowledge about BPs, most PAs rely on textual descriptions. This becomes evident when studying approaches to introduce proper models of BPs in PAs, as in the work of Schumann *et al.* (2014). Indeed, graphical notations such as Business Process Modelling and Notation (BPMN) – see Object Management Group (OMG) (2011) – are better understood by experts than by untrained persons, and their value is higher



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when complemented with textual descriptions, as noted by the studies of Ottensooser *et al.* (2012), and Nawrocki *et al.* (2006). Moreover, graphical notations cannot model every subtlety of a BP, and enabling them to do so would further increase their complexity and hence decrease their understandability (Sánchez-González *et al.*, 2011). Therefore, we argue that textual descriptions will be used to describe BPs also in the future.

Second, using natural language always implies the risk that the message that the author intends to express is not – or not exactly – the one that the reader understands. In PAs, unclear instructions may result in misunderstandings, and hence either in a waste of time – when civil servants have to understand the meaning of the instructions – or, in the worst case, in incorrect execution of BPs. As an example, let us consider an instruction that does not clearly define the actor who should be responsible for executing a certain task. As noted by Sommerville (2007), such a defect can lead to several undesired consequences, e.g., nobody might feel responsible for executing the task and, hence, the task gets delayed or not executed at all. Such issues reduce the confidence of citizens in public services and can have severe legal and financial consequences.

Given the need for understandable BP descriptions expressed in a clear and unambiguous natural language that we could observe in the field, the goal of our research is to support quality assurance of BP descriptions. Specifically, we aim at understanding the most important defects impacting the understandability of textual BP descriptions; providing practical and simple solutions to mitigate the defects; providing research directions in the field of quality assessment of BP descriptions.

To identify the most important defects, we performed an in-depth domain analysis, including a literature review and a set of interviews with PA stakeholders. The literature review revealed that there are not previous studies on text clarity in BP descriptions in PAs. As practical and simple solutions to mitigate the defects, we provide a set of guidelines and a template for editing BP descriptions. In this set, we included all guidelines that we could identify from our references and that we considered applicable to the context based on interview findings. Moreover, to provide research directions for improving BP descriptions, we survey the current literature in quality assessment of textual documents, we clarify the research gap and provide research directions in readability assessment, ambiguity detection, text summarisation, and BP model-to-text consistency. We believe that a computer-supported solution will help because humans frequently overlook defects of descriptions when they get tired from reviewing – as has been confirmed by research in the area of requirements engineering (Berry *et al.*, 2012).

Our domain analysis on the quality of BP descriptions in the PA consisted of a literature review (Section 2), and a set of interviews (Section 3). Findings from literature research and interviews were combined to define a complete list of defects that can be found in BP descriptions. This combination was chosen because there exists already a large body of knowledge regarding linguistic defects in general (see next subsection), but there is insufficient knowledge about the impact and severity of such defects, especially in our domain of analysis, i.e. in BPs in the PA (Batini and Scannapieco, 2016). As a result, we are enriching existing knowledge with empirical evidence from the field of PAs.

Accordingly, the rest of this paper is organised as follows. In Sections 2-4, we describe the domain analysis performed. In Section 5, we describe the guidelines and the template for editing BP descriptions. In Section 6, we present the research challenges that this work opens. Here, we also discuss how previous work has addressed text quality issues in general or in other domains. In Section 7, conclusion and future works are presented.

2. Literature review

This section discusses the most relevant works that we consulted along our literature review, which touched the quality of a text in general (Section 2.1), and the quality of PA documents (Section 2.2).

2.1 Books, associations and tools

Textual quality is relevant in many areas to achieve effective communication. In general, it is associated with the concepts of clarity, conciseness and absence of specialised jargon. Several books have been edited with practical recommendations on how to write using the so-called plain English, a language that emphasise clarity and brevity. For instance, the *The Plain English Guide*, edited by Cutts (1996), says, within a set of 25 guidelines on using easy words, reducing cross references, and planning before writing, that the average sentence length should be 15-20 words, and sentences should not exceed 40 words. Another reference book is *Style: Toward Clarity and Grace* (Williams and Colomb, 1995). This book is not structured with a set of guidelines as Cutts (1996), but is more of an education textbook, with theoretical reflections and practical examples to be studied rather than to be consulted as a practical manual. A peculiarity of the book is the analysis of content-related aspects such as emphasis and elegance, which are not covered in other texts.

The use of plain English is also promoted by associations such as the Plain English Foundation[1], the Plain English Campaign[2] or the Plain Language Association International[3].

Clarity of language also plays a large role when (technical) texts are to be prepared for an international audience and/or for translation into other languages. In this context, guidelines have been developed based on the concept of “International English” (Buican *et al.*, 1993).

Some tools are available to check the quality of a text. Among them, the *Hemingway Editor*[4], which is free for access and download, marks with different colours sentences that are hard to read, terms with simpler alternatives, adverbs, passive voice expressions and other quality defects. Other tools such as the plugin for Microsoft Word 2010[5] released by the University of Surrey are more focussed on readability checks – i.e. how easy is to read a text.

