IJISPM

Mission

The mission of the IJISPM - International Journal of Information Systems and Project Management - is the dissemination of new scientific knowledge on information systems management and project management, encouraging further progress in theory and practice.

The IJISPM publishes leading scholarly and practical research articles that aim to advance the information systems management and project management fields of knowledge, featuring state-of-the-art research, theories, approaches, methodologies, techniques, and applications.

The journal serves academics, practitioners, chief information officers, project managers, consultants, and senior executives of organizations, establishing an effective communication channel between them.

Description

The IJISPM offers wide ranging and comprehensive coverage of all aspects of information systems management and project management, seeking contributions that build on established lines of work, as well as on new research streams. Particularly seeking multidisciplinary and interdisciplinary perspectives, and focusing on currently emerging issues, the journal welcomes both pure and applied research that impacts theory and practice.

The journal content provides relevant information to researchers, practitioners, and organizations, and includes original qualitative or qualitative articles, as well as purely conceptual or theoretical articles. Due to the integrative and interdisciplinary nature of information systems and project management, the journal may publish articles from a number of other disciplines, including strategic management, psychology, organizational behavior, sociology, economics, among others. Articles are selected for publication based on their relevance, rigor, clarity, novelty, and contribution to further development and research.

Authors are encouraged to submit articles on information technology governance, information systems planning, information systems design and implementation, information technology outsourcing, project environment, project management life-cycle, project management knowledge areas, criteria and factors for success, social aspects, chief information officer role, chief information officer skills, project manager role, project manager skills, among others.

Topics covered

The journal offers comprehensive coverage of information systems management and project management.

The topics include, but are not limited to:

▪ information technology governance	▪ project environment	▪ project management knowledge areas
▪ information systems planning	▪ project management life-cycle	▪ scope management
▪ information systems design and implementation	▪ project initiation	▪ time management
▪ information technology outsourcing	▪ project planning	▪ cost management
▪ enterprise architecture	▪ project execution	▪ quality management
▪ information systems governance	▪ project control and monitoring	▪ procurement management
▪ information systems department	▪ project closing	▪ risk management
▪ chief information officer role	▪ criteria and factors for success	▪ communication management
▪ information technology leadership role	▪ project manager role	▪ human resources management
▪ chief information officer skills	▪ project manager skills	▪ performance teams
▪ information systems management tools	▪ portfolio management	▪ social aspects
▪ management of complex projects	▪ program management	▪ conflict management
▪ audits	▪ managing organization - structure	▪ managing organization - responsibilities
▪ innovation	▪ tools and techniques	▪ project management office
▪ ethics	▪ project evaluation	▪ contracts

Special issues devoted to important specific topics will be evaluated for publication.

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IJISPM

Editorial

The mission of the *IJISPM - International Journal of Information Systems and Project Management* is the dissemination of new scientific knowledge on information systems management and project management, encouraging further progress in theory and practice.

It is our great pleasure to bring you the third number of the fourth volume of IJISPM. In this issue readers will find important contributions on project sustainability, project evaluation, management of social business documents and on agile methods adoption.

As Gilbert Silvius and Ron Schipper state in the first article "Exploring the relationship between sustainability and project success - conceptual model and expected relationships", Sustainability is one of the most important challenges of our time. Companies are integrating sustainability in their marketing, communication and their actions. Sustainability has more recently also been linked to project management. The logic behind this link is that sustainability needs change and projects are realizing change. Several studies explored how the concept of sustainability impact project management. The research project reported in this article elaborates on these works by studying how sustainability affects project success. Project managers, logically, strive for project success and considering sustainability may influence this success. Based upon a review of relevant literature, the paper develops a conceptual model that provides a more detailed understanding of how considering different dimensions of sustainability may affect the individual criteria of project success.

The second article, "PESTOL - Framework for «Project Evaluation on Strategic, Tactical and Operational Levels»", authored by Youcef J-T. Zidane, Agnar Johansen, Bassam A. Hussein and Bjørn Andersen, is focused on the development of a conceptual holistic framework for Project Evaluation on Strategic, Tactical and Operational Levels, the PESTOL model. The model reflects the project life cycle by considering all project phases, such as identification and conception. To demonstrate the relevance of the developed model, the authors applied it to a project case, the Algerian East–West Highway megaproject.

The article "Issues for the long-term management of Social Business Documents" is authored by Verena Hausmann and Susan P. Williams. Social business documents are currently one of the fastest growing content types within organizations. As carriers of important business information they require systematic management to ensure their content is available, accurate and protected over the long-term. To achieve this requires a deep understanding of their structure, nature and use. In this paper are presented the findings of a preliminary study of social business documents. The aim of the study is to understand how social business documents are structured and to identify the issues and challenges that surround their management. Through an analysis of social business documents in four different systems are identified and compared their structural components from a user perspective. From this cross document/cross system analysis the authors develop a conceptual model for social business documents and identify issues for their long-term management. The findings also identify the need for more in-depth modeling for which are proposed methods to assist in understanding the syntactic and semantic structure of social business documents and how these change over the life of a social business document.

The fourth article, "Challenges of adopting agile methods in a public organization" is authored by Jouko Nuottila, Kirsi Aaltonen and Jaakko Kujala. Agile development methods are widely used among business enterprises. Since the introduction of the Agile Manifesto in 2001, several agile methods have been implemented, first in single-team set-ups and later in larger multi-team set-ups for complex Information Technology (IT) system development. However, the adoption of agile methods has been slow in the public sector. This is also reflected in the academic literature, as there are only a few studies discussing agile adoption in public organizations. This paper contributes to research on the use of

agile practices specifically in the context of public organizations, and sheds light on the challenges a public organization may face while adopting these practices. The aim of the paper is to identify and categorize the challenges that may hinder efficient adoption and use of agile methods in public IT projects that include private software vendors. This research is based on a case study of a large governmental office. As a result, the paper presents several categories of identified challenges, the root causes of these challenges, and a discussion of the characteristics of these challenges for the public sector.

We would like to take this opportunity to express our gratitude to the distinguished members of the Editorial Board, for their commitment and for sharing their knowledge and experience in supporting the IJISPM.

Finally, we would like to express our gratitude to all the authors who submitted their work, for their insightful visions and valuable contributions.

We hope that you, the readers, find the International Journal of Information Systems and Project Management an interesting and valuable source of information for your continued work.

The Editor-in-Chief,

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João Varajão is currently professor of information systems and project management at the *University of Minho*. He is also a researcher of the *Centro Algoritmi* at the *University of Minho*. Born and raised in Portugal, he attended the *University of Minho*, earning his Undergraduate (1995), Masters (1997) and Doctorate (2003) degrees in Technologies and Information Systems. In 2012, he received his Habilitation degree from the *University of Trás-os-Montes e Alto Douro*. His current main research interests are in Information Systems Management and Information Systems Project Management. Before joining academia, he worked as an IT/IS consultant, project manager, information systems analyst and software developer, for private companies and public institutions. He has supervised more than 50 Masters and Doctoral dissertations in the Information Systems field. He has published over 250 works, including refereed publications, authored books, edited books, as well as book chapters and communications at international conferences. He serves as editor-in-chief, associate editor and member of the editorial board for international journals and has served in numerous committees of international conferences and workshops. He is co-founder of CENTERIS – Conference on ENTERprise Information Systems and of ProjMAN – International Conference on Project MANagement.

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Exploring the relationship between sustainability and project success - conceptual model and expected relationships

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Abstract:
Sustainability is one of the most important challenges of our time. Companies are integrating sustainability in their marketing, communication and their actions. Sustainability has more recently also been linked to project management. The logic behind this link is that sustainability needs change and projects are realizing change. Several studies explored how the concept of sustainability impact project management. The research project reported in this paper elaborates on these works by studying how sustainability affects project success. Project managers, logically, strive for project success and considering sustainability may influence this success. Based upon a review of relevant literature, the paper develops a conceptual model that provides a more detailed understanding of how considering different dimensions of sustainability may affect the individual criteria of project success. The study also provides a conceptual mapping of the different relationships between dimensions of sustainability and criteria of project success. This mapping shows that the most positive relationships are expected for the relationship between sustainability and the success criteria stakeholder satisfaction, future readiness and controlled project execution. The expected relationship between considering sustainability and completing the project on schedule and within budget is uncertain.

1. Introduction

In the last 10 to 15 years, the concept of sustainability has grown in recognition and importance [41]. How can we develop prosperity without compromising the future? Industry leaders realize that 'greenwashing' of current business practices is not a solution. The 2012 BSR/Globe Scan study [7] concludes that "The most important leadership challenge facing business today is the integration of sustainability into core business functions". One of these business functions is project management, and 'green' or 'sustainable' project management' is identified as one of the most important global project management trends today [2].

Also in academic research, the relationship between project management and sustainability is explored [16, 6, 40] as one of the (future) developments in project management. The growing number of publications on the integration of sustainability into project management [40] indicate that the topic is "… picking up momentum" [42]. Based on a structured review of 164 books, articles, papers and book chapters, Silvius and Schipper [40] identify several 'impact areas' that provide leverage points for the consideration of sustainability in projects. One of these impact areas is project success. And although project success is a frequently studied topic, the relationship between considering sustainability in a project and its success is still unexplored. In line with this, Martens and Monteiro de Carvalho [29] conclude that there is a "need for studies on the convergence of sustainability issues and project management… as well as its relationship with success in projects". It is this relationship between sustainability in projects and project success, that the study reported in this paper explores. Integrating sustainability considerations in a project may be expected to, for example, relate to stakeholder satisfaction of the project [26]. However, paying attention to sustainability aspects in projects may also be perceived as costing time or money and therefore as not supportive to the time and budget constraints of a project.

The study reported in this paper aims to systemize the relationship between considering sustainability in projects and project success by developing a conceptual model for this relationship, that creates explicit constructs between the different dimensions of sustainability and the different variables of project success. The rationale behind this study is that project managers, logically, strive for project success and that considering sustainability may have an influence on project success or the perception of this success. The contribution it aims to make is to develop a multi-dimensional relationship between sustainability in projects and project success, as opposed to a one-dimensional relationship. By 'opening up' this relationship, we aim to develop a better understanding of how considering sustainability in projects may contribute to, or hinder, the success of these projects.

Following this introduction, the paper is structured in four sections. The next section will provide some notes on the methodology followed in finding and analyzing the literature on which our study is based. Following this, section 3 will explore the main constructs of the study: sustainability in projects and project success. Based upon the conceptualizations found in the literature, the following paragraph, section 4, will develop the conceptual model of the relationship between sustainability in projects and project success. Elaborating upon this conceptual model, this section will also provide a discussion of the detailed relationships between the dimensions of sustainability and the criteria of project success. This section represents the main contribution of this paper. The final section, section 5, will provide the conclusions of our study and directions for further research.

2. Methodological approach

As this study aims to develop our understanding of a given phenomenon, it is considered to be of an exploratory nature. We used the systematic literature review methodology [45] of selection, extraction, analysis and synthesis of published academic books and articles. And although all the data we collected was already published, it is generally accepted that worthy insights and contributions can be derived also from existing theoretical works [29].

Following the recommendation by Bauer and Bakkelbasi [8] that "researchers should consult Google Scholar …, especially for a relatively recent article, author or subject area", we used Google Scholar as search engine. For data

extraction, we used the databases Science Direct, Business Source Premier, Ebsco-Host and JSTOR to retrieve the full publications for our analysis. We used qualitative content analysis methods to analyze the articles. In this analysis, we combined the conventional, directed and summative content analysis approaches [20].

3. Results

This section reports the review of earlier publications on the main constructs of our study: project success and sustainability in projects.

3.1. Project success

The concept, or criteria of, project success has been a variable in numerous studies. Few people would disagree with the statement that project success is interpretable in many ways. It is, simply put, a rather "elusive concept" [37]. Most early research on project success seems to emphasize the three traditional dimensions: (within) time, (within) budget and (within) specification [35], also known as the known 'triple constraint' of time, budget and quality, "despite the fact that this method is currently subject to widespread criticism" [5]. However, starting around the early 80s of last century, other factors are emerging in literature, such as "measuring success after delivery" that "involves looking at the benefits or effectiveness of the project from the perspective of the stakeholder" [23]. In one of the most cited publications from that period that took an extended look on project success, Pinto and Slevin emphasized the importance to consider project success "over time" [36]. The development of the perception of project success over time has also been pointed out by Shenhar et al. [39].

In our analysis of studies on project success, we found 27 different 'measures' of project success. Table 1 presents these measures and their sources. From this overview, it shows that project success is a multidimensional concept and that many factors are identified that go beyond the traditional 'known 'triple constraint' criteria. Table 1 also demonstrates that there is no consensus about a universal (set of) measures for project success.

Table 1. Measures of project success found in literature.

Measures of project success	Sources								
	Pinto & Slevin [36]	Wateridge [46]	Baccarini [4]	Atkinson [3]	Shenhar et al. [39]	Collins & Baccarini [11]	Nelson [34]	Müller & Turner [33]	Thomas & Fernandez [43]
1 The project is completed within schedule	x	X	x	x	x	X	x	x	x
2 The project is completed within budget	x	X	x	x	x	X	x	x	x
3 The deliverable is meeting technical specifications		X	x	x	x	X	x	x	x
4 The deliverable is meeting functional performance requirements		X	x	x	x	x	x	x	x
5 The project management process is adequate			x			x			
6 Project risks are managed adequately						x			

Table 1. Measures of project success found in literature (cont.).

		Sources							
Measures of project success	**Pinto & Slevin [36]**	**Wateridge [46]**	**Baccarini [4]**	**Atkinson [3]**	**Shenhar et al. [39]**	**Collins & Baccarini [11]**	**Nelson [34]**	**Müller & Turner [33]**	**Thomas & Fernandez [43]**
7 The cooperation of parties and individuals in the project is good.						x			
8 The project is performed with a high standard of work quality.						x			
9 The customer of the project is using the deliverable (after completion)	x				x		x		x
10 The deliverable is fulfilling the customer's needs		x	x		x	x		x	
11 The deliverable is solving a customer's problem	x	x			x				
12 The project sponsor is satisfied with the project		x	x			x		x	x
13 The end-user is satisfied with the project	x	x	x		x	x		x	x
14 The supplier is satisfied with the project								x	x
15 The project team is satisfied with the project		x		x		x		x	x
16 The (other) stakeholders are satisfied with the project			x			x		x	x
17 The business objectives of the project are met	x	x	x	x	x	x	x	x	x
18 The business objectives of the suppliers / contractors are met				x		x		x	
19 The deliverable creates a larger market share of the customer organization		x		x	x	x			
20 The project prepares the organization for its future					x		x		x

Table 1. Measures of project success found in literature (cont.).

Measures of project success		Pinto & Slevin [36]	Wateridge [46]	Baccarini [4]	Atkinson [3]	Shenhar et al. [39]	Collins & Baccarini [11]	Nelson [34]	Müller & Turner [33]	Thomas & Fernandez [43]
					Sources					
21	The project contributes to the development of the participating organizations				x					
22	The project contributes to the development of the participating individuals				x		x			
23	The project earns public recognition						x			
24	The project reduces waste				x					
25	The project creates a positive economic impact on society				x		x			
26	The project creates a positive social impact on society				x		x			
27	The project creates a positive environmental impact on society				x		x			

In order to develop a more comprehensive set of criteria of project success, we grouped, what we considered related, measures and concluded six condensed criteria of project success.

Criterion 1: *The project is executed in a controlled manner.* This criterion refers to the project management process. This process should be 'adequate' [4; 11], with adequately managed risks [11] and with high quality of work standards [11]. When this (adequate) project management process leads to the completion of the project's deliverable according to specifications [3; 4; 11; 33; 34; 39; 43; 46] and within the agreed time and budget constraints [3; 4; 11; 33; 34; 36; 39; 43; 46], criterion 2, *The agreed project deliverable is completed on schedule and within budget*, is realized.

Criteria 3 and 4 do not refer to the project management process, but to the result of the project. Criterion 3: *The project's deliverable is 'fit for purpose'*, refers to whether the deliverable is meeting functional performance requirements [3; 4; 11; 33; 34; 39; 43; 46], whether the customer of the project is using the deliverable [34; 36; 39; 43], whether the deliverable is fulfilling the customer's needs [4; 11; 33; 39; 46] and whether the deliverable is solving a customer's problem [36; 39; 46]. Criterion 4: *The business objectives or goals of the project are realized,* is building upon this, by referring to the realization of the business case or business goals that were defined for the project [3; 4; 11; 33; 34; 36; 39; 43; 46]. This criterion also includes the business objectives of the suppliers/contractors [3; 11; 33].

Criterion 5: *The stakeholders of the project are satisfied* refers to the qualitative criteria of the satisfaction of the project sponsor [4; 11; 33; 43; 46], the end-user [4; 11; 33; 36; 39; 43; 46], the supplier [33; 43], the project team [3; 11; 33; 43; 46] and (other) stakeholders [4; 11; 33; 43].

The last criterion, criterion 6: *The project prepares the organization for the future*, refers to success measures such as the project prepares the organization for its future [34; 39; 43] and the project contributes to the development of the

participating organizations [3] or the participating individuals [3; 11]. Also included in this criterion are the measures of a positive economic, social and/or environmental impact on society [3; 11] and the public recognition that the project earns [11].

Table 2 summarizes this comprehensive set of criteria of project success and the related measures.

Table 2. Criteria of project success.

Criteria	Measures included in this criterion
The project is executed in a controlled manner	The project management process is adequate Project risks are managed adequately The project is performed with a high standard of work quality
The agreed project deliverable is completed on schedule and within budget	The project is completed within schedule The project is completed within budget The deliverable is meeting technical specifications
The project's deliverable is 'fit for purpose'	The deliverable is meeting functional performance requirements The customer of the project is using the deliverable (after completion) The deliverable is fulfilling the customer's needs The deliverable is solving a customer's problem
The business objectives or goals of the project are realized	The business objectives of the project are met The business objectives of the suppliers/contractors are met The deliverable creates a larger market share of the customer organization
The stakeholders of the project are satisfied	The project sponsor is satisfied with the project The (other) stakeholders are satisfied with the project The end-user is satisfied with the project The supplier is satisfied with the project The project team is satisfied with the project The cooperation of parties and individuals in the project is good
The project prepares the organization for the future	The project prepares the organization for its future The project contributes to the development of the participating organizations The project contributes to the personal/professional development of the participating individuals The project creates a positive economic impact on society The project creates a positive social impact on society The project creates a positive environmental impact on society The project earns public recognition

3.2. Sustainability in projects and project management

The balance between economic growth and social wellbeing has been around as a political and managerial challenge for over 150 years [13]. Also the concern for the wise use of natural resources and our planet emerged already many decades ago, with Carson's book "Silent Spring" [9] as a launching hallmark. In 1972 the 'Club of Rome', an independent think tank, published its book "The Limits to Growth" [31]. In this book, the authors concluded that if the world's population and economy would continue to grow at their current speeds, our planet's natural resources would approach depletion. The Limits to Growth fueled a public debate, leading to installation of the UN 'World Commission on Development and Environment', named the Brundtland Commission after its chair. In their report, the Brundtland commission defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [47]. By stating that "In its broadest sense, sustainable development strategy aims at promoting harmony among human beings and between humanity and nature", the report implies that sustainability requires also a social and an environmental perspective, next to the economical perspective, on development and performance.