2.2 Quality guidelines in PAs

The listed books, associations and tools are not specifically targeted to PAs, but to the general quality of a text. However, texts adopted in a PA – e.g., regulations, procedures – need to exhibit certain quality attributes that are specific for PAs. Therefore, several PAs in the world have defined a set of guidelines to be adopted by the civil servants writing PA-related documents, such as regulations, procedures, press releases and even speeches. Below, we give an overview of such guidelines.

General guidelines from the European Union (EU) are available in the document “How To Write Clearly” (European Commission, 2012), and its recent extension “Claire’s Clear Writing Tips” (European Commission, 2014). Besides providing recommendations on reasoning on the expected reader of the document, the guidelines emphasise the need to use short and simple expressions, avoid jargon and passive voice, and limit acronyms. A detailed “Style Guide” for English, directed to editors and translators was also made available by the European Commission (2011). The guide specifies a set of linguistic conventions that cover punctuation, capitalisation, abbreviations, numbers and other elements of style that an editor or translator is expected to adopt when writing/translating official EC documents.

Also the government of the USA, within the “Plain Language” initiative[6], provides a set of guidelines for writing PA texts (US Government, 2011), with specific suggestions on how to structure a document. The UK government provides style guidelines in its Website (UK Government, 2015), with a focus on writing PA documents that are published on the web. Specific guidelines are also given on how to organise a procedure (i.e. BP) description. Stemming from the work of Redish (2012), these guidelines recommend to describe procedures through numbered lists and to avoid juridical jargon even in legal documents directed to larger audience. Moreover, they recommend to keep lists of instructions short (5-10 items), and suggest that, if lists are longer, they should be grouped into shorter lists each with its own sub-heading. These latter guidelines are based on the empirical study of

Trudeau (2012), which shows that 80 per cent of the people involved in the study prefer plain English instead of legal jargon, and that the more specialist the knowledge of the reader, the higher the preference for plain English.

From the different sources consulted in our literature review, we selected a subset of main sources to guide the definition of our list of quality defects of PA documents. Such sources are the guidelines from the EU – referred in the following with the EU acronym – those of the UK government (UK acronym), and those of the US government (USA). The selection of these main sources was performed by the authors based on the following observations: the texts were focussed on PA documents, and were listing defects, besides providing solutions; the solutions listed in the other references were addressing defects already listed in these main sources.

3. Methodology

We chose interviewees from different PA offices to have a complete view of potential environments and problems. We selected three PA institutions: CNR-ISTI[7], a nationally funded Italian research institution with about 300 employees (20 administrative staff); the 2 Mears Seas Zeeën Programme (INTERREG 2MSZP[8]), a European secretariat that takes care of managing cross-border projects within EU nations (about 20 people, all administrative staff); the Sportello Unico Attività Produttive (SUAP)[9], a public Italian service for citizens, which support the procedures for opening novel businesses. Each municipality in Italy has a SUAP office, normally with one employee in each office.

We consider the CNR-ISTI group sufficiently representative of different, large and multi-functional PA realities since it is a large research institution, and the administrative staff includes people with diverse expertise who have to perform different BPs at different degrees of formalization. On the other hand, 2MSZP represents a specialised cross-national reality, in which civil servants, who work in large and structured offices, interact with representatives of other PAs, and provide BPs and regulations for their interlocutors in accordance with EU laws. Finally, SUAP is a good example of a highly specialised reality, with single civil servants acting as heads of office, with front-desk duties.

We performed two interviews (I1, I2) with the administrative staff of CNR-ISTI. Each interview involved two civil servants that were working together in the same office. Furthermore, we performed one interview with a EU Project Officer (I3), belonging to 2MSZP, and one interview involving two front-desk employees working at SUAP offices of the Marche Region (I4). To have a uniform view of the gathered information, the interviewer was always the same person – i.e. the first author. All the interviews were semi-structured (Di Cicco-Bloom and Crabtree, 2006), i.e. based on an initial list of questions, but raising additional questions when new and interesting aspects were mentioned. During the interviews, we used the term procedures instead of BPs since civil servants are more acquainted with the former term. The questions asked by the interviewer were first concerning the types of BPs performed by the interviewees and the types of documents describing BPs for their work (Section 4.1). Then, the discussion focussed on the types of defects of these documents (Section 4.2).

4. Results

4.1 BPs and types of documents

The most evident aspect that we perceived from the interviews is the heterogeneity of BPs, documents, and terminology used in the different offices. In the case of I1, the BPs (organising committees, recruiting personnel, and managing internal practices) depend on the circulars, which express variations on existing BPs that are not formally described anywhere, but rely on procedural knowledge of employees. In the case of I2, BPs (redaction of official acts related to contracts and projects) depend on internal, national and European

regulations, but also to a large extent on internal circulars. In the case of I3, a complex pyramid of EU laws and regulations is used. Similarly, in I4, employees have to refer to EU laws and regulations, but they have also to integrate them with national and local laws. With the exception of I3, for which internal BPs are rigorously documented, in I1, I2, and I4 internal BPs are generally not formalised.

4.2 Defects of BP descriptions

The main problems of BP descriptions discussed in I1 were related to the difficulties in the contextualisation of the content of the circulars. Indeed, in some cases such circulars appear to refer too many external documents, and, at the same time, they miss the goal of providing a proper summary of the content of such external documents. Such summary would help in understanding the regulatory context of the document. Moreover, not only the regulatory, external context is a problem, but also the practical context. Indeed, along I1, the absence of examples on how one should put the procedure into practice was highlighted as a main problem, together with the difficulty in finding a responsible person who knows how to address possible issues in the implementation of the process. Finally, also ambiguity of the BP descriptions was discussed as a relevant problem: if the content is ambiguous, the civil servant has to take responsibility in putting the BP into practice without knowing whether his/her choice is correct from the regulatory point of view. For example, one the interviewee mentioned a circular that states that there should not be any conflict of interest between the participants to a commission for the selection of new personnel. According to the interviewed civil servant, the circular indirectly states that the director of the institution should never participate to commissions, since these are composed by members of the institution that might be influenced by him. However, this interpretation is not explicitly stated anywhere in the circular, and the decision of including the director in the commissions is left to the civil servants who organise them.

During I2, which we recall was composed of people of the same institution of I1, the conversation took another direction. Indeed, this office has to integrate the content of the circulars with the content of EU and national laws, and one of the first problems raised was the overlapping and contradiction between the content of the different official documents, which leads to practical difficulties in the implementation of BPs. A considerable amount of time is spent in deducing what is the correct BP to implement for their tasks, given the different documents. Another largely discussed problem in I2 was the structuring of the different documents. Indeed, interviewees of I2 complain that it is often hard to understand the category of a document – which can give hints on the expected impact of the document – also because the documents are structured in a non-standardised or inconsistent way. An interesting story about the consequences of poor document clarity was also mentioned in I2. One of the interviewees told that the civil servants of the institution once received a circular about a national procedure for obtaining a unique coding number for financed projects. The circular was unclear, and was never implemented by the civil servants. After some months, when the unique project number was required by other procedures, it emerged that the civil servants ignored the circular because of its poor clarity. Hence, within one month, the institution decided to deliver a specific training course on the content of the circular.

Concerning I3, for which operational manuals that describe each single activity of the employees are constantly updated, the main problem discussed was the redundancy of these documents. According to I3, this is not only a problem of time required to read such documents. Indeed, documents tend to summarise the content of other laws, regulations and manual, without necessarily being faithful to the source. Hence, the reader might have a wrong view of the sources, and implement the BP in an incorrect way.

During I4, the main problems raised were related to the unclear motivation of both rules and external references in the documents describing the BPs. The absence of a

justification leaves the civil servant – which in I4 interacts directly with citizens – in an uncomfortable situation. S/he has to perform some activity, or ask the citizen to perform an activity, without a clear rationale. Hence, s/he can be subject of unjustified complaints to which s/he cannot give a reasonable answer different from the annoying expression: “It’s the law”.

From the interview transcripts and from the literature review, we isolated 53 different defects of BP descriptions in total. The complete list of defects is reported in Table I. The defects are partitioned into five categories: clarity of the documents, clarity of the sentences, synthesis, internal coherence, and external coherence – i.e. coherence with other documents. Each defect has an identifier, which will be referred in the remainder of the paper, when we will specify solutions to address the defects. In addition, for each defect, the main source is reported, using the previously introduced acronyms: EU, UK and USA for the different sources coming from the literature review, I1-4 for the interviews.

5. Guidelines and template

To provide simple means to address the defects of the BP descriptions identified in our domain analysis, we provided two means: a set of guidelines for editing BP descriptions (Section 5.1); a template to constrain the definition of BP descriptions (Section 5.2).

5.1 Guidelines

A set of guidelines was defined that is directed to the editors of BP descriptions. The objective of the guidelines is to let the editors be aware of the expected quality of their content. Such guidelines take inspiration from both the previously referred public guidelines for defining PA documents, and from the Plain English Guide by Cutts (1996) (referred with the acronym MC in the following). The guidelines were designed to be concise and clear, and to act as an easily accessible checklist that the editors can read to verify that their BP description has the appropriate degree of quality. For those guidelines that can be traced to one of literature sources, the id of the source (EU, UK, USA, MC) is placed close to the guideline, so that the interested reader can access the original manual, if she/he wishes to have a major insight, or more specific examples.

The list of guidelines is reported in Table II, together with the defects of our domain analysis that the guideline is expected to mitigate. The reader can verify that each defect is mitigated by at least one guideline.

We derived a grouping of guidelines by clustering them iteratively as we discovered them – based on similarity as perceived by the authors – and finally finding headlines for clusters. Hence, guidelines below are partitioned into five groups, namely general (i.e. guidelines that impact the whole procedure description), fields (i.e. guidelines that specify the fields needed in a description – these guidelines are enforced by the template described in Sect. 5.2), steps (i.e. guidelines associated to the partitioning of the procedure into steps), sentences (i.e. guidelines associated to the writing style and the clarity of the text), and warnings (i.e. guidelines associated to the specification of exceptional situations).