The vision that none of the development goals, of economic growth, social wellbeing and a wise use of natural resources, can be reached without considering and effecting the other two, got widely accepted [25]. In his book "Cannibals with Forks: the Triple Bottom Line of 21st Century Business", John Elkington identifies, this as the 'triple bottom line' or 'Triple-P (People, Planet, Profit)' concept: Sustainability is about the balance or harmony between economic sustainability, social sustainability and environmental sustainability [14]. In addition to the triple bottom line dimensions, several publications also consider other dimension of sustainability that are relevant to project management. Based upon an extensive analysis of publications that relate the concepts of sustainability to projects and project management, Silvius and Schipper [40] identify the following dimensions of sustainability:

- An economic dimension: considering economic effects and benefits;
- A social dimension: considering human and societal interests;
- An ecological dimension: considering effects on nature and earth;
- A time dimension: considering also long term effects;
- A values dimension: understanding sustainability as a normative concept;
- A geographical dimension: considering both local and global effects;
- A performance dimension: considering failure and non-performance as a waste of resources and energy;
- A participation dimension: sustainable development requires inclusion and participation stakeholders;
- A waste (reduction) dimension: reducing and, if possible, preventing waste;
- A transparency dimension: openly and proactively providing information to stakeholders;
- An accountability dimension: being willing and available to be held accountable for decisions and actions;
- A cultural dimension: respecting differences in values and culture;
- A risk (reduction) dimension: reducing and, if possible, avoiding certain risks;
- A political dimension: recognizing different interests of stakeholders.

After the analysis of the dimensions of sustainability found in the publications on sustainability in project management, they then synthesized these dimensions and concluded that the following dimensions of sustainability are relevant to the integration of sustainability into project management.

Sustainability is about balancing or harmonizing social, environmental and economic interests

In order to contribute to sustainable development, a company should satisfy all 'three pillars' of sustainability: social, environment and economic [14]. The dimensions are interrelated, that is, they influence each other in various ways.

Sustainability is about both short-term and long-term orientation

A sustainable company should consider both short-term and long-term consequences of their actions, and not only focus on short-term gains [17]. The dimension of both short-term and long-term orientation, focuses the attention to the full lifespan of the matter at hand [6].

Sustainability is about local and global orientation

The increasing globalization of economies effects the geographical area that organizations influence. Intentionally or not, many organizations are influenced by international stakeholders whether these are competitors, suppliers or (potential) customers. The behavior and actions of organizations therefore have an effect on economic, social and environmental aspects, both locally and globally. "In order to efficiently address these nested and interlinked processes

sustainable development has to be a coordinated effort playing out across several levels, ranging from the global to the regional and the local" [17].

Sustainability is about values and ethics

Sustainable development is inevitably a normative concept, reflecting values and ethical considerations of society [16; 41]. The changes needed for more a sustainable development, will therefore also reflect the implicit or explicit set of values that we as professionals, business leaders or consumers have and that influence or lead our behavior.

Sustainability is about transparency and accountability

The principle of transparency implies that an organization is open about its policies, decisions and actions, including the environmental and social effects of those actions and policies [31]. This implies that organizations provide timely, clear and relevant information to their stakeholders so that the stakeholders can evaluate the organization's actions and can address potential issues with these actions.

Complementing the principle of transparency, is the principle of accountability. This principle implies that an organization is responsible for its policies, decisions and actions and the effect of them on environment and society. The principle also implies that an organization accepts this responsibility and is willing to be held accountable for these policies, decisions and actions.

Sustainability is about stakeholder participation

Considering and respecting the potential interests of stakeholders is key to sustainability. ISO 26000 emphasizes the behavioral side of this principle, by mentioning "proactive stakeholder engagement" as one of its principles [21]. Stakeholder participation therefore requires "a process of dialogue and ultimately consensus-building of all stakeholders as partners who together define the problems, design possible solutions, collaborate to implement them, and monitor and evaluate the outcome" [19].

Sustainability is about risk reduction

The so-called precautionary principle is based on the understanding that in environment-society system interactions, the complexity, indeterminacy, irreversibility and nonlinearity has reached a level in which it is more efficient to prevent damage, rather than ameliorate it [5]. The recent Deepwater Horizon oil-spill disaster, has fueled the discussion on the suitability of financial risk management techniques for societal and environmental risks.

Sustainability is about eliminating waste

The importance of eliminating waste is mentioned by several authors [28]. They refer to "The Seven Wastes" as identified in the Toyota production system. These seven wastes are: overproduction, waiting, transporting, inappropriate processing, unnecessary inventory, unnecessary or excess motion and defects. The principle of eliminating waste can also be found in the cradle-to-cradle concept [30] that builds upon the idea that waste equals food.

Sustainability is about consuming income, not capital

Sustainability implies that nature's ability to produce or generate resources or energy remains intact. The 'source and sink' functions of the environment should not be degraded. Meaning that the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity of the environment to assimilate waste should not be exceeded [18]. The principle may also be applied to the social perspectives [41]. Organizations should also not 'deplete' people's ability to produce or generate labor or knowledge by physical or mental exhaustion. In order to be sustainable, companies have to manage not only their economic capital, but also their social and environmental capital.

The dimensions of sustainability listed above provide a well-developed conceptualization of sustainability in projects and project management. We will therefore use this conceptualization in the development of the conceptual model of the relationship between sustainability in projects and project success.

4. The relationship between sustainability in projects and project success

4.1. Conceptual model

Based on the conceptualization of the constructs sustainability in projects and project success, developed in the previous paragraph, we can now develop a conceptual model of the relationship between these two constructs. Fig. 1 shows this conceptual model.

Sustainability	Project success
Sustainability is about balancing or harmonizing social, environmental and economical interests	The project is executed in a controlled manner
Sustainability is about both short-term and long-term orientation	The agreed project deliverable is completed on schedule and within budget
Sustainability is about local and global orientation	The project's deliverable is 'fit for purpose'
Sustainability is about values and ethics	The business objectives or goals of the project are realized
Sustainability is about transparency and accountability	The stakeholders of the project are satisfied
Sustainability is about stakeholder participation	The project prepares the organization for the future
Sustainability is about risk reduction	
Sustainability is about eliminating waste	
Sustainability is about consuming income, not capital	

Fig. 1. Conceptual model of the relationship between sustainability in projects and project success.

4.2. Expected relationships

The relationship between considering sustainability in projects and project success is addressed only marginally in the emerging literature on sustainability in project and project management. In fact, only Craddock [12], Mishra et al. [32], Tiron-Tudor & Ioana-Maria [44], Kaysi [24] and Martens & Monteiro de Carvalho [29] explicitly mention this relationship. And although these studies are mostly of conceptual nature, only Tiron-Tudor & Ioana-Maria report an empirical study, these publications conclude the following relationships.

Craddock [12] discusses the evolution in thinking about project success and concludes that "views on project success have changed over the years from definitions that were limited to the implementation phase of the project life cycle to definitions that reflect an appreciation of success over the project and product life cycle" [23]. From the reference to the life cycle in this conclusion, he links project success to excellence in organizations and 'business excellence models, such as the European Foundation for Quality Management (EFQM) model. And as one of the EFQM model's eight fundamental concepts of excellence is "Taking responsibility for a sustainable future" [12], the relationship between sustainability in projects and success is established.

Mishra et al. [32] links project success to ethics in business. They conclude that "The project manager should make sure that he is completing the project while keeping the ethical standards and social impact in mind". This appeal on ethical behavior of the project manager can also be found in the 'Codes of Ethics and Professional Conduct' that were issued by the Project Management Institute [38] and the International Project Management Association [22] in recent years. In fact, the IPMA code explicitly mentions sustainability as one of the professional responsibilities of the project manager, without explicitly linking this to project success.

Tiron-Tudor & Ioana-Maria [44] studied the level of integration of sustainability into projects and the success of projects in a sample of 35 companies. Based upon an analysis of the correlation between integrating sustainability considerations and project success, they found that this correlation has certain controversies. They found cases where successful projects were not necessarily induced by sustainability, and also cases where a sustainable practice did not lead to success. They concluded that there should be other factors influencing projects outcomes. However, they also concluded that "On the whole, the two compared variables, sustainability integration within project management and projects success, seem to fluctuate in the same trend and there are no significant discrepancies between them" [44].

In a study of the success of several projects related to the London 2012 Olympic Games, Kaysi [24] describes how the London Velodrome Park project is considered a success, despite of being completed in 2011 at a total cost of £105 million, far overrunning the estimated budget of £20 million in 2004. The strength of the project was its motto and its sustainability legacy; "it was a great opportunity to show that London was ready to deliver its greenest venue" [24]. The author concludes that "In order to create successful and valuable projects "sustainability" becomes paramount for project management" [24].

Martens and Monteiro de Carvalho [29] recognize the need for studies on the convergence of sustainability, project management and project success. They provide a theoretical contribution to the discussion on this relationship, by conceptualizing the main constructs based on a study of academic publications.

Next to the publications discussed above, that explicitly address the relationship between sustainability and project success, the relationship between the underlying variables of the two constructs, as identified in the conceptual model of the relationship (Fig. 1), is addressed in more publications. For example Maltzman and Shirley [28] discuss the sustainability dimension of eliminating waste and relate this to the quality, and eventually success, of a project. And Eskerod and Huemann [15] conclude in their study of the relationship between sustainable development and project stakeholder management, that "Stakeholder management has been seen as a core activity for creating project success" and that "seeing project stakeholder management in the context of sustainable development is a necessity in the future and that this will place new demands on project stakeholder management".

By exploring the literature for indications on the underlying relationships between the constructs of our conceptual model, we developed the following analysis of expected relationships between dimensions of sustainability in projects and project management and criteria of project success.

Sustainability is about balancing or harmonizing social, environmental and economic interests

This dimension of sustainability is expected to have a positive effect on the success criterion 'executed in a controlled manner'. Reasons for this being that considering social and environmental interest of stakeholders, next to the economic

interests, reduces the risk of the project in the form of disturbances of the project by stakeholders that feel that the project is neglecting (their) social and environmental interests [40]. Considering sustainability may therefore logically contribute to a controlled execution of the project.

The effect of considering social, environmental and economic interests on the well-known 'triple constraint' of time, budget and quality, is less clear. It can be imagined that considering social and environmental interest in the project may lead to extra resources or costs. However, the point made above, that considering sustainability may prevent certain risks, may provide a compensation for this effect. The criteria that relate to the result or deliverable of the project, such as the deliverable being 'fit for purpose' and 'realizing the business objectives or goals' may be positively or neutrally affected by the consideration of social, environmental and economic interests. A positive effect should especially be expected when the main stakeholders of the project have a sustainability ambition.

Logically, considering social, environmental and economic interests may have a positive effect on stakeholder satisfaction, as also the stakeholders that represent the social and environmental interests are more proactively engaged in the project. A similar reasoning can be developed for the criterion 'the project prepares the organization for the future'. As more organizations integrate sustainability into their strategies, an explicit consideration of social, environmental and economic aspects will increase the strategic contribution of a project.

Sustainability is about both short-term and long-term orientation

Considering both short and long term aspects of the project may influence the project management process in a similar way as described in the criterion balancing or harmonizing social, environmental and economic interests. Meaning that also in this criterion, considering both short-term and long-term is expected to reduce the risk of the project in the form of disturbances of the project by stakeholders that feel that their (long term) interests are not considered. Considering sustainability may therefore logically contribute to a controlled execution, and thereby success, of the project.

As considering both short and long term aspects of the project logically includes the future use of the deliverable of the project and the effects of that use, this criterion is expected to contribute to the criteria that relate to that future use, such as the deliverable being 'fit for purpose' and 'realizing the business objectives or goals'. A similar reasoning can be developed for the criteria stakeholder satisfaction and preparing the organization for the future.

Again, the effect of considering both short and long term aspects of the project on the triple constraint of time, budget and quality, may be less clear. However, there is no obvious reason to assume that considering long term aspects of the projects may go at the expense of short term aspects. More logical would be the expectation that the triple constraint criterion will be considered less important for the success of the project, as the longer term perception of project success concentrates on other criteria [39].

Sustainability is about local and global orientation

Much in line with the reasoning in the previous sections, considering both local and global aspects of the project may reduce the risk of the project, thereby contributing to a more controlled execution of the project. The effect of this criterion on the triple constraint of time, budget and quality, may again be less clear. Introducing a global orientation may lead to extra resources or costs.

The effect of considering both local and global aspects of the project on the deliverable being 'fit for purpose' and 'realizing the business objectives or goals' is also less clear. However, if any effect should be expected, it would logically be positive, as introducing a global orientation may also reduce the risks of using the deliverable after the project's completion. A similar reasoning can be developed for the criteria stakeholder satisfaction and preparing the organization for the future.

Sustainability is about values and ethics

The relationship between project management, ethics and values is most explicitly addressed in the work of Mishra et al. [32] discussed earlier and the Codes of Ethics and Professional Conduct of both the Project Management Institute [38] and the International Project Management Association [22]. And although the relationship between ethics and professional conduct implies a normative perspective on the professional behavior of project managers, the mere fact that the project management community highlights this relationship makes it relevant to the success of the project management process. This means that there should be a positive effect expected of the dimension values and ethics on the success criteria 'controlled execution of the project' and 'completing the deliverable on the agreed schedule and budget'. Another motivation for this expected positive effect is, again, the risk reduction of the project that considering values and ethics may bring.

The effect of considering both local and global aspects of the project on the deliverable being 'fit for purpose' and 'realizing the business objectives or goals' is less clear. On the criterion 'stakeholder satisfaction', a positive effect should be expected, which may, however, depend on the values and ethical morale of the stakeholder him-/herself.

The effect on the criterion 'preparing the organization for the future', may also be unclear. However, if we reverse the reasoning, it should be concluded that executing a project in a non-ethical way, will certainly not prepare the organization for the future. Any effect of considering values and ethics in the project should therefore logically be positive.

Sustainability is about transparency and accountability

Providing timely, clear and relevant information to stakeholders may logically be expected to the 'stakeholder satisfaction' criterion of project success. On first sight its effect on the success criterion 'completing the deliverable on the agreed schedule and budget' may be less positive if providing timely and transparent information to stakeholders leads to extra costs during the process execution. However, in line with the reasoning provided earlier, providing timely, clear and relevant information to stakeholders may also reduce the risk of the project in the form of disturbances by concerned stakeholders. Transparency and accountability may therefore contribute to a 'controlled execution of the project' and possibly also to 'completing the deliverable on the agreed schedule and budget'.

The effect of transparency and accountability on the success criteria that refer to the future use of the deliverable of the project and the business goals of that use, may be less clear. If an effect needs to be hypothesized, however, it would be logical that this effect is positive, as a transparent and accountable project may create a higher acceptation of the project's deliverable by the relevant stakeholders.

Regarding the criterion 'preparing the organization for the future', we also expect a positive effect of transparency and accountability of the project, as the risk of issues leading to future claims is logically reduced.

Sustainability is about stakeholder participation

The 'stakeholder participation' dimension of sustainability in projects and its relationship with project success is addressed in several publications. For example Labelle and Leyrie [26] refer to the effective management of stakeholder-project relationships as an important success factor in projects. They conclude that consultation and participation of stakeholders during project development and execution led to a "win-win relationship based on trust". And that "this contributed to the fact that the project was completed within the time limits and planned budget, and that it exceeded the many targets set by regional partners" [26]. Also Aaltonen and Kujalab [1] observe that "the concerns of social and environmental activists need to be carefully considered as part of the project decision making in order to ensure project success". Engaging stakeholders in the project's development and execution also reduces the risks of

stakeholders opposing the project [10] and may develops trust and relationships that enables future cooperation in projects and business operations.

Basically all studies on stakeholder participation and engagement point out its positive effect on project success. Therefore the effect of stakeholder participation on all criteria of project success is expected to be positive.

Sustainability is about risk reduction

The reduction of risk logically relates positively to both the success criteria relating to the project's execution and to the quality of the deliverable of the project. The precautionary principle that is the background of this dimension of sustainability could result in changes in the project development or definition. For example, by refraining from starting a potentially risky project, although the business case for the project is positive. It can also be imagined that extra costs are incurred during the project's executing, resulting from risk reduction actions. The effect of risk reduction on the 'triple constraint' of time, budget and quality, is therefore assessed as both positive and negative. The effect on all other criteria is expected to be positive.

Sustainability is about eliminating waste

The 'no waste' dimension of sustainability is highlighted in several publications on sustainability in project management, including Ma [27] and Maltzman and Shirley [28]. As waste represents a cost, for example in the form of obsolete materials, transportation or removal costs, the reduction of waste logically may lead to greater project success in terms of 'completing the deliverable on the agreed schedule and budget'. Whether the reduction of waste also leads to greater project control, or a deliverable that is more 'fit for purpose', can be debated. However, preventing waste is expected to have a positive effect on the criteria 'stakeholder satisfaction' and 'preparing the organization for the future', as it may logically lead to innovations and the development of new processes that create efficiencies also in future projects. An example of this effect is the improvement of the 'fresh water to cola' ratio that Coca-Cola realized when they were criticized for extracting fresh water from a vulnerable society, when establishing a new factory in India.

Sustainability is about consuming income, not capital

On this dimension, Silvius and Schipper [40] point out that the task orientation and peer-pressure within projects may create a high pressure environment, with higher risks of stress and burnout, compared to other work environments. This effect is confirmed by other studies on projects and burnout. The unplanned absence of resources, being either the project manager or members of the project team, creates a risk for the timely execution of the project. Taking this dimension into account will therefore positively contribute to a 'controlled execution of the project' and most likely also to 'completing the deliverable on the agreed schedule and budget'.

Whether there is also an effect on the deliverable being more 'fit for purpose' or the realization of business objectives, is less clear. On the criteria 'stakeholder satisfaction' and 'preparing the organization for the future', a positive effect should be expected. The reasoning being that team members that experience burnout or stress will most likely be less productive for a longer period of time.

Table 3 summarizes this expected relationships between the dimensions of sustainability and the criteria of project success. From this table it shows that the majority (76%) of the relationships between dimensions of sustainability and criteria of project success are expected to be Positive or Potentially positive. 6% of the relationships were classified as Negative/Positive, as indications could be found for both positive and negative effects. Only one relationship, the effect

of 'local and global orientation' on completing the project on schedule and within budget, was classified as Potentially negative. For some 17% of the relationships, we could not hypothesize a relationship.

Most positive relationships are expected for the relationship between sustainability and the success criteria 'The stakeholders of the project are satisfied', 'The project prepares the organization for the future' and 'The project is executed in a controlled manner'. Given the nature of sustainability, a positive effect on stakeholder satisfaction and future readiness may not come unexpected. The positive relationship with the controlled execution of the project, however, may be more surprising. This effect is caused by the risk reduction that is associated with a more explicit consideration of sustainability dimensions in a project.