In order to clarify the usage of part of these guidelines, we consider it helpful to illustrate some of them with examples. In the following we have provided examples for those guidelines concerning linguistic defects that are non-obvious; can be illustrated within a single sentence; cannot be found in other manuals. For the examples, we adapted the text of the real-world BP descriptions that we downloaded from the Web. Each row of Table III refers to: the guideline (G-ID from Table II); the associated defect (D-ID from Table I); an example of a defective sentence; and a suggestion for improving it. Additional examples can be found in the manuals referenced in Table II.

D-ID	Defect	Source
<i>Clarity of documents</i>		
1.a	The document does not have an explicit argument/topic	I2
1.b	The document does not have an explicit motivation/function	I4
1.c	The document or the sections do not have a clear title	EU
1.d	The document is not partitioned into sections	I1
1.e	The document does not include practical examples	I1
1.f	The document does not explain the motivation of specific rules or instructions	I4
1.g	There is no glossary	EU
1.h	There is no reference to the software tools that shall be used	I2
<i>Clarity of sentences</i>		
2.a	Sentences use a difficult language	UK
2.b	Sentences are too long	UK
2.c	Sentences include too many different concepts	USA
2.d	Rules/instructions are difficult to understand	UK
2.e	Rules/instructions are difficult to put into practice	I4
2.f	Relevant terms do not have a clear definition	EU
2.g	Sentences have an ambiguous structure	I1
2.h	Sentences use ambiguous terms	I1
2.i	Sentences use terms that are typical of other offices	I1
2.j	Sentences use too many synonyms	I4
2.k	Sentences contain grammatical errors	I1
2.l	Sentences contain juridical jargon	UK
2.m	Terms have specific meanings but they are used inappropriately	I2
2.n	Acronyms and abbreviations are not defined	UK
<i>Synthesis</i>		
3.a	The document contains too many references to laws and regulations	I1
3.b	The document contains repetitions	I2
3.c	The document does not make clear what is important and what is not	I1
3.d	The document contains lists of steps that are too long	UK
3.e	The document is too long	I3
3.f	The document is too detailed	I3
3.g	The document contains obvious information	EU
3.h	The document refers irrelevant information	I3
<i>Internal coherence</i>		
4.a	Relevant information is missing from the document	I4
4.b	The document does not make clear what are the institutions/offices involved	I2
4.c	The document does not explain who are the subjects involved	I2
4.d	The recipient of the document is unclear	I2
4.e	The document describes a procedure, but there is no explicit sequence of steps to be carried out	USA
4.f	The document describes a procedure with an explicit sequence of steps, but some steps are missing	I4
4.g	The document describes a procedure with an explicit sequence of steps, but the sequence is illogical	USA
4.h	The document does not explain what to do/who to contact if a problem occurs	I1
4.i	The document contains parts that contradict each other	I2
4.j	The document defines constraints that are too strict	I1
4.k	The document defines constraints that are illogical according to common sense	EU
4.l	The document leaves too much room for individual choices	I4
4.m	The structure of the document is inconsistent	I2
<i>External coherence</i>		
5.a	The document does not include enough context information	I1
5.b	The document combines instructions with context information	I4
5.c	The document does not have an explicit category	I2

(continued)

Table I.
List of defects from
the domain analysis

D-ID	Defect	Source
5.d	Documents in the same category do not have a uniform structure	I2
5.e	There is inconsistency between the category of the document and its contents	I2
5.f	The document defines rules or procedures that overlap with other documents	I2
5.g	The document contradicts other documents	I2
5.h	The document contains copy-paste errors	EU
5.i	The document refers to other documents without justifying the reference	I4
5.j	The document does not mention other important documents	I1

5.2 Template

According to the defects identified during the domain analysis, we defined a template for editing BP descriptions, which can be used by editors of the PA to improve the clarity of their content. The fields of the template, together with a short description, are reported below. Moreover, for each field, we refer the defects that are expected to be mitigated by that field:

- category [5.c]: the category of the document;
- headline [1.a, 1.c]: a short title describing the content;
- source documents [3.a]: identifiers of norms, regulations or any other document from which the BP has been derived;
- reference documents [3.a]: identifiers of norms, regulations or any other document that might have an impact on the current description;
- glossary [1.g, 2.n]: list of definitions that are useful to understand the BP;
- context [5.a, 5.b]: a brief overview of the information that might be useful for a reader to understand the current BP;
- summary [3.d-3.f]: brief summary of the BP;
- motivation [1.b]: the higher-level objective of the BP;
- intended readership [4.d]: type of roles that should read this NL content;
- involved actors [4.b, 4.c]: actors (e.g. people, offices, authorities, etc.) that are involved in the BP;
- input documents [3.a]: documents used as input for the current BP, if any;
- output documents [3.a]: documents produced by the current BP, if any;
- required tools [1.h]: software or hardware tools to be used to perform the BP, if any;
- instructions [4.e, 4.b]: actual description of the BP, expressed in the form of steps;
- examples/experiences [1.e]: list of real-world examples to practically describe the BP;
- what to do in case of failures [4.h]: suggestions of possible alternative choices to take if something goes wrong while performing the current BP;
- contacts of involved offices [4.b]: name, phone number and e-mail of the offices involved in the BP;
- contacts of experts [4.h]: name, phone number and e-mail of the BP experts to contact to ask for clarifications; and
- FAQ [4.h]: list of frequently asked questions.