Positive relationships are also expected between sustainability and the success criteria 'The project's deliverable is 'fit for purpose'' and 'The business objectives or goals of the project are realized'. The most uncertain relationship is expected between considering sustainability and completing the project on schedule and within budget.

Table 3. Expected relationships between dimensions of sustainability and criteria of project success.

	The project is executed in a controlled manner	The agreed project deliverable is completed on schedule and within budget	The project's deliverable is 'fit for purpose'	The business objectives or goals of the project are realized	The stakeholders of the project are satisfied	The project prepares the organization for the future
Sustainability is about balancing or harmonizing social, environmental and economic	Positive	Negative / Positive	Positive	Positive	Positive	Positive
Sustainability is about both short-term and long-term orientation	Positive	Unclear	Positive	Positive	Positive	Positive
Sustainability is about local and global orientation	Positive	Potentially negative	Potentially positive	Potentially positive	Potentially positive	Potentially positive
Sustainability is about values and ethics	Positive	Positive	Unclear	Unclear	Positive	Potentially positive
Sustainability is about transparency and accountability	Positive	Negative / Positive	Positive	Positive	Positive	Positive
Sustainability is about stakeholder participation	Positive	Unclear	Positive	Positive	Positive	Positive
Sustainability is about risk reduction	Positive	Negative / Positive	Positive	Positive	Positive	Positive
Sustainability is about eliminating waste	Unclear	Positive	Unclear	Unclear	Positive	Positive
Sustainability is about consuming income, not capital	Positive	Positive	Unclear	Unclear	Positive	Positive

5. Conclusion

The understanding of how the consideration of sustainability influences project management processes and practices is an important condition for the much needed integration of sustainability concepts into project management. The study reported in this paper developed a conceptual model for the relationship between sustainability in projects and project

success. Based on a review of relevant literature on the two main constructs, sustainability in projects and project success, a conceptual model was developed that showed that the relationship between sustainability and project success is not a simple one. The literature on sustainability in project management identified nine dimensions of sustainability, whereas the measures for project success that were reported in earlier studies were clustered into six criteria. With this model, a more detailed understanding of how the different dimensions of sustainability may affect the individual criteria of project success could be developed.

The study also provided a conceptual mapping of the different relationships between dimensions of sustainability and criteria of project success. This mapping showed that the most positive relationships are expected for the relationship between sustainability and the success criteria 'The stakeholders of the project are satisfied', 'The project prepares the organization for the future' and 'The project is executed in a controlled manner'. Positive relationships are also expected between sustainability and the success criteria 'The project's deliverable is 'fit for purpose'' and 'The business objectives or goals of the project are realized'. The expected relationship between considering sustainability and completing the project on schedule and within budget is uncertain.

The limitation of the study reported in this paper is that it is based upon an analysis of literature and a conceptual mapping. However, the conceptual model developed in the study provides a good foundation for empirical testing of the expected relationships and is therefore a valuable contribution.

The empirical testing of the expected relationships is logically a clear recommendation for further research. The authors plan to do this in a survey based study that explores how project managers and other stakeholders in projects, perceive the different relationships between considering sustainability and project success, as identified in the conceptual model. This approach, exploring the perceptions of the relationships instead of measuring the correlations between the dimensions of sustainability and the criteria of project success for a sample of projects, is selected because the perception of the different criteria of project success change over time [39], which makes it impossible to acquire reliable data of a sufficient sample that allows for establishing significant correlations. Of course, the measurement of perceptions of relationships introduces a more subjective element, however, as some authors indicate that project success is a subjective perception anyway [35; 37], this is not considered an issue.

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PESTOL - Framework for «Project Evaluation on Strategic, Tactical and Operational Levels»

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Abstract:
The paper focuses on the development of the ex-post conceptual holistic framework for Project Evaluation on Strategic, Tactical and Operational Levels, the PESTOL model, by reviewing different definitions of project success and/or failure and combining the findings with the logic framework. The model reflects the project life cycle by considering all project phases, such as identification and conception. To demonstrate the relevance of the developed model, the authors applied it to a project case, the Algerian East–West Highway megaproject. The project has attracted media attention and a number of media discussions of the project have been limited to the completion of the project in a short-term perspective. In this regard, the discussions have been notably associated with delays and expenditures coming in over budget, referring to project efficiency. One reason for the media focus on these aspects alone is that they can easily be measured. The relevance of the project and its effects - whether it attains its goals and objectives measured in terms of effectiveness, including impact and sustainability - can only be verified at a later stage, after the project has delivered its results. These are much broader aspects and are therefore difficult to measure.

1. Introduction

All social institutions, whether medical, educational, religious, economic, or political, are required to provide "proof" of their legitimacy and effectiveness in order to justify society's continued support [1]. This is also the case for construction and infrastructure projects, especially large-scale projects, in light of the colossal budgets spent on them. Requests for funds must compete with those of other agencies, and new projects and programs must be justified, while old projects and programs must be shown to have been efficient and effective. In this contest for public projects, evaluation is a major "weapon" [1, 2]. Suchman [1] justifies the need for "proof" through evaluation as due to the need to determine the extent to which current programs and projects are meeting the challenge of a rapidly changing world.

Various definitions of evaluation have been presented over the years. The American Public Health Association [3] defined evaluation as "the process of determining the value or amount of success in achieving a predetermined objective." Scriven [4] stated that evaluation is "The process of determining the merit, worth or value of something." Patton [5] defined program evaluation as "the systematic collection of information about the activities, characteristics, and outcomes of programs for use by specific people to reduce uncertainties, improve effectiveness, and make decisions with regard to what those programs are doing and affecting." However, his definition is too broad and it reflects especially ex-ante, monitoring, and mid-term evaluations. In this paper, we focus on ex-post evaluation. The OECD [6] has defined evaluation as "A systematic and objective assessment of an ongoing or completed project, program or policy, its design, implementation and results." Ex-post evaluation can be described as an evaluation of an intervention (in our case, a project) after the intervention has been completed. In addition, ex-post evaluation is conducted after a certain period following the completion of a target project, with emphasis on the effectiveness and sustainability of the project. Such evaluations aim to derive lessons and recommendations for the improvement of future projects and programs [6]. Ex-post evaluation is often considered the weak connection in the planning, implementation, and operation of public projects. To date, the assessment methods have tended to rely on ex-ante appraisal, making predictions of how a scheme or policy might perform, rather than being based directly on the outcomes of past decisions [7, 8]. Worsley [7] mentioned that ex-post evaluation can serve multiple purposes, of which the two primary ones are learning and/or improvement and accountability and/or control. Weiss [9] defined evaluation as "evaluation research, the tools of research are pressed into service to make the judging process more accurate and objective. It collects evidence systematically from a representative sample of the units of concern".

The purpose of this paper is not only to develop a model for evaluation but also to use it as a framework for evaluating a project case and to gather the lessons learned so that they could be applied to similar projects in the future. A further purpose is to improve decision-making by applying a holistic view to the evaluation of similar projects instead of making decisions based on a narrow, short-term vision.

This paper consists of seven sections: (1) "Introduction", in which we explain what motivated us to write this paper; (2) "Methodology and research design"; (3) "Theoretical framework"; (4) "Development of the PESTOL model", in which the step-by-step development of the model is presented; (5) "The megaproject case"; (6) "Evaluation of the megaproject based on the developed framework", in which we describe the application of the developed model to the megaproject case; and (7) "Conclusions".

2. Methodology and research design

The work reported in this paper utilized several approaches and research methods. First, a literature review was conducted of existing evaluation frameworks and models in order to understanding what aspects they encompass. A search for sources that have proposed different relevant frameworks was conducted through relevant library and science databases covering all journals that we considered relevant (e.g., *International Journal of Project Management*, *Journal of Project Management*, *Project Appraisal Journal*, *Administration in Social Work Journal*, and many other academic journals related to evaluation). Our research was extended to other journals related to social sciences, behavioral sciences, psychology, public heath practice, and health care, since these were the first to publish articles specifically on

evaluation and evaluation research. Other databases and search engines were utilized to uncover books published since the 1960s, technical reports, and public documents as well as more "marketing-oriented" sites (e.g., OECD and USAID). We used a wide range of search terms, including "evaluation", "project success", "project performance", "ex-post", "effect", and "diagnosis". The logic model was deemed most relevant for further analysis, on the basis of its suitability and extent of use for the evaluation of projects. Additionally, we examined other frameworks and models originating from the OECD, NORAD, CONCEPT, USAID, and JICA, many of which have been developed based on the logic model. The literature review was concluded by analyzing the existing models along two dimensions: (1) the evaluation dimensions covered, and (2) whether the evaluation was conducted by an external third party or by the project itself.

Next, the principles of design science (e.g., [10-13]) were applied to develop an alternative evaluation framework. The design process was initiated from the gap not covered by existing frameworks. However, the strengths of extant frameworks were used as guidelines for the design of the alternative model. As prescribed by proponents of design science, the development was carried out through an iterative process of identifying requirements, developing conceptual solutions, evaluating these, and further refining the most promising ones until a final design was reached. Ultimately, a new evaluation framework was developed that built on existing ones.

Finally, an illustrative case project was used to demonstrate how the new evaluation framework could be applied to actual projects. As described by Siggelkow [14], the purpose of an illustrative case is not to attempt to verify empirically an evaluation framework. This would require further research, in which the framework would be applied to a larger set of case projects and systematically evaluated, something we intend to do in the future. Rather, as in our case, the purpose of a case study is to provide a rich description of how the framework can be applied in practice, thus both aiding readers in understanding how the framework has been composed and what the different aspects of the framework entail in practice. The challenge in our study pertained more to the validity and the reliability of the collected data. To achieve good validity with high triangulation quality, we used a qualitative case study research approach, as described by Yin [15]. In case studies, typically a combination of methods is used in data collection, such as archives, interviews, questionnaires, and observations. The data may be qualitative (e.g., words), quantitative (e.g., numbers), or both. For our case project we used a qualitative method, with primary data (interviews) and secondary data (materials and data obtained internally from the project sponsor's website [16], database, and official archived documents, as well as externally from other websites and media archives with numerical audio-visual records). Between the middle of the third quarter and the whole of the fourth quarter of 2014 more than 30 interviews were held with users, contractors, and other stakeholders (internal and external to the case). Most of the interviews were conducted as virtual interviews by conference calls or phone calls. During the same period, data were also collected during on-site inspections (more than five visits to some of the sites of activity). The data collection followed a pre-defined protocol that incorporated information and facts such as transcription of the interviews, gathered data, and codification of the results so that they would fit the evaluation framework.

Reliability in qualitative research can be improved by focusing on various aspects, such as transparency. Moisander and Valtonen [17] described both research process transparency and theoretical transparency as ways to improve reliability in qualitative research. We applied both types to our research to ensure its reliability.

3. Theoretical framework

When discussing ex-post project evaluation, it is relevant to look at the degree of success (and/or failure) associated with the project as a whole. How project success is defined, described, and categorized forms the basis for discussing evaluation criteria, such as efficiency, effectiveness, relevance, impact, and sustainability [18, 19]. Since the PESTOL model is based on the logic model, which dates back to late 1960s, it is necessary to present a brief historical review of logic models. Furthermore, since the model's framework reflects the whole project life cycle, we review some of the project life cycle models that have been developed over the years.

3.1. Project success or failure and subjectivity in project evaluation

Project evaluation is highly complex and subjective. Inherently, it involves a combination of basic assumptions underlying the activity being evaluated and of personal values on the part of both those whose activities are being evaluated and those who are doing the evaluation [1]. Evaluation and agreeing on project success or failure has been a central topic in project management literature since the mid-1980s [20-34]. The research within this topic has included efforts focusing on defining what makes a project successful, who should judge the results, and when the judgments should be made [35]. There have also been efforts to examine how success should be measured [30, 31, 35-37]. Jugdev and Müller [35] have shown that the definition of success has progressed from definitions that were limited to the implementation phase of the project life cycle to definitions that cover the entire project and product life cycle by different stakeholders. Success is now defined through several dimensions and according to different stakeholders, ranging from the efficiency of the project management effort or adhering to planning (project management success), to criteria that reflect the impact of the project on its end-users, on business, on societies (project success), and on creating opportunities for the future [22, 24-26]. However, the question of how to measure success is still unclear in project management literature [36]. Ika [30] has demonstrated that the various approaches to measuring success may be categorized into two broader groups: the "objectivist" and the "subjectivist" approach. In the former, success measures have been viewed as those that can not only be defined upfront but also measured objectively at the end of the project, regardless of any contextual changes during execution or after delivery. This objectivist approach has been subject to significant criticism because it assumes that [36]:

- Estimated time and cost to produce the specified deliverables can be predicted at the beginning of the project;
- The time frame for determining success is immediately after the project has been completed;
- With the exception of financial benefits, other expected benefits such as customer satisfaction from a project are usually hard to quantify or measure;
- All stakeholders come to the same conclusion about a project's ability to achieve its expected benefits.

In recognizing the flaws of the basic assumptions in the objectivist view, the subjectivist approach views success as extrinsic to the project. Success is regarded as a result of a political and dialogical process and that different stakeholders evaluating the same project might come to different conclusions [31, 34]. Many different approaches have been used to assess success in subjective terms. Myers [38] argued that success is an opinion and consequently could be both objective and subjective and could change over time. By contrast, Wilson and Howcroft [39] argued that project evaluation can be seen as efforts by one group to establish their narrative of the project as the "legitimate" version of events surrounding the project. Objective measures are used to legitimize their narratives and enroll supporters and to marginalize those who are opposed to their position.

3.2. Brief historical review of logic models

Logic models date back to the late 1960s. Suchman [1] was the first author to use the term "logic model" in combination with evaluation research. He built on the work of Greenwood [40] and Chapin [41], who offered conceptual and methodological analyses to experimental approach, which considerably broadened the logic model to include longitudinal and "ex-post facto" social surveys [1, 40, 41]. In 1970, the U.S. Agency for International Development (USAID) developed the Log Framework Approach (LFA) to assist in the planning, management, and evaluation of development activities. Other contributions were made by Weiss [9] and by Wholey [42], who developed techniques to check the readiness of a program to be evaluated. Bennett [43] contributed the hierarchy of evidence, which he had developed to evaluate the effectiveness of extension programs and document evidence of their impacts. In his hierarchy of evidence the true impact increases farther up the hierarchy because the lower levels are important precursors but are not necessarily evidence of impacts [44, 45]. The widespread use of logic models is probably to some degree due to the United Way of America's book *Measuring Program Outcomes: A Practical Approach*, published in 1996 [46], as this significantly helped to increase its popularity and application worldwide [45, 47]. Since then the logic model has been used by most international agencies [48]. Improvements to and use of the logic model by evaluators has continued to result in a broad array of theoretical and practical applications.

3.3. Brief historical review of project life cycle or lifespan models

All projects consist of a number of different phases that form their project life cycle or lifespan. Patel and Morris [49] outlined the life cycle as unique in distinguishing projects from non-projects. They defined project life cycle as "the sequence of phases through which the project will evolve. The basic life cycle follows a common generic sequence: Opportunity, Design & Development, Production, Hand-over, and Post-Project Evaluation. The exact wording varies between industries and organizations. There should be evaluation and approval points between phases, often termed 'gates'". Project life cycle is defined in the current edition of the *PMBOK Guide* [50] as "the series of phases that a project passes through from its initiation to its closure. The phases generally are sequential, and their names and numbers are determined by the management and control needs of the organization or organizations involved in the project, the nature of the project itself, and its area of application". Archibald [51] mentioned that the project life cycle has an identifiable start and end that can be associated with a time scale. Stuckenbruck [52] said that the project life cycle consists of sequential phases: Conceptual, Definition, Production or Acquisition, Operation, and lastly Divestment. Kerzner [53] drew a clear distinction between the project lifespan and the product lifespan. Cleland and Ireland [54], in their generic project life cycle, made an important distinction between the various phases, which are decision points at which an explicit decision is made concerning whether the next phase should be undertaken. Their thinking represents an important development for two reasons: (1) it introduces the idea of strategic high-level decision gates, at which a decision is taken as to whether to continue; and (2) it is distinguished from earlier research that emphasize that such phases may, and frequently do, overlap [55]. Today, most companies, institutions, and large organizations of all types have a tailored project life cycle model to meet their own strategic plans.

4. Development of the PESTOL model

4.1. Developing the logic model and the associated evaluation criteria

Our review of a number of models that built on the original logic model led to the development of the logic model shown in Fig. 1.
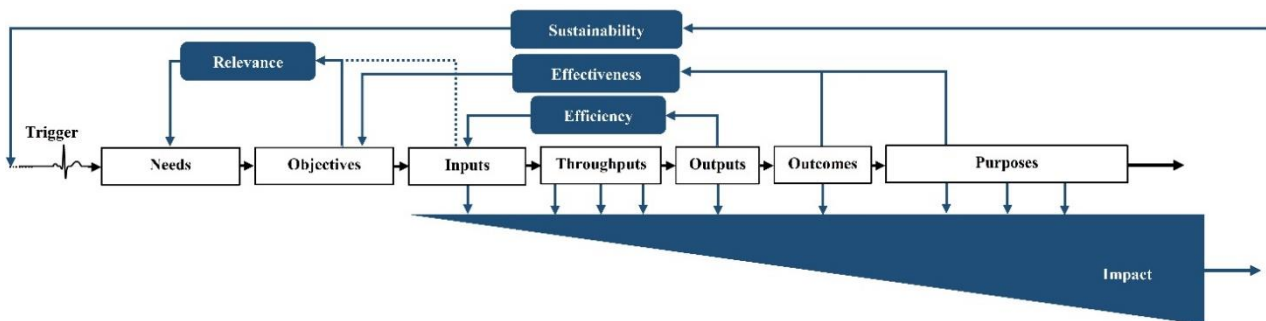

Fig. 1. The logic model and the associated evaluation criteria.

By using circular interplay between the logic model and the project life cycle (Fig. 2), we initially tried to extract a rational generic project life cycle and thereafter to define a project life cycle that met our logic model. This interplay resulted from superposing both models on each other to harmonize them in a consistent approach.
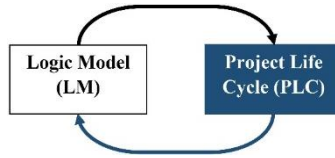
Fig. 2. Circular interplay.

The new elements in the model (Fig. 1), which did not exist in the pre-existing models, are as follows. In Fig. 3, which is part of the logic model's sequence used by earlier models [6, 43, 46, 56-60], "inputs" go through a black box called "activities" to give "outputs." "Outputs" will lead to "outcomes," which in turn result in "impacts".

In the model in Fig. 1, this logic model has been changed. Since the concept is based on cause and effect, we have the following perception. In the short sequence of the logic model related to "activities" (see Fig. 4), each cause has an effect: a "Trigger" (inputs) results in "Needs" (outputs), "Needs" (become inputs) then result in "Objectives" (outputs), and so forth. Thus, the "outputs" from previous element become "inputs" for the next element. "Activities" are not part of the logic model but they belong to the project life cycle. Consequently, each element from the logic model always relies on "Activities" to be transformed into the next element. For example, "Needs" as inputs will need a group of activities, which we call the "Conception" phase, in order to be transformed into outputs, which are "Objectives", and so forth (see Fig. 5).
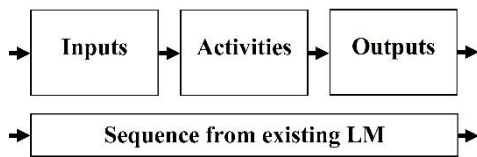

Fig. 3. Sequence of the existing logic models.

Fig. 4. New interpretation for the logic model.

Since the newest element in the logic model sequence is "Throughputs", it must be defined. Since we could not find a definition in project management sources we resorted to a definition from business and strategic management and system engineering references. In business and strategic management, throughput is defined as "the movement of inputs and outputs through a production process. Without access to and assurance of a supply of inputs, a successful business enterprise would not be possible" [61]. In system engineering, it is defined as "Material, energy, and/or information that enters the system in one form and leaves the system in another form" [62]. In our case, the system is the "Project". Therefore, "Throughputs" are continuous inputs and outputs during the block activities called "Project" (shown in Fig. 5).
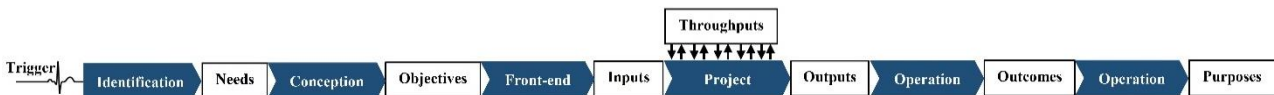

Fig. 5. The logic model combined with the project life cycle.

The evaluation criteria we use in the PESTOL model are relevance, effectiveness, efficiency, impact, and sustainability. The main difference between existing logic models and the model in Fig. 1 concerns "impact". In other models, impact it is the last element of the sequence, but here it is considered an evaluation criterion. "Purposes" is used as an element in the logic model instead of "Impact". This is presented in the model in such as way as to show that impacts will become apparent at the point when the decision is taken to put "Inputs" into the system. The magnitude of an "Impact" increases with time. The effects of the "Impact" may vary from positive to negative depending on, for example, perceptions.

4.2. Developing the project life cycle and its three levels

From our examination of the definitions of the project life cycle (presented in the theory section above) and by extracting the first phase's appellation, which differs from one author to another, the most repeated term we found was "Conception". Other authors have used the terms "Concept", "Conceptual", "General Conception", "Opportunity", "Objective Definitions", "Identification", "Idea", and "Analysis".

We start the project life cycle with "Identification". The reason is that before starting the second phase (i.e., "Conception") it is wise to first identify the "Needs", which is the logic behind the life cycle shown in Fig. 5. Hence, first, "Trigger" (e.g., opportunity, threat, problem, idea, society, or a parliament) triggers the "Identification" of "Needs". Those "Needs" will cause a decision to be made to start the next phase, which is "Conception". In this phase, "Objectives" are defined. Once the "Objectives" have been defined, the next decision will lead to the "Front-end" analysis phase. Once completed, the project is established with agreed "Inputs". Those "Inputs" become an input to the "Project". During the running of the system called "Project", there will be emergent "Throughputs" that nurture or undermine it. As soon as the system "Project" reaches its end, it will give "Outputs". The most important output is the delivered product. Once it has started functioning during the "Operation" phase, the product will give "Outcomes". The "Operation" phase will keep running because it has "Purposes". The system called "Project" consists of three sequential phases—"Plan and Design", "Construction", and "Closeout" - with a parallel phase called "Procurement". Most authors have regarded procurement as a work package or an activity, but for us it is more than that since it is the most important work package and since it feeds most of the other packages it is appropriate to upgrade it to a phase. In summary, the generic project life cycle will involve the following sequential phases: (1) "Identification"; (2) "Conception"; (3) "Front-end"; (4) "Plan and Design"; (5) "Construction"; (6) "Closeout"; (7) "Operation"; and (8) the "Procurement" phase in parallel with phases 4, 5 and 6.

The project life cycle can be divided into three levels (Fig. 6.) by setting boundaries for each subsystem. The *operational level*, which is the inner subsystem, the project itself, is where concerns are more about efficiency measured in terms of cost, time and scope [60]. The *tactical level* reveals the usefulness of the project, such as its relevance, effectiveness, and the achievement of its objectives [60]. The *strategic level* refers to the system or the whole life cycle from the moment when "Phenomenon" pushes the "Trigger" until the long-term impacts are felt. At this level, the most important aspects to address are the sustainability and the positive or negative economic impacts [60]. In the generic project life cycle model shown in Fig. 6, we have added an x-axis that represents the time line. At each time "T_n," a decision "D_n" is taken to start the next phase.

4.3. The complete PESTOL Model

By combining the logic model shown in Fig. 1, the illustration of the interaction between project life cycle phases and the logic model in Fig. 5, and the project life cycle model in Fig. 6, we generated the concept of the "Falling Star," shown in Fig. 7.

Samset [60] defines them as all unexpected positive and/or negative changes and effects of the project, both in the short term and the long term. In our case, "Impact" as evaluation criterion is divided into the following levels: during the project impact, the short-term and mid-term impact, and the long-term impact (Fig. 7).
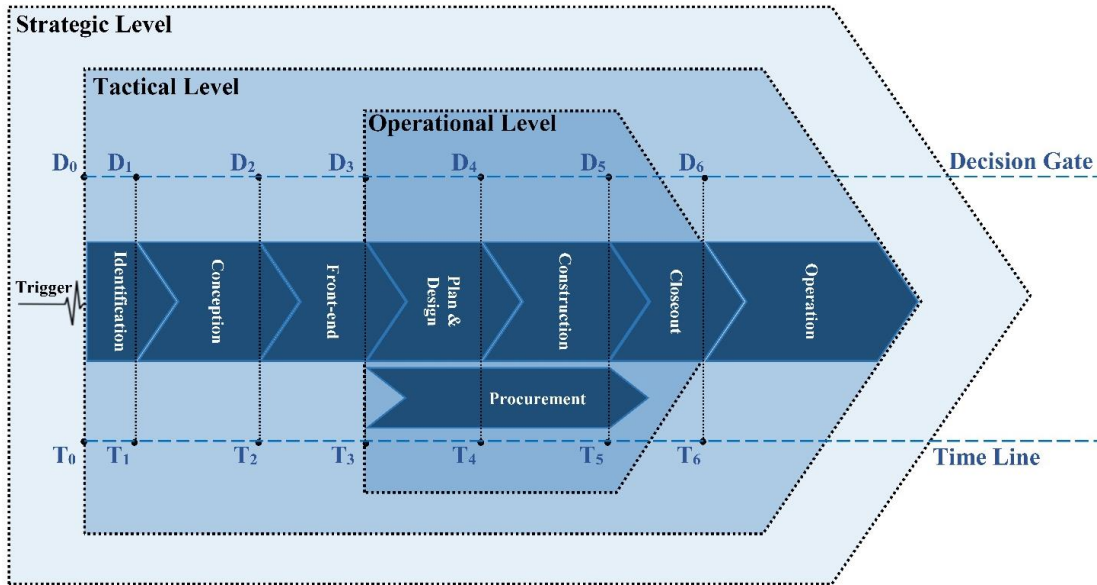
Fig. 6. Project life cycle and its three levels.
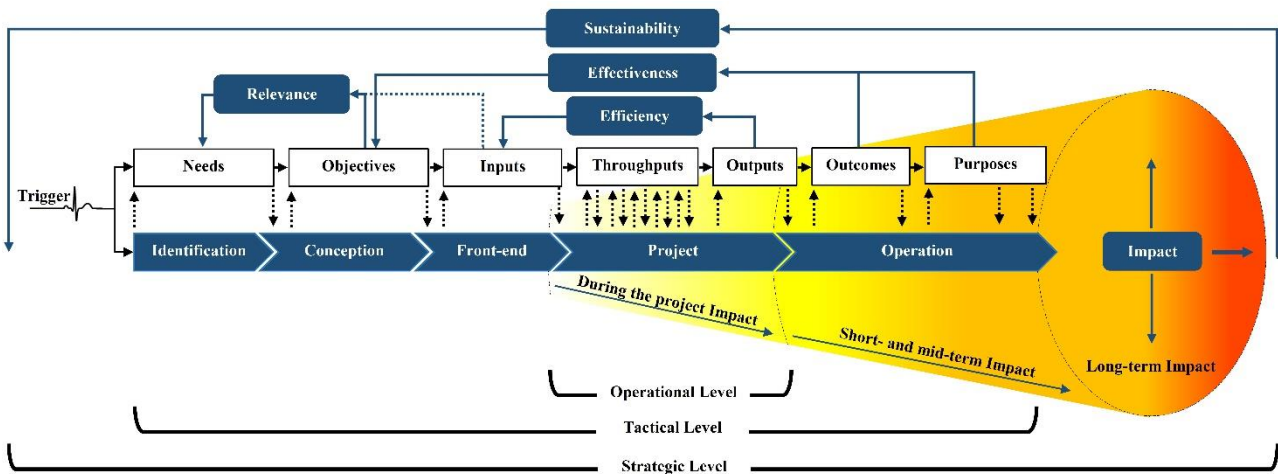
Fig. 7. The "Falling Star".

Efficiency is a measure of the ratio between the input and the output [6, 43, 46, 56-60]. In this paper efficiency is regarded as a question of doing things properly and producing project outputs in terms of the agreed scope, cost, time, and quality. An important point should be clarified here: Quality is not a constraint per se, but often a by-product of the other three factors (scope, time, and cost), and one that generally suffers when the others are not properly managed [18, 63, 64].

Effectiveness is a measure of the extent to which management attains its objectives [6, 7, 60].

Samset [60] defined relevance as "an overall assessment of whether a project is in harmony with the needs and priorities of the owners, the intended users and other attested parties. A change in policies or priorities could imply that a project is assigned lower priority, or that it loses some of its rationale. It becomes less relevant". In the present paper, relevance deals with the needed time (T_0 to T_3) to make the right decision (D_3) to start the implementation of the project (i.e., GO). If the decision is GO and the project becomes less relevant because of a change of policies or priorities, the assessment of relevance will instead be handled further by effectiveness, impact, and sustainability.

Sustainability concerns measuring whether the benefits of an activity are likely to continue after donor funding has been completed and/or withdrawn. Projects need to be environmentally sustainable as well as financially sustainable [6, 18, 60].

All of these factors contribute to formation of the PESTOL model shown in Fig. 8.
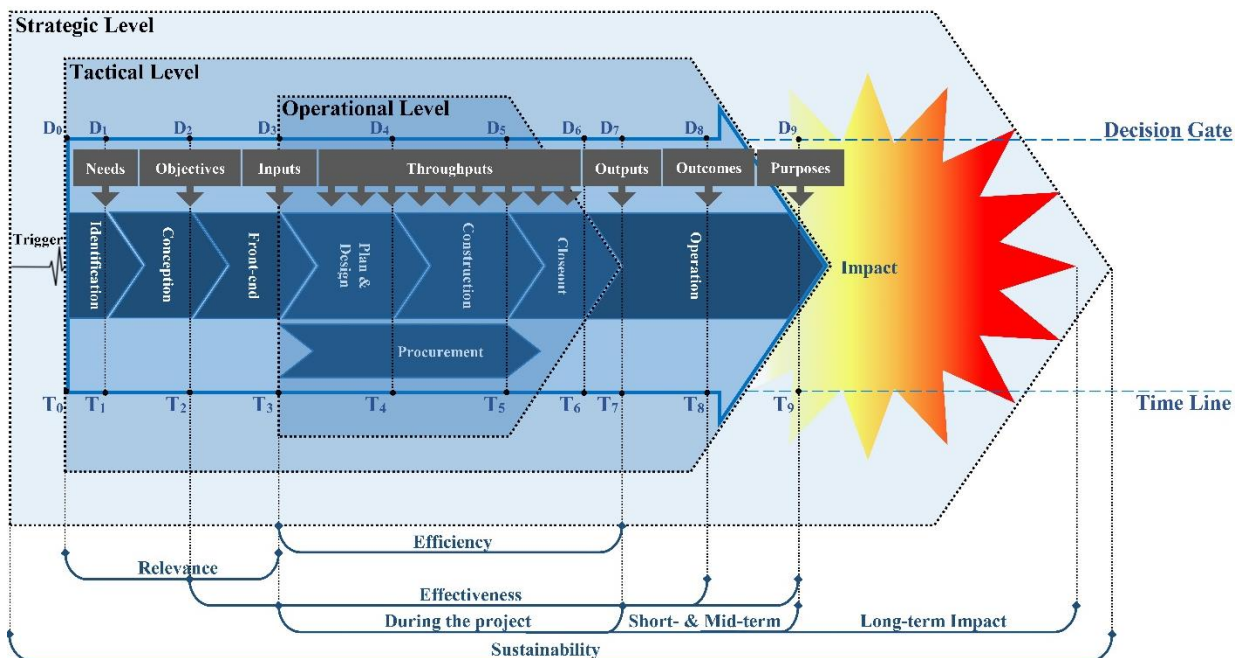

Fig. 8. The PESTOL model.

5. The megaproject case

To date, the cost of the Algerian East–West Highway megaproject has been more than USD 11.2 billion [16], and the project is considered Algeria's most important road project and the largest public works project worldwide. It was due for completion in the fourth quarter of 2009 but was delivered behind schedule. The megaproject has generated over 100,000 jobs. The road was intended to cut travel times and provide better and safer access to the north of Algeria, stimulating economic development there [16]. The megaproject was part of the 7000 km "AutoRoute Transmaghrébine Programme", which is being developed in many stages. The first stage was the East–West Highway, which involved the construction of a 1216 km section linking Annaba in the east to Tlemcen in the west, passing through 24 Algerian departments (out of a total of 48 departments). The East–West Highway is a six-lane toll highway. It connects most of northern big cities of the country. The development was planned to have 12 tunnels, 70 viaducts, and 60 interchanges. It included provisions for building truck stops, service stations, and maintenance facilities [16].

6. Evaluation of the Algerian megaproject based on the developed framework

The evaluation of the megaproject was based on the stakeholders' perceptions, by asking the interviewees to grade each criterion on a scale ranging from 1 to 6, corresponding to very bad, bad, fair, good, very good, to excellent. After completing the interviews, averages were calculated and compared to the planned and realized objectives to check for inconsistencies [19]. The planned and realized objectives and the interviewees' reflections on the five measures are summarized in Table 1. The lowest score was for the operational level (efficiency), but there were higher scores for the tactical and strategic levels. In the following subsections we explain each evaluation separately and lastly explain their dependencies. The evaluation is subjective in nature, since the respondents perceived and interpreted their work subjectively, and the researchers who gathered the qualitative data from the sources interpreted the data with a degree of subjectivity.

Table 1. Planned versus realized objectives of the Algerian megaproject [16, 18].

Measures	Planned objectives	Realized objectives	Score/ 6
Efficiency	1 – Estimated project cost: < USD 7 billion	1 – Final project cost: > USD 11.2 billion – Project cost overrun: > USD 4.2 billion	1
	2 – Starting implementation: late 2006 – Planned implementation finish date: late 2009	2 – Implementation finish date: late 2014 – Project delivery behind schedule: > 5 years	
	3 – Deliver the whole scope	3 – Operational but still not completely delivered	
Effectiveness	1 – Reduce traffic and shorten travel time	1 – Objective met	6
		2 – Reduce carbon dioxide emission	
		3 – Fewer accidents compared to on previously used road	
Relevance	1 – Time-saving and increase the fluidity in traffic	1 – Objective met	6
Impact	1 – Create temporary employment	1 – Creation of more than 100,000 jobs	3
		2 – Destruction of houses and trees standing in the way of the project	
Sustainability	1 – Cover the maintenance of the highway from its income in the operational phase	1 – The highway will not generate any income since its usage will be free until 2017	4
	2 – Enlarging the transportation network by other highways	2 – The highway has highlighted the gaps in the existing transportation network, which has made the government consider further expansions	

6.1. Efficiency (score: 1 out of 6)

The efficiency was a tragedy for the project. The project was completed more than five years behind schedule. The initial plan was to finish the project within three years, but because of the complexity of the project and many technical obstacles (including thousands of internal stakeholders), it was impossible to achieve the target date of completion. In addition, there was a cost overrun of more than USD 4.2 billion compared to the initial estimate. The time and cost estimations were based on incorrect assumptions; for example, by supposing that the land is flat and that the project would need minor modifications. This was not the case for the project because most of the land mountainous or hilly; hence billions of tons of soil needed to be removed from or to the highway. In additional to the delays, there were extra costs relating to external stakeholders (e.g., NGOs, landowners, and the habitants affected by the construction of the road) [19, 65].

6.2. Effectiveness (6 out of 6)

There has been a significant and important reduction in travel time and travel costs. The objective of the project was to reduce the number of traffic jams, shorten travel time for the users, and reduce the numbers of accidents. In addition, it was anticipated that linking Tunisia to Morocco would increase the number of tourists using the route. Some studies

have shown that the carbon dioxide emissions on the new highway have been reduced by 40% compared to on the narrow road that it replaced [16]. The traffic jams on the former road were mainly caused by a high number of accidents (registered). The number of accidents has since been reduced by half and the explanation for this is very simple. People have various reasons for travelling and they drive at different speeds according to their sense of urgency; the provision of six lanes instead of two lanes has improved the road authorities' ability to organize traffic and drivers' priorities.

6.3. Relevance (6 out of 6)

The project idea emerged in the late 1970s and has remained relevant since then, yet it seems that the identification and conception phases took more than 40 years to make the decision to start the front-end analysis for the project. Since time-saving and increasing the flow of the traffic were the main reasons for the project and for linking the different infrastructures (airports, seaports), and the big cities, the investment is considered relevant. Increased traffic volume and reduced travel time does not in itself increase the benefits for the community. Rather, the benefits also depend on the purpose of the journeys. Much of the time, the highway is used by heavy vehicles that boost industry and provide factories with primary materials.

6.4. Impact (3 out of 6)

Table 2 lists all of the impacts from the start of the project until the evaluation.

Table 2. Positive and negative impacts.