G-ID	Guideline	Defect
<i>General</i>		
1.1	Be clear, concise and coherent (EU)	3.e-h, 4.i
1.2	Divide the procedure into steps (US)	4.e
1.3	Motivate the procedure, the steps and the references	1.b, 1.f, 4.k, 5.i
1.4	Leave the appropriate space for individual choices	4.j, 4.l
1.5	Do not describe obvious/common sense issues (EU)	3.g
1.6	Put it into practice what you wrote to check its applicability	2.e, 4.a, 4.e
1.7	Provide examples	1.e
1.8	Your procedure shall not contradict/overlap with other procedures	5.f-g
1.9	Take care that the structure of the document follows the structure of other documents in the same category	5.d
1.10	Take care that the content of the document is consistent with its category	5.e
<i>Fields</i>		
2.1	Provide a glossary (EU)	1.g, 2.f
2.2	Define an overview of the procedure	3d-f
2.3	Specify the topic and the category of the procedure	1.a, 5.c
2.4	Specify the scope/context of the procedure	5.a
2.5	Specify the intended reader of the procedure	4.d
2.6	Specify the subjects involved in the procedure	4.b-c
2.7	Partition the content into sections	1.d
2.8	Specify the tools needed to perform the procedure (web link, documents, software)	1.h
2.9	Reference only those documents that are strictly relevant	3.a, 5.j
2.10	Reference other relevant documents instead of repeating their content	5.f
<i>Steps</i>		
3.1	Divide a procedure in logically linked steps (USA)	4.e, 4.g
3.2	Separate the steps with new lines	4.e
3.3	Define a label for each step	4.e
3.4	Use bullet points or numbered lists to identify the steps (USA)	4.g
3.5	If the chronological order of the steps is important, use a numbered list (USA)	4.g
3.6	If the order of the step is not important (steps can be performed in parallel), use bullet points (USA)	4.g
3.7	Use action verbs in steps (Do, Make, Fill-out, etc.) (MC)	2.d-e
3.8	Use the imperative action verb at the beginning of each step (MC)	2.d-e
3.9	If conditions apply to the action, include them before the action verb (MC)	2.d-e
3.10	Do not mix instructions in steps with contextual information	5.b
3.11	Use 7-10 steps maximum for each procedure (UK)	3.d
3.12	If more than 7-10 steps are needed, partition the procedure into sub-tasks (UK)	3.d
3.13	Give clear and verbose headings (EU)	1.c
3.14	Use a consistent structure for all parts of the procedure	4.m
<i>Sentences</i>		
4.1	Clarify acronyms and abbreviations (UK)	2.n
4.2	Highlight keywords and relevant content	3.c
4.3	Delete redundancies	3.b
4.4	Avoid grammatical errors	2.k
4.5	Avoid linguistic ambiguities in words and sentences	2.g-h
4.6	Use connectives (hence, therefore, etc.) between sentences (USA)	1.f
4.7	Use short sentences (max 25 words) (UK)	2.d, 2.b
4.8	Use short paragraphs (max 5 sentences) (UK)	1.d, 3.f
4.9	Cover only one topic per sentence / paragraph (USA)	2.c
4.10	Avoid double negations (USA)	2.a, 2.d
4.11	Keep subject, verb and object close together (USA)	2.a, 2.d
4.12	Use the word must for obligations (USA)	2.d

(continued)

Table II.
List of guidelines
for contributors of
the BP descriptions

Table II.

G-ID	Guideline	Defect
4.13	Use verbs instead of nouns (evaluate instead of carry out an evaluation of) (EU)	2.a, 2.d
4.14	Do not use synonyms for important terms	2.j
4.15	Do not use passive voice and name the subject who performs the action (EU)	4.c
4.16	Use adverbs only rarely	4.l
4.17	Avoid inconsistent use of terminology	2.m
4.18	Avoid inconsistent/contradictory content	4.i
4.19	Adapt the terminology to the target audience (EU)	2.i
4.20	When recycling text (copy/paste), make sure to properly adapt it (EU)	5.h
4.21	Do not use difficult terms (UK)	2.a, 2.d
4.22	Do not use juridical jargon (UK)	2.l
<i>Warnings</i>		
5.1	Define warnings at the beginning, or before the step causing the warning (EU)	4.h
5.2	Tell the reader what to do if he/she makes a mistake	4.h
5.3	Include questions that you imagine the reader might have, and answer them (EU)	4.h
5.4	Specify people to contact in case of problems with the understanding of the procedure	4.h, 2.d
5.5	Specify people to contact in case of problems with the execution of the procedure	4.h, 2.e

6. Research challenges

The presented guidelines and the template are designed to address the problems of BP descriptions, but, as any recommendation, rely on the good will of the civil servants who edit the descriptions. Hence, to guarantee that a textual document has the required degree of quality and does not include defects, other computer-aided approaches have to be put into place to support the validation of the descriptions. We have identified four macro-areas of research in which computer scientists can provide their contribution towards a higher degree of quality of BP descriptions in the PA, namely readability (Section 6.1), ambiguity (Section 6.2), relevance and text summarisation (Section 6.3), modelling and consistency (Section 6.4).