Occurrence	Positive impacts	Negative impacts
During the project impacts	1 – Creation of more than 100,000 new jobs 2 – Creation of many start-up companies in the field 3 – Knowledge and experience transfer	1 – CO_2 emissions (during construction phase—thousands of engines operating day and night) 2 – Demolished houses, felled trees, destroyed lakes, loss of wild animals (i.e., anything that stood in the way of the highway) 3 – Fatal work accidents (e.g., use of explosives to speed up progress caused the loss of lives and many injuries) 4 – Traffic jams increased during construction
Short- and mid-term impacts	1 – Better planning for future similar projects (for better outputs) 2 – The number of accidents have reduced compared to on the former road 3 – CO_2 emissions have decreased compared to the former road (during the operation phase) 4 – Shorter travel times	1 – Increase in illegal merchandise trafficking with neighboring countries 2 – Accidents on the highway are generally fatal due to the high speeds involved 3 – Some youths use the highway for illegal rallies
Long-term impacts	1 – Improvements in the national industries 2 –Flow of tourists from neighboring countries 3 – Good vision for the extension projects	1 – Migration of thousands of birds, especially from the destroyed lakes 2 – Higher taxes since the use of the highway will be free for several years (at least until the end of 2017)

There were significant positive impacts on employment during the project, as it created more than 100,000 new jobs. Furthermore, the knowledge and experience that were transferred to local companies should result in increases productivity levels in future similar projects. Other positive short-term and mid-term impacts are as listed above under "Effectiveness": reductions in the numbers of accidents, decreased CO_2 emissions, improved traffic flows on the road, and improvements in the national industries. There were also negative impacts during the project. For example, the

highway crosses an international nature reserve - Lac des Oiseaux - many houses were demolished to make space for the highway, fatal accidents were caused by one of the contractors when explosives were used to speed up the work, and many trees were felled in the forest that highway passes through. Another negative impact has been the increase in illegal merchandise trafficking with neighboring countries.

6.5. Sustainability (4 out of 6)

The long-term effects of the project are probably greater than the short-term and medium-term effects. The further expansion of the highway to the high hills (in the middle north of the country) and to the south as far as the border between Algeria and Niger will reinforce the transportation network. The immediate effect of the highway is the shorter travel times, while medium-term effects will begin to show as changes in industries and in all different sectors and services. In the longer term, one could initially expect to see changes in the structure of industry and in demographics. The long-term effect will probably be a balanced distribution of the population along the highway since people would no longer have to worry about their means of transportation. This redistribution would probably include industries that rely heavily on the highway.

In any project there is a proportional relationship between relevance and effectiveness. The measure of relevance at some stage is handled further by the effectiveness, as shown in Figure 9. The Algerian megaproject was relevant with regard to satisfying the needs. The effective way was that the outcome is produced and that the purpose of the project satisfies the goals and the objectives of the project. By contrast, the desire for a high degree of effectiveness will adversely affect efficiency; the more we want to be effective (by shaping the desired outcome with respect to emerging changes), the more efficiency will suffer. The impact of the megaproject (especially the positive short-term and mid-term impacts) has to some extent related to effectiveness with regard to the positive effects and the opportunities. However, a project of this size may have negative impacts. The sustainability of such a project will initially depend on success at the tactical level and once all the impacts of the project have been identified the sustainability will become clearer. However, in cases of general success, the sustainability of the project will depend on a good plan for maintaining the positive effects of the outcome of the project.
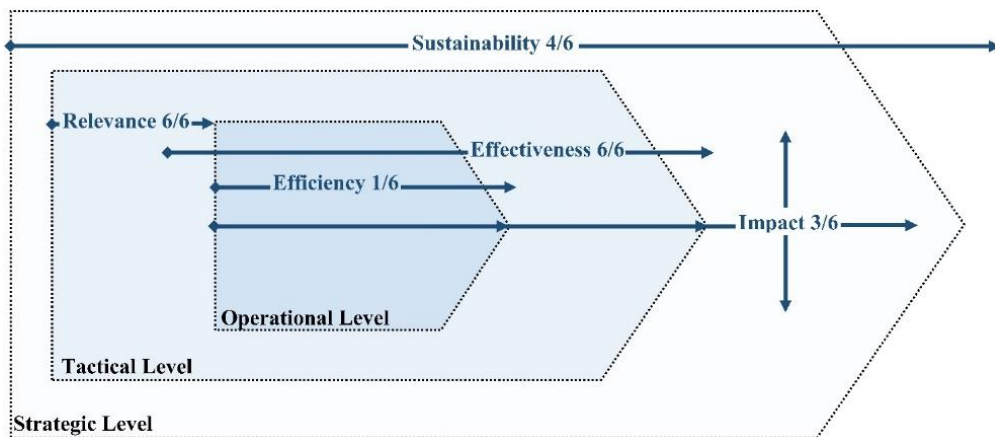

Fig. 9. The five measures' dependencies

7. Conclusions

In this paper we have described the development of an ex-post project evaluation framework. Following a review of a large body of literature, we found gaps in the extant evaluation models. We combined elements from existing evaluation models to form an improved framework, the Project Evaluation on Strategic, Tactical and Operational Levels (the PESTOL model). We applied the model to a case project to verify its applicability. The evaluated megaproject showed the relevance of the model, how it covers the whole project life cycle, and how it handles the links between different measures.

We do not claim that the model presented in this paper is the "ultimate" evaluation model, but rather that it can be used as a reference guide to ex-post evaluations. Nevertheless, there are some limitations within the model, such as the subjectivity in the scores that rather reflects stakeholders' perceptions, and that often there will be partiality in the judgments. Where necessary, for further research to develop a systematic method based on the model in order to reflect the evaluation measures and their rationality.

Another issue concerns how to link the ex-post evaluation model presented in this paper to ex-ante, monitoring, mid-term, terminal evaluations. That can be done by developing "mirror" models that reflect the PESTOL model. In such cases, there would be continuous evaluation of a program or project from the trigger until the purpose that it is going to serve is fulfilled. That would also serve to improve management and decision-making during the whole life cycle of the project.

Acknowledgments

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Issues for the long-term management of Social Business Documents

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Abstract:
Social business documents are currently one of the fastest growing content types within organizations. As carriers of important business information they require systematic management to ensure their content is available, accurate and protected over the long-term. To achieve this requires a deep understanding of their structure, nature and use. In this paper we present the findings of a preliminary study of social business documents. The aim of the study is to understand how social business documents are structured and to identify the issues and challenges that surround their management. Through an analysis of social business documents in four different systems we identify and compare their structural components from a user perspective. From this cross document/cross system analysis we develop a conceptual model for social business documents and identify issues for their long-term management. Our findings also identify the need for more in-depth modeling for which we propose methods to assist in understanding the syntactic and semantic structure of social business documents and how these change over the life of a social business document.

1. Introduction

Enterprise Collaboration Systems (ECS) are software platforms built around a combination of Enterprise Social Software (ESS) components (e.g. social profiles, tags, wikis, blogs) and classical groupware components (e.g. e-mail, group calendars, document libraries, workflow engines) [1], [2]. These "socially-enabled" collaboration systems are predicted to transform the digital workplace and are generating much interest for researchers and practitioners [3]–[5]. They have the potential to enhance collaborative work by improving communication, supporting joint work within and between business teams, coordination of workflows and tasks, and enhancing information sharing and the management of information and knowledge assets. Such systems are now generating large volumes of information in the form of social content, which is currently one of the fastest growing content types within organizations [6]. These large volumes of social content are comprised of a wide variety of documents (e.g. wiki entries or blogs posts), many of which contain important business information that requires systematic management. However, a recent survey of organizations reveals that whilst many organizations have clearly defined enterprise information management (EIM) programs for traditional document types, social business content is not yet included in such programs and remains largely unmanaged [7].

In this paper we focus attention on social business documents and their management. We present the findings of a preliminary study to investigate the nature and structure of social business documents. The work is part of a wider research program that explores the long-term management of social content. Our aim is to understand how these newer forms of information artifact are structured and to identify the issues and challenges that surround their long-term management. The paper is organized as follows. Section 2 provides background and context to enterprise collaboration systems and social business documents and their importance as carriers of business information. In section 3 we present the current study to examine the structure and nature of social business documents, its aims and objectives and the research design. This is followed by a presentation and discussion of the study findings and the implications for further work.

2. Enterprise collaboration systems and social business content

Enterprise collaboration systems are socio-technical systems that support collaborative work within a company. They are comprised of hardware, software, people and their work practices, organizational procedures and business processes. ECS are information infrastructures that combine multiple traditional groupware and content management components with enterprise social software components. They are usually implemented as a single integrated ECS suite or platform (e.g. IBM Connections, Microsoft SharePoint, Atlassian Confluence and Alfresco). However, ECS may also be built up as a portfolio of more loosely coupled stand-alone collaboration tools (e.g. specialized software for wikis, blogs from multiple vendors/sources) that may (or may not) be integrated with each other [8]. Rather than functioning as a communication delivery channel, ECS provide a platform upon which social interaction can occur [2, p. 2]. This interaction and the collaborative business activities that ECS support were initially termed Social Business [9], [10] or Enterprise 2.0 [11] to emphasize their social media-like nature. However, the social-media like components are only a part of an ECS. The strengths of ECS cannot only be found in the interactions that are supported, but also through their possibilities to transform work by combining existing technologies to coordinate activity streams, schedule tasks and events, and repositories and libraries of documents to capture and share information and knowledge. Documents are central to all the communication, coordination, collaboration and information sharing activities that take place using an ECS, and it is to the topic of social business documents that our attention now turns.

2.1 Social business documents

The incorporation of social media/Web 2.0 functionality into enterprise collaboration systems has resulted in the creation of new types of documents which we have termed 'social business documents' [12]. In using the term document to describe such artefacts we follow the work of scholars in the Library and Information Sciences cf. [13],

[14]. Defining a document as "any concrete or symbolic indexical sign, preserved or recorded toward the ends of representing, of reconstituting, or of proving a physical or intellectual phenomenon" [13, p. 10].

Social business documents are a class of digital business document, found alongside emails, business reports, webpages, podcasts, etc. Examples of social business documents include blog posts, wiki entries, social profiles, comments, etc., each of which contains business-related information (Table 1). A characteristic that distinguishes social business documents is that they are collaboratively developed and shared; a network of interactions and activities is built up and surrounds the core content of the document. As instances of digital documents, social business documents inherit all the characteristics of digital documents, however their social nature adds further complexity, which make them more challenging to control and manage.

Table 1: Examples of Social Business Documents.

Name	Description	Purpose/Aim
Wiki entry	One page of a wiki which includes information in the form of text, links, images and videos.	To collaboratively capture and share business information and knowledge.
Discussion/Forum message	Entry on a particular topic that is open for discussion. It can include text, images and links.	To capture and exchange ideas and opinions and support business decision-making.
Blog post	Entry on a particular topic from one user. It can include text, images and links.	To capture information and share opinions on specific topics.
Status message	Text message communicating a recent update.	To update and inform colleagues within the enterprise network.

2.2 Social business documents as compound documents

Social business documents are examples of compound documents; that is, they consist of more than one component, for example, the main text, tags or comments [12]. Asprey and Middleton [15, p. 11,57] have discussed this characteristic in the context of emails and HTML web pages. An email, which contains text, attachments and links to other documents, is a combination of content, which together forms a compound document. Similarly for HTML pages, if an HTML page contains links to other documents such as pictures or downloadable pdf files, server side includes etc. then the whole object should be seen as a compound document. Asprey and Middleton [15, p. 317] use the term compound document and refer to "document[s] created at the time of viewing that comprises components from several digital sources in different formats brought together for display so that they manifest themselves as a coherent document". We apply the concept of a compound document as an analytical tool to examine the different components in social software in the study reported in Section 4.

2.3 Social business documents and social content

Not only are social business documents compound documents they also contain materially different types of content (see Table 2 for examples). For example, a blog post contains the main content, which is the core information (e.g. a post about a new product, project etc.) and is the reason the post is created. This core information is then socially enhanced through, for example, the addition of comments to the original content, liking, sharing and tagging. These 'attached' elements are important parts of the document in context. Comments are, in themselves also social business documents (they can be liked, tagged, etc.) –they contain information that may be of value to an organization. For example, a comment might show how a topic developed, essentially capturing the discourse around the topic. Whilst comments are a social business document unit in themselves they are not of value unless attached as context to the thing that is being commented on (i.e. the post). There is also social content that is not, by definition a document but also contains important information about the main content. For example, a like shows that someone has (most likely) read a

post and agrees with it. A like is not content in itself but it is part of the social milieu that surrounds a social business document, in effect a like is a form of workplace awareness showing what another user has done. From an audit or records management point of view these peripheral social elements to a blog post are part of the post and should be managed together.

Table 2: Examples of attached social content.

Name	Description	Purpose/Aim	Why it is not a social document
Like	Expression of favor for some specific information.	Recommend content; Shows consent	If seen alone the context of the like is gone and it no longer relates to any information. All likes are the same, the difference is in what someone likes. When attached to a wiki entry as an example, it becomes part of that social document.
Tag	A keyword or index term attached to other documents.	Clustering content for better resource discovery	A tag alone is just a word and has no context or explanatory power. It becomes part of a social document when it is attached to it and is rather a special kind of metadata.
Comment	Written annotation related to another social document.	Adds opinion, concerns or ideas to something	A comment itself might include important information and could be seen as a document. However, comments are always attached to something and thus are a contextual component of a social document.

The majority of social business documents are *born-social*; that is, they are created within enterprise social software with the express intention of being interactive and collaborative. When created within the system, a wiki entry already has the functionality of version control, of commenting and collaborative tagging. However, some documents may *become-social* through being opened to collaborative interactions. 'Traditional' digital documents such as pdfs or office documents do not have collaboration features as standard; when created in their original systems (e.g. Open Office or Microsoft Office) there is no possibility to collaboratively tag or like the file. However, when they are uploaded into an ECS these collaborative features become possible, the document becomes embedded in a collaboration space. The document is now a social business document. Thus, even though we are primarily focusing on examples of born-social documents such as a wiki entry or a blog post, it important to note that traditional digital documents, e.g. spreadsheet, a CAD file or an image, can become social business documents consisting of the content/file itself and the individual social components.

2.4 Documentary practices

A wide range of document types and document-related practices mediate work in an ECS. For example, working on tasks such as collaborative writing/editing in a wiki, sharing documents in libraries, updating status messages, commenting on posts, liking, etc. Many of these practices are collective-practices with multiple authors working on the same document. This can mean that some social business documents are always *in-the-making*, published before they are a final version, frequently updated with comments, and/or with no expectation of a final version but rather a continuous evolution of their content.

Social business documents have the properties (prolonged state of incompletion, their durability, their fragmentation, the diverse commitments of their authors, the evolving nature of their content, etc.) of what Zacklad [16, p. 206] has defined as Documents for Action (DofA). These properties present a number of document management challenges, especially with regards to traditional views of the information lifecycle.

As discussed earlier these digital documents still require management to ensure that important business information is effectively organized, stored, used and disposed of, and this is not currently occurring [7]. To manage social business documents in ways that account for their more fragmented and evolutionary character we need to know much more

about their nature, structure and uses. In the remainder of the paper we present a study to investigate the nature and structure of social business documents, propose a strategy for analyzing them and examine the implications for social business document management.

3. Research approach

This study aims to provide a deeper understanding of the structure and nature of social business documents. The findings will contribute to the specification of functional requirements for social business documents and to the design of processes and strategies for their long-term management, which are goals of our wider research program. A preliminary definition of social business documents and their characteristics have already been identified (see [12]); these are briefly discussed in section 2 above. In order to develop the capability to manage social business documents effectively an understanding of what social business documents are, where they occur and how they are constructed needs to be established and forms the basis of the study reported in this paper. Social business documents are analyzed by examining their nature and structure through the following research steps outlined below (see Fig. 1).
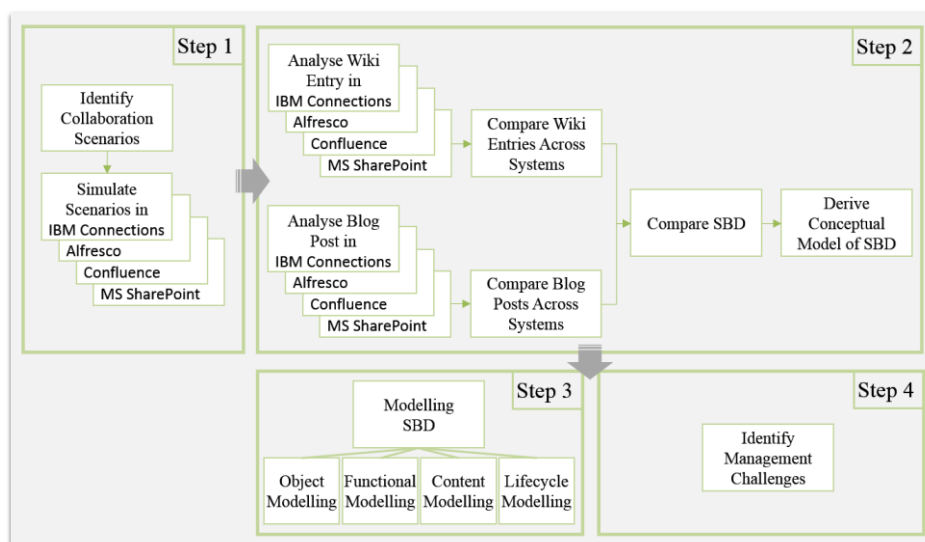

Fig. 1. Research Steps

Step 1: Identify Collaboration Scenarios. Key collaboration scenarios were developed to guide the analysis of social business documents. The scenarios illustrate how groups and individuals within organizations use collaboration tools to work together. Two of these collaboration scenarios are discussed in this paper. They were created to illustrate information exchange and communication during the use of i) a wiki and ii) a blog application. Each collaboration scenario was then simulated within four of the most widely used ECS: IBM Connections, MS SharePoint, Alfresco and Atlassian Confluence (see section 4.1).

Step 2: Analyze social business documents. Adopting a user perspective, an analysis was undertaken to identify the components that can be added to the wiki and blog applications in each system. The findings about the two document types (wiki entry and blog post) were compared to i) identify the presence/absence of specific components and ii) to compare the similarities and differences between the two document types both within and between the four systems.

Finally, a conceptual model was developed, outlining the social business document components identified in the analysis (see section 4.2 and 4.3).

Step 3: Modelling social business documents. Following the preliminary analysis the two social business document types and their components are examined in more detail, using four different modelling approaches: object, functional, content and lifecycle modelling. The different views of social documents are developed in order to understand how they are constructed from both a technical and an organizational level. The different modelling perspectives are outlined in section 4.4.

Step 4: Identifying management challenges. Given the complex, compound nature of social business documents, step 4 begins the work of identifying the challenges of managing social business documents. Through the implementation of the collaboration scenarios and the analysis of social business documents a number of issues for their long-term management are identified. These will be further investigated and developed in later stages of the project through in-depth case studies of ECS in use (see section 5).

The research follows an exploratory research approach with the aim of providing an understanding of the nature and structure of social business documents. The findings form the foundation for future in depth analyses. Based on insights from previous work and the industry case studies (future work), we will identify requirements, strategies and practices for the long-time management of social business documents.

4. Components of social business documents

As outlined above (section 2), the idea of compound documents is not new and can be found in descriptions of, for example, e-mails or web pages. Social business documents also have the characteristic of being compound documents [12]. Using the compound document concept as a basis, the following sections use two collaboration scenarios to examine social business documents in more detail. Each scenario is simulated in four different ECS and the findings are analyzed in order to develop a conceptual model for social business documents. Finally, we discuss different modelling approaches that provide additional perspectives on understanding social business documents.

4.1 Collaboration scenarios for SBD

Schubert and Glitsch (2015) present an approach to defining use cases and collaborative scenarios within enterprise collaboration systems. They "refer to *use cases* for activities that are unpredictable in their exact sequence (and thus flexible)" [17, p. 164] and define a *collaboration scenario* as "a sequence of activities that is carried out by one or more people (actors) in an effort to achieve a common goal (collaboration)" [17, p. 163]. Use cases express wider organizational activities and consist of one or more scenarios. Examples of use cases in ECS are knowledge sharing, enterprise communication and project and team organization. Collaboration scenarios in turn describe the detailed view of activities such as file sharing, creating and managing meeting minutes, discussions or information exchange [18].

In order to analyze social business documents two different collaboration scenarios representing typical information exchange and communication were developed. The scenarios are set in an organization that works together with companies all over the world and has its own representatives in different countries and therefore depends on collaboration support. In order to extend their portfolio the company is planning a new service offering. The two collaboration scenarios outlined in Table 3 are included in this use case.

Both scenarios described within the table above could be performed using word processing tools to capture the information, shared drives to store the documents and e-mails to distribute additional information to the responsible employees. However, only assigned employees would have access to the information and the possibility to make new contributions. With the use of wikis, blogs, etc. collaboration and information exchange becomes much easier [19]. Communication is more transparent and visible for a broader user group and it is possible to create and use different kinds of content. In order to outline this different content and to analyze the use of social business documents, the collaboration scenarios were simulated in four different enterprise collaboration and enterprise content management

systems. Based on the scenarios outlined above, social business documents created in the wiki and blog are further analyzed. Below we present the findings from two of the four systems: IBM Connections is used as an example of an ECS and Alfresco as an example of an ECMS.

Table 3. Collaboration scenarios examples.

Scenario	Developing a program outline	Searching for Partner: keep employees up to date
Description	The company needs to create an outline of a travel program providing a short overview of each day. This information will later be published as information to customers.	A partner for one special activity needs to be found, but the case company is waiting for additional information from the supplying company. As time passes, an update on the current status should be given to employees to keep them up to date.
Application	Wiki	Blog
Tasks involved	▪ Create & capture program information, to inform employees about the outline ▪ Update information, enabling all project members to work on the outline ▪ Comment information, to reason updates ▪ Improve findability	▪ Create & capture update information ▪ Disseminate information to employees ▪ Edit information because of a mistake ▪ Comment information ▪ Improve findability

4.2 Analyzing social business documents

Scenario 1 – Wiki usage

When using IBM Connections as a platform for information organization and exchange a community is opened to organize the new offering. The program outline is written within a wiki entry, which consists of the main content itself, comprising text and pictures and its metadata such as the creator, creation and update date etc. However, the pictures are not stored within the content object, they are integrated via a link to the attachment of the wiki entry. Furthermore, different employees could edit the outline, with each change leading to a new version, which can be viewed and restored. In order to explain the edits made to the outline, the wiki comment functionality was used. In addition, the entry was tagged with different terms for better findability and employees who saw the entry have 'liked' it to show their consent.

Similar to communities in IBM Connections, sites can be set up in Alfresco. These are used as a kind of project room and a wiki entry for the program outline is added. The functionality of the two systems differs, so does the structure of the wiki entries. However, similar content components can be found within the wiki entry in Alfresco. The wiki entry in Alfresco consists of the main content, its metadata, the uploaded pictures, different versions and tags. In contrast to the wiki entry in IBM Connections, the Alfresco wiki entry cannot be commented on. Further, pictures are not uploaded through attachments, but are either linked from an external file or uploaded through the document library and linked internally.

Fig. 2 shows what the Scenario 1 wiki entries look like in IBM Connections (left) and Alfresco (right).

Further analyzing wiki entries in Atlassian Confluence and Microsoft SharePoint reveals similar components. Table 4 summarized the findings of the wiki analyses across the four systems and provides an overview of similarities and differences between them.
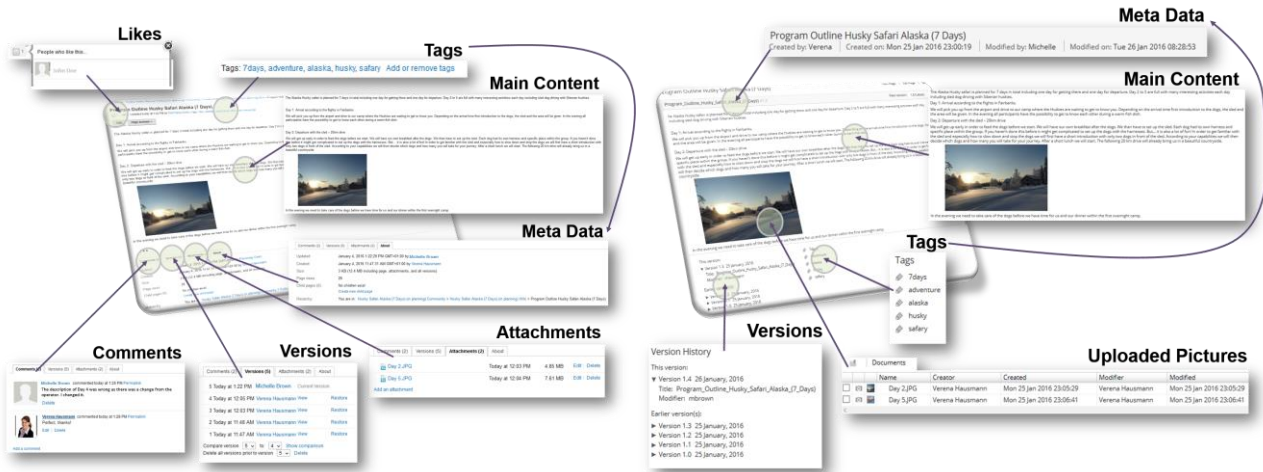
Fig. 2. Wiki entries in IBM Connections (left) and Alfresco (right)

Table 4. Wiki entry components in the different systems

	IBM Connections 4.5	Alfresco Community 5.0	Atlassian Confluence 5.8.14	MS SharePoint 2013
Content	x	x	x	x
Versions	x	x	x	x
Comments	x	-	x	x
Attachments	x	-	x	-
File uploads	(x)	x	(x)	x
Notifications	-	-	x	-
Tags	x	x	x	x
Likes	x	-	x	x
Likes to Comments	-	-	x	-
Picture etc. to comment	-	-	x	-
			Note board	

x = available   - = not available   (x) = attachments are uploaded to a file directory in the background

Scenario 2 – Blog usage

The purpose of a blog is different to that of a wiki [19], consequently the functionality is different, with a different set of components. However, analyzing the blog posts reveals similar results as for the analysis of the wiki entries. In both systems, the blog posts are set up in the same community/site as the wiki entries. They also comprise text and pictures and are tagged for better findability in both systems.

Within the blog post in IBM Connections, the pictures are not directly uploaded as attachments to the post, but automatically uploaded to a file system and linked within the post. This is a different process than in the IBM

Connections wiki. The IBM Connections blog post offers the possibility to notify people about the post itself. Thereby it is possible to send additional information through an e-mail message produced via the system. Furthermore, it is not only possible to comment on a post, as with the wiki, but also to like the comment. Whilst the IBM Connections wiki entry allows version control, the blog post does not. Even though the metadata of the blog post captures who created the post at which time and which person last edited it, the system does not provide information about what was edited and what happened between the content creation and the last edit. Comparing the IBM Connections blog post to the blog post in Alfresco shows less functionality and there are fewer components in the Alfresco blog post. In Alfresco we can only find the content with its metadata, tags, comments and uploaded files. Fig. 3 illustrates what a blog post looks like in IBM Connections (left) and in Alfresco (right).
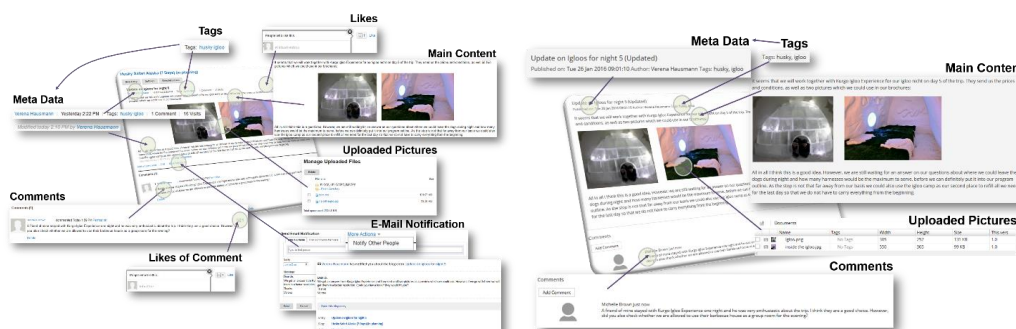

Fig. 3. Blog Post in IBM Connections (left) and Alfresco (right)

Table 5 shows the components available in the blog post in all four systems under analysis.

Table 5. Blog post components in the different systems

	IBM Connections 4.5	Alfresco Community 5.0	Atlassian Confluence 5.8.14	MS SharePoint 2013
Content	x	x	x	x
Versions	-	x	x	-
Comments	x	x	x	x
Attachments	-	-	x	-
File uploads	x	x	(x)	x
Notifications	x	-	x	-
Tags	x	x	x	x
Likes	x	-	x	x
Likes to Comments	x	-	x	-
Picture etc. to comment	-		x	-
				Note board

x = available   - = not available   (x) = attachments are uploaded to a file directory in the background

The examples of the wiki entry and the blog post outlined above are representative examples of social business documents in the different systems and reveal various aspects of the structural differences and complexity of the documents, the different kinds of implementations within the systems, the different terminology used within the systems and richer content capture capabilities.

One example of the structural differences of social business documents as compared with traditional digital documents is the implementation of a comment. As for a wiki entry, it is also possible to comment an MS Word document. However, with the MS Word document, the comment is embedded directly within the file itself, a comment to a wiki is attached to the wiki entry. As collaboration tools often allow the capture of additional content such as a like which is not available within traditional documents, they offer possibilities for richer, more expressive content. This increases the volume of content created as well as the complexity of the documents being compound documents.

All these characteristics lead to interesting challenges for social business document management. It is necessary to not only view the main content as valuable information that must be protected and managed, but also the different components attached to it. For example in the case of legal discovery or audit, the comment attached to a blog post may be of equal material or contextual value.

Tags are additional descriptive metadata and a like is an example of awareness information that shows that a person has accessed the document and most probably agrees with the content. Similarly with a comment, it depends on the perspective and the interpretation whether the like is a valuable component for the document. Most of the time it may not be important, however, if it is used as an indicator for consent to a decision, it might then be important.

A conceptual model of social business documents can assist us in understanding their general structure. However, because of variations in the ways different systems implement these structures it is also necessary to understand the individual system implementations in order to manage social business documents in ways that meet legal and organizational requirements.

4.3 Conceptual model of social business documents

Although the specific functionalities within the software offerings differ, as do the implementations within the various systems, the general notion that a social business document consists of more than its main content and additional metadata holds for all systems. Building upon our analysis outlined above, we developed a representation of a conceptual information model of social business documents including their possible components (see Fig. 4).
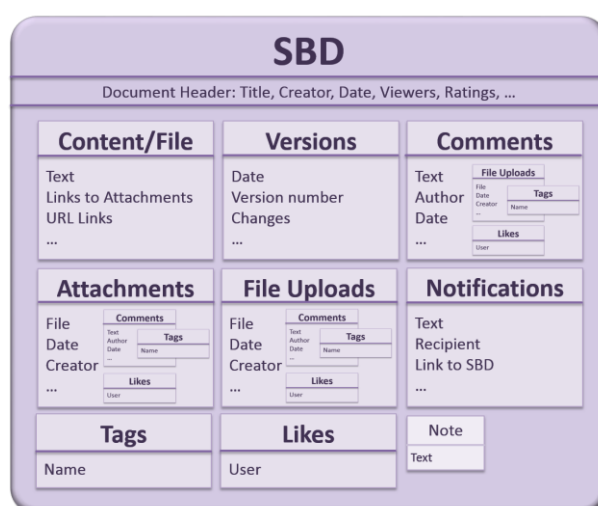

Fig. 4. Conceptual model of social business documents.

4.4 Modelling social business documents

Presented above is the user view of social business documents as compound documents. As Asprey and Middleton outlined, compound documents consist of "components from several digital sources in different formats" [15, p. 317]. Salminen et al. [20, p. 644] posit that a well-grounded document analysis is needed in order to define effective standards for digital documents. Therefore, the existing documents and their management practices need to be studied and described.

In order to understand social business documents in more depth and to identify strategies for their management more knowledge about their technical implementation, as well as their organizational instantiation is required. Document engineering approaches provide methodologies for developing new documents. However, they can also assist in analyzing existing documents. Guided by the approach of Glushko and McGrath [21] we defined four different modelling processes to represent different views of social business documents: object modelling; functional modelling; content modelling; and lifecycle modelling. Table 6 provides an overview of the aim, outcome and contribution of each approach for the research study. All diagram notations identified as outcomes from the different modelling approaches are adapted to fit the needs to describe the aspects for managing social business documents.

Table 6. SBD modelling approaches

Modelling approach	Aim	Outcome	Contribution
Object modelling	Identify syntactic elements of structural information models of SBD	UML class diagrams ER-diagrams	Understand the technical implementation of SBD in order identify their structure in order to develop methods for the long-term management of SBD.
Functional modelling	Identify functional information model of SBD	UML activity diagrams	Understand the different user-side modifications that can be applied to SBD over their lifetime.
Content modelling	Identify semantic elements of structural information models of SBD	Metadata models (information inventory)	Understand the organizational requirements for information about SBD.
Lifecycle modelling	Identify changes to SBD during their lifecycle	Lifecycle view	Understand which elements of SBD change over their lifetime and when and how these impact the management of SBD in order to identify SBD management requirements at different points in time.

Object Modelling

Object modelling enables the analysis of social business documents from the technical, system perspective. The aim of object modelling is to identify the structural information models of different social business documents. To achieve this, the instantiated documents within the systems need to be analyzed in their actual implementations within the different systems in order to understand their characteristics. In object modelling the structure of social documents is analyzed by identifying the different components and their attributes, along with their relationship to each other in the database.

We will use the UML class diagram representation in order to analyze how social business documents and their components are stored within the databases. The Unified Modelling Language (UML) is widely used for modelling software designs and analysis and can be seen as a de-facto standard. The UML class diagram outlines a domain as objects represented by classes and relationships between them in order to describe the static structure of the domain on a semantic level. Each class can be described through its title, attributes and operations [22], [23, p. 71,73]. By describing

the syntactical structure we can examine where content is stored, how the different components of a social business document are linked to each other and what metadata exists and where it is stored. While UML class diagrams can describe the dynamic aspects of a system by including attributes and methods, Entity-Relationship (ER) [24] diagrams focus on a static view of the system. Therefore ER diagrams will also be used in order to model SBD in a more abstract way.

By analyzing social documents in different stages of their lifecycle, the object modelling will identify changes to the document from the system perspective. The object modelling will contribute to understanding the structure of social business documents in order to reveal possible issues arising with their long-term management. For example, analyzing a wiki entry with the help of the object modelling in IBM Connections revealed that the main content of the wiki entry and its attached files are stored as files in the filing system, whereas all other content such as the metadata or tags are stored within a database. Creating database backups for archival activities or security reasons without saving the files in the file system would in the example presented here lead to a loss of information.

Functional Modelling

Functional modelling investigates what can be done to and with a social business document. Through analyzing social business documents from a user perspective the functional modelling aims to determine the functional information model of social business documents and thus their processing and modification possibilities.

The UML activity diagram is a behavioral modelling technique [22, p. 141] which draws ideas from Petri nets, event diagrams and SDL state modelling techniques. Activity diagrams can be used for describing workflows and behavior. The main element is an activity which can, dependent on the perspective, be some kind of task or a method for a class [22, p. 129]. Within the functional modelling for social business document we take the conceptual perspective in which an activity describes a functions/task you can perform. Whereas a flowchart can only depict sequential processes, activity diagrams can outline parallel processes [22, p. 131].

The functional model will contribute to understanding the user-side modifications to social business documents that are possible over their lifetime. Potential problem areas could be revealed, by showing that, for example, a blog post that has been written and commented on can be still edited after the comment was made. The problem here is, if there was no version control on the post the original version of the post to which the comment was attached may not be visible anymore. In order to discover these issues, a mapping of the functional modelling and the changes to the object models during their lifetime is necessary.

Content Modelling

While the object modelling analyses the syntactical aspects of social business documents, the content modelling should enhance the structural information model with semantic aspects. The content modelling approach will provide further insights into organizational aspects of SBD. To achieve this the general metadata kept within the different systems for each SBD will be analyzed. Furthermore, audit related information, which might be important for SBD will be identified.

In order to discover information resources, Burk and Horton [25, p. 57] outline a method for creating an information inventory. An information inventory should show who (sources) holds which information (document such as annual reports, trade publications etc.), who is responsible for them, etc. It provides an overview of all information available and provides detail about their nature and management requirements

With content modelling we adapt the idea of an information inventory in order to develop general models, which outline the important information that should be kept with/about social business documents. By describing the instantiation of the documents, not only the metadata information provided by the systems, but also information such as stakeholders, responsibilities etc. are analyzed. Such information can also be seen as metadata of social business documents and categorized into: administrative, descriptive, preservation, technical and use metadata [26].

This organizational view of the content modelling will assist in identifying the audit related information required for managing social business documents.

Lifecycle Modelling

Finally, the lifecycle modelling will provide a holistic view of social business documents over time. To achieve this the findings of the object, functional and content modelling will be combined in order to understand which components and elements of social business documents change over their lifetime and how they change. These insights can assist in identifying different management requirements of social business documents at different points in time.

The modelling approaches outlined above and the connected views are necessary to understand how social business documents are constructed, both, technically and organizationally in order to be able to formulate functional requirements and be able to adequately manage them. Burton and Horton [25] have previously noted that we have to know the different elements of information in their context in order to be able to manage information.

5. Issues for long-term management

As outlined at the beginning of this paper, wiki entries, blog posts and all other social business documents can contain valuable business information that requires systematic management. Thus, not only is the structure, design or form important for defining value, but most important is the content itself. As with other digital content, social business documents are legally discoverable information and thus can become evidence in legal proceedings [27]. It also needs to be managed in terms of knowledge management and preservation, information quality, operational risks, etc. However, the nature and structure of social business documents, their characteristics, the system they are created/captured with and organizational requirements add to these management challenges.