6.1 Readability

According to our study, we have seen that, among the defects, appears the difficulty that the civil servants encounter in reading their BP descriptions. Defects such as juridical jargon (2.j), excessive length of the sentences (2.b) and other defects listed in the group named “clarity of sentences” can be summarised as defects of language clarity. In general, this problem is addressed by the computational linguistics field that goes under the name of readability.

Approaches to assess text readability focus mainly on the stylistic dimension, i.e. assuring that a text can be easily read in terms of vocabulary, sentence structure and other expressional elements by a certain group of readers (Dale and Chall, 1949). Early work on automatic readability assessment was mainly focussed on defining formulas that could associate a degree of readability to entire documents. In general, such readability formulas assume that words with more syllables, and sentences with more words are less readable (Kincaid *et al.*, 1975; Coleman and Liau, 1975). Web-based implementations of these formulas are also largely available online[10].

More recent studies on readability have started to take into account the actual content and structure of sentences, based on the observation that a shorter term or a shorter sentence are not necessarily more readable than longer ones (Dell’Orletta *et al.*, 2014). In particular, these works address the degree of difficulty of the vocabulary (Chall and Dale, 1995), and the complexity of the syntax adopted in the documents (Petersen and Ostendorf, 2009; Aluisio *et al.*, 2010; Feng *et al.*, 2010; Nenkova *et al.*, 2010; Ma *et al.*, 2012; Tanaka-Ishii *et al.*, 2010). All the cited works perform readability assessment at the document level – i.e. they provide a

Table III.
Illustration of
relevant guidelines
with examples

G-ID/D-ID	Example defect	Suggested improvement
3.7/2.e	The supervisor needs to be aware of any extended periods of time that an employee will be unavailable	The employee must notify the supervisor of any extended period of time during which the employee will be unavailable
3.9/2.e	Projects with a sufficient average score will be recommended for approval or recommended for approval under conditions	If the average score of a project exceeds Y, it will be recommended for approval. If it is between X and Y, it will be recommended for approval under conditions
3.10/5.b	Inspectors may find it useful to review some of their interventions, perhaps using the five elements listed here as a guide, to consider whether alternative approaches could have been more effective	Inspectors should review their interventions and consider the effectiveness of alternative approaches. The five elements below may serve as guidance for this: [...]
3.13/1.c	Application process	How to apply to become a CDC
4.5/2.h	The field office will forward the application to the appropriate official for a final decision. (vagueness)	The field office will forward the application to the official who is responsible for the given area of operations. The official will take the final decision
4.5/2.g	The employee met the council and the head of office and the secretary assessed his presence. (syntactic, coordination)	The employee met the council. The head of office and the secretary assessed his presence
4.5/2.g	The delegate assesses the presence of the candidate, and he provides his signature. (syntactic, anaphoric)	The delegate assesses the presence of the candidate and provides his signature
4.9/2.c	Applications [...] must be submitted or authorised by the co-ordinating investigator (CI) of the study in question who may delegate responsibility for completing the application form and uploading study documents to other members of the study team	Applications [...] must be submitted or authorised by the co-ordinating investigator (CI) of the study in question. The CI may delegate responsibility for completing the application form and uploading study documents to other members of the study team
4.10/2.a	If the committee does not disagree about candidate selection [...]	If the committee agrees on a candidate [...]
4.11/2.d	LEAP Academy will, according to the rules set forth in N.J.A.C. 6:3-9, submit to the Commissioner of Education an enrolment report for the forthcoming year by June 1	LEAP Academy will submit an enrolment report to the Commissioner of Education for the forthcoming year by June 1. They need to do this according to the rules set forth in N.J.A.C. 6:3-9
4.15/4.c	The procedure shall be carried out before the end of March 2015	The certification authority shall carry out the procedure before the end of March 2015
4.21/2.a	Review of decisions eligible for appeal	Review of decisions allowed for appeal
4.22/2.1	To disagree with the dissolution petition fill in the acknowledgement of service form	To disagree with the divorce petition fill in the acknowledgement of service form

readability measure, or rank for the entire document – and not at the sentence level. These approaches help little in our context, where guidance is needed regarding the improvement of specific parts of a text. Hence, the challenge here for computational linguists resides in the need to establish more fine-grained techniques that are able to quantify the readability of a single sentence, and in identifying potential readability defects. In this sense, recent research in text simplification (François and Bernhard, 2014) can provide useful outcomes that can be in principle employed also in the PA context. Nevertheless, one should keep in mind that one cannot completely discard juridical jargon, which in principle hampers readability. Indeed, the usage of juridical terms historically emerged for a need of precision, which cannot be neglected. On the other hand, juridical jargon also implies complex sentence structures, which can in principle be replaced with more readable sentences. Hence, our vision is that research on readability of PA documents shall primarily focus on detecting readability defects at the level of sentence structure rather than at the level of terminology.