Characteristic and content issues: Even though many of the characteristics of social business documents such as the multiple authoring, easy shareability and location independency lead to positive opportunities when working with social documents, many characteristics also bear challenges and risks [12]. When managing, archiving or deleting social business documents it is important to consider the compound document, including all the components of the social document.

Furthermore, the lifetime/durability of social business documents is often not well defined. Because of their interactive nature and their possibility for further editing, it remains unclear when a document is finished/terminated. If not locked for further editing, new comments, more likes etc. can emerge years after the document was created. The question of when to archive or delete a document remains open.

System-related issues: Depending on the system type where social business documents are captured, (e.g., ECS or ECMS, and even ERP Systems) different levels of information and document management capabilities can be found. However, most of the document management methods such as content types, declaring a record or retention periods cannot be applied to, are not implemented for social business documents.

Organizational issues: Often organizations do not have a clear overview of what information they have, where it is stored or in which form it is kept. Thus they have insufficient knowledge about what needs to be managed in which way. Further, many organizations do not have a strategy for managing social business documents [28]. Guidelines outlining how to proceed with this content are missing, and if in place at all, the archiving and deletion aspects in particular are not being addressed [8]. Questions such as, who is the owner of a document brings challenges. Is it the author of the document, even though someone else subsequently edited the document? And what about the attached components? Who is responsible for them?

The following list summarizes the problem areas identified within our preliminary analysis of long-term management issues:

- Compliance issues;

- Records management issues;

- Loss of information quality;

- Knowledge management;

- Operational risks (not finding information);

- Exporting (transferability);

- Archiving.

There are many open issues when it comes to managing social business documents. However, how something should be managed, whether it should be deleted or retained, and when and for how long, should be dependent on the content, not the medium. If the same information in paper can be given a retention period and be archived or deleted, so too should social business documents. The challenge is in finding the best strategies and practices for achieving this.

6. Conclusion and implications for future work

The aim of this study was to understand how social business documents are structured in order to identify the issues and challenges that surround their long-term management. Given their characteristic nature as compound documents we began by analyzing the components of social business documents in different systems. In terms of generalizability we developed a conceptual model of social business documents outlining their components and the occurrence of nested components. However, because of the different implementations and approaches within the software systems we also outlined the need for more in depth modelling methods to i) identify how social business documents are implemented from a technical perspective, ii) understand functional possibilities for their change and iii) understand lifecycle issues.

This paper provides first insights into the user view of social business documents. The modelling approaches will especially address the technical implementations. In order to examine organizational issues and requirements to/with social business documents, industry case studies will be performed as a next step of the overall research project.

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Challenges of adopting agile methods in a public organization

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Challenges of adopting agile methods in a public organization

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Abstract:
Agile development methods are widely used among business enterprises. Since the introduction of the Agile Manifesto in 2001, several agile methods have been implemented, first in single-team set-ups and later in larger multi-team set-ups for complex Information Technology (IT) system development. However, the adoption of agile methods has been slow in the public sector. This is also reflected in the academic literature, as there are only a few studies discussing agile adoption in public organizations. This paper contributes to research on the use of agile practices specifically in the context of public organizations, and sheds light on the challenges a public organization may face while adopting these practices. The aim of this paper is to identify and categorize the challenges that may hinder efficient adoption and use of agile methods in public IT projects that include private software vendors. This research is based on a case study of a large governmental office. As a result, this paper presents several categories of identified challenges, the root causes of these challenges, and a discussion of the characteristics of these challenges for the public sector.

1. Introduction

Software development processes have evolved radically from traditional control-oriented and sequential waterfall models to today's agile development methods, the underlying principles and values of which are declared in the "Agile Manifesto" [1], [2]. Agile development methods combined with corresponding project management methods are intended to increase efficiency and flexibility in software projects and minimize unnecessary specification, administration, documentation and unproductive work [3]. Indeed, in recent studies agile methods have been proved to contribute to project success by increasing customer satisfaction and enabling flexible change management in software development, particularly within private sector projects [4]. Currently, the use of agile software procurement is gaining prominence within public sector software procurement projects. Applying agile methods in a multi-organizational public sector context requires radical changes in the way projects are negotiated, contracted, procured and organized in order to maximize created value over the project lifecycle. To date, though, only scant attention has been devoted to empirically identifying and describing the managerial challenges that may relate to the procurement and execution of agile software projects within the public sector context.

Agile methods were first implemented in small teams, projects and companies, but during the last few years the usage of agile methods has also been scaled up for use in large system development and distributed software development. However, public agencies and governmental organizations have been slow in adopting agile practices, with the exception of some specific high-tech research organizations. This situation is also reflected in academic research. Only a handful of studies exist on agile methods adoption in public organizations. Abrahamsson et al. [5] identified several research gaps in their editorial. They call for further research by stating that "with agile methods being routinized and infused in the adopting organisations, one of the most pressing issues is the need to develop a better understanding of the implementation of agile at the organisational level" [5]. Mangalaraj et al. [6] suggest in the same special issue that there are myriad issues and challenges that an organization needs to overcome to sustain agile methods. They call for research to elucidate "issues in managing the change to new and conceptually different software development approaches". Similarly, Conboy et al. [7] discuss organizational challenges in adopting agile practices and then call for further research on "the effectiveness of agile method adoption" and new research on agile project management. Furthermore, Conforto et al. [8] call for more research on agile project management and use of agile practices in software and other industries. Project Management Journal [9] also calls for more research on agile implementations and project management in different contexts. As these numerous calls for more breadth and depth of research into agile methods show, there are many topics in this area that would benefit from further study.

We found these calls for research encouraging and well-aligned with our interest in studying different forms of flexibility in projects and co-creational value in projects utilizing agile practices. Our specific interest for this paper was to study a public organization conducting software procurement with a project setup that is utilizing agile practices. Specifically, this paper was designed to investigate the kinds of challenges a public organization faces when adopting agile practices in subcontracting a software project. In addition, we wanted to gain a thorough understanding of the root causes of these challenges. To gain this understanding, we used a case study as our chosen methodology, with our chosen case being a public agency that was subcontracting complex IT system development from private software vendors. This agency's development project utilized agile methods and provided a great insight into the adoption and implementation of agile practices.

In this paper, we first review the earlier literature on the challenges in adopting agile methods. We then present the methodology and the case study setting, followed by the empirical findings. Finally, we discuss the findings and conclude with a summary of the obtained results and suggestions for the development of future research.

2. Earlier research identifying challenges in adopting agile practices

The utilization of agile practices has been rapidly increasing during the last fifteen years, and there has been a distinct change in the type of organizations using them. This change is also reflected in research on the adoption of agile methods. The first years of research focused on early adopters, single team studies and implementation in small organizations; the research focus later shifted to studying multi-team implementations and adoption in larger organizations. In our view, the current wave of studies has increasingly been focusing on the adoption of agile practices in procured and internal multi-site set-ups, off-shore implementations, and increasingly, as this paper does, on agile methods adoption in public organizations. In this section, we will briefly review the earlier studies. We will first consider the challenges that have been identified in research in small organizations and studies on early adopters, then discuss challenges in large system development and distributed software development. Finally, we will look at the few existing studies related to challenges identified in the public sector.

2.1 Challenges for small teams and early adopters

There are several studies on the challenges a development team can face while adopting agile practices. These practices emphasize the human factor in software development and agile development focuses on the talents and skills of individuals [10]. It is essential for the successful implementation of an agile approach to get customers, developers, and other involved individuals to understand their roles and responsibilities in an agile project setup [11]. Individuals must be committed to work following the agile definition of different roles as the agile setup is very much self-driven and self-disciplined [12], [13]. There can also be psychological barriers to success with agile methods. Conboy et al. [14] focused on the people-related challenges in a study with several companies and they found that some software developers fear that their possible skill deficiencies will be exposed in an agile team. This can cause social stress and resistance to agile adoption. Increased reliance on social skills and team work can also be problematic for some individuals [14]. Similarly, the agile approach is based on a different ideology than traditional methods, e.g. the waterfall model of software development and control-oriented project management [15]. For the successful implementation of an agile approach, the mindset of individuals must be receptive for agile principles to enable the organizational environment accept the agile methods [13]. Asnawi et al. [12] also noticed that it can be difficult for the individuals to adopt agile practices if they have worked with control-oriented project management methods previously. Lack of motivation to use agile methods can also be a problem; this is usually related to the fact that developers are familiar with agile practices but do not embrace the values and principles of an agile approach [14].

Prior research has identified some key issues in organizational readiness for the use of agile methods. Asnawi et al. [12] recognize that it is important to have management involvement in the transition to the utilization of agile methods. Management needs to support the changes required in the software-development-related processes in order to optimize processes for agile methods [15]. Also, management support is needed to get customer, vendor, and/or stakeholder acceptance and buy-in for using agile methods in executive-level discussions between the companies [11]. Individuals in an organization utilizing agile practices should get proper education and training in the implementation of agile methods [12], [15]. This is important not only for ensuring that the organization has enough knowledge of agile practices but also increasing individuals' understandings of how different roles work in a project organization utilizing agile methods. It is also important that customers understand their roles and participation as part of agile development [12]. Another difficulty is that developers can lack business-related knowledge regarding the system they are working for. This can be a significant issue, especially if the business owner and product owner are not working closely with the agile team [14]. In addition, a small team of developers needs to master several technology areas and have business understanding to be able to take care of the tasks they have [14].

Optimal organizational structure, project size and number of teams are widely discussed issues in agile research. Asnawi et al. [12] found empirical support for a claim that it is easier for agile practices to be adopted in small companies and teams. This idea of small teams being optimal for agile practices was supported by earlier research [10], [15]. Scholars suggest two reasons for this. First, small and startup companies have more dynamic culture which is

naturally better suited to flexible and agile practices [12]. Secondly, small companies usually do not have any legacies to follow; they have not established formal and rigorous processes yet [10], [12]. The recommendation of limiting the size of an agile organization is often linked with the importance of direct communication. Efficient communication is important when a software development project utilizes agile practices, especially because of the goal of having less documentation compared to traditional methods. There is no requirement specification done for the whole project in the beginning; typically, requirements are agreed on for the next sprint and goals, and requirements are sketched for 2-3 following sprints [15]. Developers need to get the requirements for each sprint in time and they need to understand them correctly, otherwise they might have incorrect assumptions and thus not work on what actually needs to be done [11], [12]. In order to succeed with this type of continuous discussion between the product owner and the agile team, they need to have the discipline to follow agile practices. Customers and software vendors should discuss the software development project in question and agree that agile methods are suitable for the project [12]. This does not mean that agile methods are proved not to be suitable for specific type of projects, but rather, that for the successful implementation of agile methods both parties must share the same understanding of how to utilize agile methods [11]. This also increases clarity regarding the project goals and the management structure of agile governance and decision-making. Devolved decision-making in agile team meetings can cause problems if individuals do not feel comfortable in sharing their opinions, or if the decision-making is not fair and democratic.

Knowledge transfer has been also identified as a possible challenge in an agile set-up. Agile practices promote minimizing required project documentation, and this might make it difficult to conduct a proper knowledge transfer in a situation when one or several individuals leave the team [12]. This was one of the main concerns of project managers. On the other hand, agile practices suggest ensuring that projects have high-quality and well-commented source code to make it easier for new programmers to take over. Another identified issue related to personnel management was that companies have not developed agile-specific recruitment policies or agile-compliant performance evaluation methods to support individual- and team-level abilities [14]. This makes it difficult to evaluate and educate individuals and agile teams.

As the issues listed above demonstrate, researchers have found that people-related factors and social factors are more important than the technical factors in the successful adoption of agile practices [12], [15]. There is one exception, though: communication tools are essential for agile practices if there are several individuals or teams working on a project who are not located at the same office. Agile practices are based on efficient communication, and in case of physical distance between the teams there must be efficient virtual communication tools available, and the individuals and teams should feel comfortable using them. The situation is naturally even more challenging if the teams are based in different time zones [12].

2.2 Challenges for large organizations and multi-site operations

Lindvall et al. [16] studied several large companies (ABB, Daimler-Chrysler, Motorola and Nokia) while the companies began using agile practices in pilot projects. These companies reported increased agility in pilot projects and improvements at least in one of the measured attributes: customer satisfaction; quality; productivity; and cost. Along with the positive results, the companies identified challenges and possible challenges for the adoption of agile practices. They found that the greatest challenge was not related to agile practices but to integrating agile practices into the project environment's existing processes [16]. The same issue of a possible mismatch between agile, lightweight processes and standard industrial processes was identified by Boehm and Turner [15]. Lindvall et al. [16:30] argued that "*in a large organization, a project cannot be truly independent*"; rather, each project interacts and has several interfaces with other projects, teams and processes inside the organization. This creates challenging situations, especially if one project or project team is using agile practices but other surrounding projects and teams are not.

Similar single-team implementation, it is also important to have a committed customer in a larger-scale and/or multi-site agile adoption [16], [18]. Using an agile approach, product features are defined and specified during the project. An agile team is developing features incrementally in sprints, releasing a small portion of all product features after each sprint [15]. A dedicated customer is needed to continuously identify, define, and prioritize the features to be

implemented during the next sprint(s). The customer must also continuously work together with an agile team to accept the implemented features and participate in the planning work with the team [16], [17]. In larger organizations there are usually many teams working on a single project, and thus each team must be able to communicate and coordinate with other teams. This might be challenging in an agile setup, especially if other teams are not using agile practices [16]. Teams are also often located separately in several offices and this can create communication and coordination problems as agile practices assume efficient real-time communication [5], [11], [16].

There are several challenging issues related to development processes which are typically well-defined and mandatory in large organizations and might conflict with agile practices. Agile practices encourage self-driven, self-disciplined teams to plan testing, test-cases, and quality control, but in larger organizations test case verification and quality reviews are often centralized and centrally-controlled [5], [11], [15], [16], [17]. Agile practices also usually suggest that a developer, or a pair of developers, can integrate new software frequently into the Software architecture baseline as they wish, but especially in larger systems this is controlled and monitored because there is centralized architectural control over system development [16], [17]. Agile practices assume iterative development, small releases and continuous integration. Thus, agile practices can be seen to favor new system development from scratch. Bowers et al. [17] identified some complications when agile practices were used to update and maintain a legacy system. While the agile development focused on developing and delivering small releases, there were lots of legacy interfaces and internal dependencies in the legacy system which caused many unexpected errors in the system testing [15], [17].

Agile practices very often contradict traditional quality systems in large organizations. This can be a challenge, especially if teams using both traditional and agile approaches are working on the same software system [15]. For example, formal reviews of project documentation, source code and test cases are usually part of the traditional software quality system but they are not part of the agile approach. Differences in the process can also lead to a situation of double work done, once in an agile team and then again as required in a traditional process [16], [17]. There are also other process-related implications. Agile practices promote self-disciplined decision making, feature development and integration on a team level. This should also apply to managing changes. However, in large organizations there often are change control boards for system or architectural changes [16], [17]. This might reduce the flexibility provided by agile methods and decrease the customer's perceived value of the implementation of an agile approach.

2.3 Challenges for public organizations

Studies conducted on agile methods adoption in public organizations are rare. A small number of studies, however, do touch upon the topic. Asnawi et al. [12] found that for some companies it was difficult to use agile methods when working for the government, as agile methods were not used there and governmental organizations were unfamiliar with agile practices. Kärkkäinen [19] also noted that if there is a plan to use agile methods, this should be visible in the procurement announcement by the public organization. When the project is started, there should also be a consensus between the project parties on which method will be used and how the roles will be defined and allocated [19]. There was also an organizational observation made by Asnawi et al. [12] that the personnel turnover rate was high in governmental offices, and this was a challenge for using agile methods efficiently. As these studies demonstrate, the research on adoption of agile methods in the public sector is still quite general, and more research is clearly needed.

Software is widely spread in society; the companies developing software form a big portion of project business industry [20], [21], [22]. However, a lot of challenges still seem to exist in executing software projects successfully [21], [22]. The public sector has also struggled with managing software projects; there are several reported cases of major failures in public software procurement [22], [23], [24]. The difficulties in the public sector form a fairly topical issue as governments seek to increase efficiency by digitizing their operations and providing online services based on software [23], [25], [26]. Public organizations have some characteristics which make their software procurement more challenging compared to the private companies. There is a legal environment regulating the procurement activities and related processes [27]. The government IT systems are usually very large and complex by nature [23]. The innovation speed and the pace of development are also generally slower than in the private sector [23], [26]. In addition, the lack of appropriate management has been claimed to be a salient factor that causes difficulties in public software projects [23].

Finally, it is reported that the development processes are not optimal in the public sector and thus it is difficult to estimate the received value of the projects and to get the maximum output from them [23]. There have been different approaches in research to suggest improvements for these challenges. For example, Hardy and Williams [25] have examined e-procurement software systems and Atkinson [28] analyzed how different contract models enhance software procurement. In this paper, the focus is on the adoption of agile methods in a public organization.

3. Research approach

As the knowledge related to challenges with the adoption of agile methods in public organizations is still very limited, an inductive, single-case-study approach was selected [29]. We considered the case study approach to be most suitable for the purpose of this study, as we wanted to gain a rich and in-depth understanding of the challenges in adopting agile practices in the public sector. The case study organization is a government transport safety agency which operates as an appointed commission under the ministry of transportation and communications in the Finnish government. The government agency, herein referred to simply as Agency (pseudonym), is responsible for the oversight and administration of specific area of public and private services to citizens, companies, non-profit organizations and other government offices. Agency issues permits, regulations and approvals in the transport sector. It handles transport sector taxation and registration. Agency also oversees compliance with rules and regulations governing the transport system. It has over 500 employees and manages an annual budget over 100 million euros. Agency is a large organization, but Agency's IT department has traditionally been relatively small. However, there is currently a need to deploy more resources for software projects to add to the number of online services Agency offers. To access capable resources, Agency's management has decided to increase software subcontracting, and they have also made a decision to start to use agile methods in the subcontracted projects. Agency is one of the first government offices widely utilizing agile methods, and is therefore a very interesting and suitable subject for research on agile project management in the public domain.

Semi-structured interviews were used to gain insights into informants' experiences of the adoption of agile methods in Agency, agile practices used in Agency's projects, and project management practices in agile development. The key people working on the selected project were interviewed, and several other people in Agency were also interviewed to gather background information on the decisions to adopt agile practices in Agency. In addition, a few participants in the first agile pilot project in Agency were interviewed to learn about the progress of the adoption of the agile approach in Agency. During the interviews, informants were asked to provide their background information and an overview of their experience with agile methods, and then to describe the project stages from procurement to delivery. After this, the interview focused more on the advantages of and challenges with using agile methods in the project. The interviews were done with two researchers, except for 4 instances when this was impossible due to conflicting schedules. The duration of the interviews was 50-120 minutes, and they were conducted face-to-face at the interviewees' offices between April and July 2015. The interviews were recorded (audio) and transcribed for content analysis [30]. The transcribed data was semantically complex, thus we decided to rely on human coders [30], [31]. Computer-assisted qualitative data analysis software, NVivo, was used to support the coding of the research data and facilitate data analysis. Open coding was used to identify the challenge areas, then the initial list of challenges was reviewed by several researchers; finally the challenges were grouped into the categories and subcategories presented in this paper [30]. This methodology enabled us to access rich data both from interviews and background material to analyze this case. The interviews with the representatives of the SW subcontractor also provided additional insights into the project and the adoption of agile methods. Information about the informants is presented in Table 1.