6.2 Ambiguity

Still in the group that we named “clarity of sentences”, we have defects that refer to ambiguity (2.g, 2.h). Ambiguity of terms and sentences occurs whenever the meaning intended by the information producer (i.e. the writer) differs from the meaning understood by the information consumer (i.e. the reader) (Ferrari *et al.*, 2015). Ambiguity of terms is associated to the so-called word-sense disambiguation (WSD) task (Navigli, 2009). Techniques for WSD aim at identifying the intended meaning of a polysemous term – i.e. a term with multiple meaning such as “bass” (which can indicate “bass guitar” or a kind of fish) – depending on its linguistic context. Several approaches exist that address this problem, which use unsupervised (Agirre and Edmonds, 2007; Véronis, 2004), supervised (Lee and Ng, 2002) and knowledge-based approaches (Banerjee and Pedersen, 2003; Navigli and Velardi, 2005). However, such techniques are mainly aimed to support information retrieval (IR) and machine translation, and are not oriented to detect ambiguity as a defect. Indeed, given a term, currently available tools are oriented to produce a potential sense among the possible ones, and do not associate a degree of ambiguity to the term.

Instead, ambiguity as a quality defect has been largely studied in the field of requirements engineering, in which requirements – i.e. statements indicating properties and behaviour of a software – need to be understood by different stakeholders involved in the development of a system – e.g., customers, developers and testers – and should be free of ambiguity to avoid misunderstandings about desired system properties. Some studies address the identification of typical ambiguous terms and constructions (Berry *et al.*, 2003; Gnesi *et al.*, 2005; Gleich *et al.*, 2010). Other work addresses ambiguity by translating requirements into formal languages or models (Cimatti *et al.*, 2011; Ambriola and Gervasi, 2006; Kof, 2010). Finally, some work focusses on the usage of natural language understanding methodologies (Mich and Garigliano, 2000; Kiyavitskaya *et al.*, 2007). The most mature works in this field, which can be employed also for PA documents, concern: the identification of vague expressions (Gleich *et al.*, 2010; Gnesi *et al.*, 2005), such as “as soon as possible”, “appropriate” – see example 4.5/2.h in Table III; the identification of syntactic ambiguities, such as coordination (Chantree *et al.*, 2006) and anaphoric (Yang *et al.*, 2011) ones – see examples 4.5/2.g in Table III.

Besides requirements engineering, ambiguity has also been studied for the domain of legal texts, where different interpretations of, e.g., contracts or statutes, lead to problems in jurisdiction (Solan, 2004; Solan *et al.*, 2008) and in interpretation of regulations (Massey *et al.*, 2014).

Especially syntactic ambiguity has been addressed as a problem in technical texts intended for (cheap) translation where human translators have to spot such ambiguities when post-editing machine translations; solutions are based e.g., on so-called “syntactical cues” as discussed by Kohl (1999).

Overall, we believe that research on ambiguity in PA documents can leverage the literature concerning vagueness and syntactic ambiguity in requirements. For lexical ambiguity – i.e. when a term has more than one vocabulary meaning – inspiration can be taken from works on Word Sense Disambiguation, but such works shall be tailored for defect identification.

6.3 Relevance and text summarisation

Most of the defects listed in the group named “synthesis”, are due to the presence of some form of redundancy, e.g., due to the excessive number of external references (3.a), or to the absence of clarification of what is relevant and what is not (3.c). Addressing these problems with automated means is not straightforward. Indeed, all these defect deal with the vague concept of relevance. Relevance is studied in the field of IR, and several notions are introduced in the literature (Borlund, 2003; Huang and Soergel, 2013), from topic relevance (i.e. relevance of an information item with respect to a certain topic), to evidential relevance

(i.e. relevance of an information item to reason about a certain fact), to situational relevance (i.e. relevance of an information item for performing a specific task). In the case of BP descriptions, research should mainly focus on situational relevance. Indeed, these descriptions should be used by civil servants to help them performing specific tasks, and it is therefore important to devise strategies that allow emphasising those parts of the text that provide practically usable information, i.e. information that can be used to perform a task.

To address this goal, research should look at works on automatic text summarisation (Nenkova and McKeown, 2012; Lloret and Palomar, 2012). Text summarisation techniques are distinguished in extractive and abstractive (Lloret and Palomar, 2012). Extractive approaches score the sentences of a document based on their computed relevance, and produce a summary that includes a subset of relevant sentences. Abstractive approaches attempt to manipulate the original content to produce a summary, with a particular focus on the coherence of the produced summary. In case of BP descriptions, extractive approaches such as those listed by Gupta and Lehal (2010), can be useful to identify which are the relevant sentences in a BP description, and suggest the editor which ones should be highlighted. Moreover, these approaches can be also employed to suggest which are the redundant sentences that could be discarded. Abstractive approaches could be employed to produce actual summaries, to be placed at the beginning of the BP descriptions.

All these approaches can be adapted to the domain of BP descriptions. However, as noted by Ferreira *et al.* (2013), the effectiveness of automatic summarisation highly depends on the subject of the text that is used. Hence, appropriate experiments on real-world BP description shall be carried out to assess the applicability of these methods.

6.4 Modelling and consistency

Part of the problems listed in the groups of “internal coherence” and “external coherence” are addressed by means of our template (e.g. 4.b-d and 4.h, referring to specific actors to be mentioned, or 5.c, referring to the document category). Nevertheless, some of the relevant problems concern the logical consistency (e.g. 4.f-g, 4.i) of the BP description, and these problems cannot be automatically addressed only looking at the text. To address these problems, more rigorous representations of the BPs are required. In this sense, the BPMN notation (OMG, 2011) is a natural candidate to model BPs in the PA.

In the PA domain, studies were performed, e.g., in the Spanish PA by Torres *et al.* (2010), and in the Swiss PA by Schumann *et al.* (2014). Moreover, BPMN was used also to model health-care processes – which can be regarded as special cases of PA processes – by Müller and Rogge-Solti (2011) and by Ruiz *et al.* (2012). These works generally aim at showing the effectiveness of a rigorous modelling approach in a human-intensive regulated environment, with the goal of easing decision making. Other works make a step forward, and focus on the analysis of the BPMN models of the PA (Falcioni *et al.*, 2012; Bruni *et al.*, 2011).

Overall, these works can in principle address inconsistency problems raised in our domain analysis (e.g. 4.f-g, 4.i). However, as noted by Ottensooser *et al.* (2012), and Nawrocki *et al.* (2006), since BP descriptions in the PA are going to be complemented with textual ones, problems of inconsistency, although discarded in the models, might still remain in the text. Therefore, we argue that technologies shall be devised to identify the consistency between the textual procedure description, and the corresponding model. In this sense, approaches exist that are able to generate textual descriptions from BPMN models. In particular, Leopold *et al.* (2014) presents a tool-supported approach for natural language generation of BP descriptions from BPMN models. In this way, the consistency of the NL description is guaranteed by construction, assuming that the original model is consistent. On the other hand, research shall also look at other lightweight approaches to ensure model-to-text consistency, since, in some cases, a manually edited BP description might cover aspects that are not covered in the model. In this case, one wants to check that the degree of alignment

between BP description and model, e.g., to see if relevant entities mentioned in the model are also mentioned in the text, and vice-versa. To address this goal, research should look at terminology extraction techniques (Medelyan *et al.*, 2013). Extracting the relevant terms of the BP descriptions and comparing them with the labels in the BPMN models can provide a lightweight strategy to check existing relations between text and model.

Of course, not all the problems can be addressed through modelling. For example, steps that are illogical according to common sense (4.k), or constraints that are too strict or too weak (4.j, 4.l) cannot be automatically identified through model analysis. However, we argue that the sole fact of having a model, which implies having a rigorous and concise representation of the BP, can provide a clearer perspective on which are the illogical parts of a BP.

7. Conclusions and future work

Effective communication of BP knowledge is a primary need for any structured organisation. This is particularly true for PAs, in which poor communication of BP knowledge to civil servants may hamper the efficiency of the bureaucracy, and lead to citizens' distrust towards the means of their state.

In this paper, we provide an insight on the current problems in PA documents, in which part of the BP knowledge is currently conveyed, and on solutions to improve the quality of such documents. To identify the problems of current PA textual documents, we present a thorough domain analysis, comprising a literature review and interviews that involve PA stakeholders. To define the solutions, we provide a PA-specific template for editing BP descriptions, which is oriented to reduce a large part of the problems identified, and a set of editing guidelines. Moreover, we review the relevant literature in different fields, namely readability, ambiguity, relevance and modelling, and we highlight how the contributions of the current literature can be applied to automatically address the defects that our research revealed. Our near future commitment is the development of specific techniques to address readability and ambiguity problems in BP descriptions. Moreover, we plan to employ modelling techniques based on BPMN, and we plan to devise strategies to verify the alignment between textual BPs and BP models. We foresee that validation strategies based on this dual representation of a BP (natural language and model) can mitigate coherence and synthesis defects. From a practical standpoint, we foresee that a higher degree of automation in text quality assurance will speed-up the BPs of PAs, by reducing communication problems, and by establishing a clearer way of communication between BP stakeholders.

Notes

1. www.plainenglishfoundation.com
2. www.plainenglish.co.uk
3. www.plainlanguagenetwork.org
4. www.hemingwayapp.com
5. <http://goo.gl/Wx1Tef>
6. www.plainlanguage.gov
7. www.isti.cnr.it
8. www.interreg2seas.eu/en/program
9. www.impresainungiorno.gov.it/psc-italy
10. <https://readability-score.com>

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