In addition to data from interviews, in this study we also used publicly available information, documentation and presentations on Agency. We also acquired internal documentation, presentations and memos from Agency to gain a deeper understanding of the adoption of agile methods inside the organization.

Table 1. List of informants.

Informant occupation	Organization	Experience (years)	Interview duration	No. of interviewers
Business Product Owner 1	Agency	> 15 years	88 minutes	1 researcher
Business Product Owner 2	Agency	> 10 years	70 minutes	2 researchers
Development Manager	Agency	> 5 years	82 minutes	2 researchers
ICT Development Manager *	Agency	> 15 years	87 minutes	2 researchers
ICT Product Owner *	Agency	> 5 years	55 minutes	2 researchers
ICT Project Manager	Agency	> 10 years	50 minutes	1 researcher
Purchasing Manager	Agency	> 25 years	120 minutes	2 researchers
Scrum Master 1	SW Subcontractor	> 15 years	86 minutes	1 researcher
Scrum Master 2	SW Subcontractor	> 10 years	54 minutes	2 researchers
SW Developer	SW Subcontractor	> 10 years	57 minutes	1 researcher

* interviewed during a single session

The project we investigated in this study is a software development project which produced a software solution for organizing and managing driving license examinations nationwide. The solution is running on a server, accessing several existing databases (e.g. exam content database and id database for candidates) and enabling remote connection by users (examination offices by computer and driving test examination officers by tablets). The software solution includes several interconnected components as it has interfaces to systems managed by other organizations and interfaces to databases (other government offices and e.g. insurance companies). Multiple user groups access the service with several types of devices. The solution is not a large software product, but it is a complex system in a dynamic environment. Agency implements Scrum as its agile method. Scrum masters and software developers are provided by the subcontractor; other project-related roles are internal ones. Agency uses a slightly modified Scrum: in addition to Scrum's default roles they have an administrative project manager and an ICT product owner for technical issues and requirements.

4. Findings

The informants from Agency were generally satisfied with the results of agile adoption in the organization and they thought that the transition to using agile methods instead of traditional software (SW) development methods was successful. In addition, they had observed remarkable improvements in the efficiency of the software development process compared to the traditional methods. Similarly, the informants from the SW subcontractor were satisfied with the project and cooperation with Agency. The positive impact of the adoption of agile methods was also recognized by Agency management. Based on information obtained from management presentations, development productivity was increased, transparency of development activities was enhanced, and relative portion of administrative work was decreased (even up to 25%). The increase of efficiency enables Agency to develop more digitized services with the

limited budget they have. This is one of the main reasons why Agency management considered agile adoption to be successful.

However, there were also significant challenges with the adoption of agile methods. Based on analysis of our data, we identified seven categories of challenges:

- Documentation;

- Education, experience and commitment;

- Stakeholder communication and involvement;

- Roles in agile set-up;

- Location of the agile teams;

- Legislation;

- Complexity of SW architecture and system integration.

Detailed descriptions of the challenges identified in the agile adoption are presented in Table 2. Illustrative quotes are also included to demonstrate the root causes of the challenges and to highlight the perceptions of the informants.

Table 2. Identified challenges in the agile adoption of Agency.

The source of the challenge	Challenge description
Documentation	One of the agile principles is "working software over comprehensive documentation" which is sometimes wrongly understood as "no documentation at all". Furthermore, agile methods were first meant to be used and implemented in rather small and independent software projects. There are different types of requirements for documentation in a small environment compared to a large system in a complex environment. In a large public organization there is a need to share information in a much wider sense than in a small private organization. There are several external user groups for the service developed by Agency and they need documentation. Also, as the development team was remotely located, the requirement for documentation was more important, as in the case of continuous direct communication between the product owner and the team. Finding the right balance of documentation has been challenging for Agency.
Illustrative quotes: *Some of the feature requirements are not documented. The agile method promotes less documentation but there should be documentation on what was done and why we made the choices we made. As organization evolves and people leave, without documentation the knowledge is lost. – Business Product Owner 1, Agency* *If the vendor gets changed then where is the information of the project as the documentation is light-weighted? There lies a risk upon this... – ICT Project Manager, Agency*	

The source of the challenge	Challenge description
There is light documentation on this project maybe too light, I think we should have more documentation. – Scrum Master 1, SW Subcontractor	
Education, experience and commitment - *Organizational readiness and commitment*	Introduction of agile methods and their adoption was initiated by the ICT department, and other teams were only involved later. In other organizations, some people felt that the agile methods were brought in by the ICT department/management and thus that the planning and readiness was inadequate in the beginning. There were some challenges also in change management in the transfer from the waterfall approach to the agile one.
Illustrative quotes: *We use internal people to test the product features. While starting to use agile we didn't have as much documentation as we used to have. It caused some problems, people who started testing were confused that where are the use cases we earlier tested against. I told them we don't have them, that in agile model we have user stories instead. It was a conflicting situation. – Business Product Owner 1, Agency* *It came quite suddenly to me, the change was led by the management… by the ICT team. They wanted that we start to use agile. – Development Manager, Agency*	
Education, experience and commitment - *Personnel education and commitment*	Introduction of agile methods was started by initiating product owner trainings and trainings on agile methods. After a successful pilot project, the roll-out to all projects was started and overall agile adoption was started. Some people thought that the agile methods were introduced quickly and thus the education and training was inadequate in the beginning. This issue also relates to the ongoing service digitization activities in Agency. The activities expose more people to software development and agile methods - people who are originally coming from other business disciplines. Therefore, many people need to learn new skills in addition to their earlier area of responsibilities.
Illustrative quotes: *I participated in one product owner training but I was not very well trained when we started to use agile. I knew the terminology. But there were many new tools involved, backlogs and other new issues, I wasn't ready for it in the beginning. – Business Product Owner 1, Agency* *We had a training earlier but when we started with agile I had forgotten it already. Also in the beginning the scrum master at the time couldn't help us with agile methods so it was quite difficult. We couldn't manage the method in the beginning so we needed help from the agile team, what to do and when. Especially when we didn't manage all the tools yet. – Business Product Owner 2, Agency*	

The source of the challenge	Challenge description
Education, experience and commitment - *Agile knowledge, awareness of the method and experience*	While the waterfall method is strongly specification- and documentation-based, agile methods rely on fluent and continuous communication, trust, and good cooperation. The waterfall method relies on a well-defined process, but agile methods build on the idea that skillful, innovative individuals and teams solve problems together by utilizing the strengths of team members and communicating efficiently. There is a major philosophical change in the transfer from the waterfall approach to the agile one, which can even require change in the organizational culture. Agency struggled with this change. One example is that previously there were several professionals who joined together to make feature specifications so it was basically a one-time effort. Now with agile practices, the specification work requires continuous involvement and this caused challenges in Agency.

Illustrative quotes:

Good communication is the base for everything in agile. And trust. Also openness is a key thing... Sometimes we can't be sure if they really do their part in the project. We are not sure if the testing is done by the customer as it should be done. – Scrum Master 1, SW Subcontractor

We needed to discuss through the customer with other teams. It was a rigid approach. It would've been easier to discuss directly via virtual tools. Sometimes we traveled to the same location to discuss. – Software Developer, SW Subcontractor

The responsibilities were not clear in the beginning. However, it helped when we made the RACI matrix. – Business Product Owner 1, Agency (RACI=Responsible, Accountable, Consulted, Informed)

The communication is really important. Some people do it naturally better than the others, the communication is important. – Development Manager, Agency

Agile methods require good communications, there are still some challenges between the teams. – Business Product Owner 2, Agency

Agility requires change in attitudes individually, it requires responsibility and change individually. – ICT Development Manager, Agency

Stakeholder communication and involvement - *Agile planning vs. stakeholder*	Agency develops large IT systems which are also used by several stakeholders, usually large companies. These stakeholders use the services automatically via their own IT systems. When service interfaces are renewed or added, the stakeholders also need to plan and implement changes to their software systems.

The source of the challenge	Challenge description
communication	There is interdependence between the software systems that must be anticipated early enough to allow all of the related organizations to make the changes needed. However, based on the agile planning principles, the interfaces may not been defined early enough to be able to communicate the interfaces to the stakeholders as early as necessary. Thus, this is a challenging issue and needs to be considered in agile projects.
Illustrative quotes: *We have strong interfaces to our partners and thus we can't implement all agile development methods because they need to know interface specifications beforehand. – Development Manager, Agency*	
Stakeholder communication and involvement - *Flexible changes allowed by agile methods vs. stakeholder communication*	As agile planning is done iteratively sprint by sprint; it is possible that some preliminarily-agreed-upon design choices would need to be changed, and the order of implementation would be changed or some features dropped. If any of these changes require stakeholders to change their implementation, it is a challenge as stakeholders will be informed late.
Illustrative quotes: *Sometimes when we made changes to implementation or prioritization of features it caused challenges in stakeholder interfaces as when we told them that they needed to change their implementation, then they needed to ask those changes from their subcontractors. They use waterfall development methods and it was tricky to synchronize. – Development Manager, Agency*	
Stakeholder communication and involvement - *Agile processes vs. stakeholder involvement*	As agile planning and specification work is done incrementally during the project, it is challenging to involve stakeholders in the planning. Also, because of the (incremental) feature release cycle, it is a complex task to involve customers and end users in pilot testing. Especially as Agency has multiple end user groups that are geographically widely spread.
Illustrative quotes: *We definitely would've liked to run some pilot testing for the system. There are many user groups for the system and it would've been a necessity to have different user groups testing it. – Scrum Master 1, SW Subcontractor*	
Roles in an agile set-up - *Role of the product owner*	There is a big change in the role of the product owner as defined in agile methods compared to traditional methods of software development. It is essential for the successful implementation of agile methods that the product owner is available to the agile team and is able to provide the team with clearly-defined user stories/requirements in a timely manner, contribute to the prioritization of user

The source of the challenge	Challenge description
	stories in the backlog, and support the team when they are deciding the activities for the next sprint. This type of working pattern is new to the product owners if they are used to traditional development methods and can cause challenges in agile adoption. The product owner role was totally new to many people; they had lot of other tasks to perform simultaneously and they were not used to close cooperation with the development team. Forming such a close working relationship with a vendor was also a new way of working for a public organization.

Illustrative quotes:

When I think retrospectively, I should have been more actively working on the backlog and following the status of implementation. – Business Product Owner 1, Agency

Especially in the beginning, we didn't follow the agile methods well enough. At some point we realized that we didn't participate in the scrum activities as we should have been and the team was working without guidance. – Business Product Owner 2, Agency

It requires a lot from a product owner to participate in the project in a way that scrum agile mode demands. – Scrum Master 1, SW Subcontractor

Roles in an agile set-up - *Multiple interfaces of product owners*	The product owner works together with the Scrum master and the agile team to take care of the responsibilities of requirement specification and prioritization. The product owner, however, collects the input from several business area owners, technical experts, legal advisors etc., so there is dependence between the contribution of the product owner to the agile team and the availability of internal stakeholders and the information they provide.

Illustrative quotes:

Product owners are really strained and they do not have enough time to concentrate to work with the scrum team. You only meet them in the official meetings, there is no informal discussion as much as they should be in agile approach. – Scrum Master 2, SW Subcontractor

Sometimes product owner couldn't exactly define the specification of what was needed so we implemented features based on our understanding and after the sprint demonstrated the implementation to customer to see if any changes were needed. – SW Developer, SW Subcontractor

Roles in an agile set-up - *Business product owner vs. ICT product owner*	Agency utilizes two product owners in agile projects: the business product owner is responsible for business requirements, and the ICT product owner is responsible for system requirements and technical questions. This approach can create confusion in the agile team on product ownership and responsibilities.

The source of the challenge	Challenge description
Illustrative quotes: *It wasn't always clear to the agile team who to contact when they had questions. I have been working for the project as a stable resource but they also knew that ICT product owner takes care of technical issues. But maybe the roles have not been clear enough in every situation. – Business Product Owner 2, Agency*	
Roles in an agile set-up - *Project manager vs. business product owner*	Traditionally, a project manager owns the project budget, but in agile projects there is a product owner who manages the budget and uses it for the features prioritized for each sprint. Agency utilizes the model of an administrative project manager and a business product owner in agile projects which does not exactly follow the agile principles and might create conflicting situations between the roles.
Illustrative quotes: *In the first agile project I was involved with, there were some role issues… The project manager wanted to have the ownership of the project and sometimes it was conflicting with the agile ideas. For example, sometimes the project manager didn't remember to invite the business product owner to all necessary meetings which was a problem. – Business Product Owner 2, Agency*	
Roles in an agile set-up - *Scrum master vs. Business product owner*	The Scrum master and the product owner are the key roles in agile methods and determine if the project is managed successfully. The product owner is responsible for defining what is to be implemented, and the Scrum master is responsible for the implementation. In the beginning, Agency had some challenges with the cooperation between these central roles.
Illustrative quotes: *At first, the scrum master didn't manage or didn't implement the agile methods in the most optimal way. We didn't have enough experience of the agile methods and the scrum master didn't implement them and the situation hindered the project progress. – Business Product Owner 2, Agency*	
Location of the agile teams	Agency also has experience on a project in which an agile team and a Scrum master were working remotely from a separate location. Although virtual communication tools were available, it was difficult to organize the agile development remotely, and the cooperation was not on the same level as the co-located teams.
Illustrative quotes: *We ended up in a virtual project world. We could operate like that, there were no major problems, but it is not as good as having all in the same location. – Scrum Master 1, SW Subcontractor*	

The source of the challenge	Challenge description
Let's say that some issues would have been easier to organize if the team was located here. Communication can be organized via tools, chats etc. but it is not the same as sitting in a same room with the team when there are things to discuss. – ICT Product Owner, Agency	
Legislation - *Public procurement act*	Finland's public procurement act regulates what kind of data on companies (in preparatory bidding and competitive dialogue) can be used, and how it can be used to evaluate the companies. For example, it is not possible to use the formal or informal positive track record of a company as a reference in competitive procurement. Past experience of cooperation or personal opinions cannot be used either - only the documents and discussions presented during the bidding can be used for evaluation of companies. There is one exception: if a company participating in the bidding has worked as a vendor for a public office, a record of reclamations and notices of defects can be used as a negative reference. However, this type of record is available only for two years prior; older incidents cannot be used. The objective of the public procurement act is to guarantee a fair and neutral position for all companies participating in the bidding. Any possible long-term relationship between Agency and its vendors cannot put any vendor in a favorable position in the procurement process. However, as successful implementation of agile methods builds trust and good dialogue between organizations, this type of legislation can be a hindrance for the most optimal vendor selection.
Illustrative quotes: *Some of the big companies are professionals of making bidding documentation; they have lots of experience on it. They have experts on writing bidding documents and they know how to answer all the questions by the customer. Sometimes when you read those documents and you compare the data to your own experience on how those companies work in practice you can see come conflicts between the documents and the real project work by them. But it is impossible to use your experience or history knowledge on the evaluation; you can only use the documents. But that's how it goes, you only have to live with it. – ICT Development Manager, Agency*	
Legislation - *Information sharing*	There are also some peculiar consequences for project implementation because of the public procurement act. In the worst case, it prevents information sharing to all stakeholders as would be necessary. This is a challenge as agile methods are based on open communication and information sharing.
Illustrative quotes: *There was a plan to collect more information from stakeholders but as one of them was going to participate in the next competitive procurement, we couldn't share this issue with them. – Business Product Owner 1, Agency*	

The source of the challenge	Challenge description
We couldn't share all the information with the stakeholder as they could've got competitive advantage to the next competitive procurement. – Scrum Master 1, SW Subcontractor	
Legislation - *Timing of new legislation*	Agency also develops new or updated digital services which are based on new or changed legislation. There is a predetermined date when laws come into effect, and any corresponding digital services need to be available immediately. This sets a target date for a software project, as it usually was set for a project utilizing the waterfall development method. However, agile methods usually use continuous integration, and this difference in approaches can affect agile project dynamics.
Illustrative quotes: *After a sprint, we release features to the development environment. They will wait there until the date when the law comes to effect. In that sense, our approach is somewhere between the agile and the waterfall. – Development Manager, Agency* *You need to consider when the law comes to effect, in a sense it limits the options for a product owner, it sets a schedule for the project. – ICT Development Manager, Agency*	
Complexity of SW architecture and system integration - *Complexity of SW architecture*	Agency develops digital services that a) have several user groups in the market, b) integrate with several backend systems and databases, and c) are developed by several teams. Technically, this means that the software architecture of those services is complex and has many interfaces and integrations. As agile methods were originally meant for rather small and isolated systems, the complexity of developed systems causes challenges in agile adoption.
Illustrative quotes: *It has been quite challenging, while implementing features with agile, we always need to think what are the other systems affected and what is the impact. – Development Manager, Agency* *Backend systems are developed by other teams. It is challenging to take into account all the backend systems and databases. – Business Product Owner 2, Agency* *There are backend systems we only use through interfaces while we develop our service. It is a bit challenging for example when planning performance and performance testing. – Scrum Master 1, SW Subcontractor*	
Complexity of SW architecture and system integration - *Complexity of system integration*	Agency develops digital services and complex systems by subcontracting software projects. These services also use other backend systems and databases which were developed earlier. The integration of separate systems is done through technical interfaces. Agency does not maintain the existing systems and databases but uses

The source of the challenge	Challenge description
	subcontracted resources for maintenance, repairs, and upgrades. Agency is coordinating these development and maintenance activities. With complex systems there can be several companies involved with bilateral contracts with Agency and with bilateral service level agreements regarding the implementation of changes and upgrades needed for the systems and interfaces. This kind of complex environment is challenging for agile methods, which promote continuous and instant release and integration.

Illustrative quotes:

We have had big problems with our system integration environments. It kind of made it impossible to follow the scrum cycle. – Business Product Owner 1, Agency

Agile adoption reflects the organizational capabilities in my opinion. After we got teams working ok, we faced problems with technical infrastructure and system integration. – ICT Product Owner, Agency

We have had problems with the system integration. For example we couldn't provide the agile team with a possibility to continuous release and integration as the assumption is with agile methods. – ICT Project Manager, Agency

The system integration and interface management has been difficult. For example, a while ago our integration interface to a backend system just stopped working. After a while we realized that it was changed but we were not informed at all. – Scrum Master 1, SW Subcontractor

5. Discussion

The adoption of agile methods was considered to be successful by the management of Agency. This assessment was based on the measurable metrics inside the organization. Despite this, we identified several major challenges in the agile methods adoption. Some of the challenges are, as expected, similar to the ones recognized in prior literature. However, some of the challenges we identified are particularly unique to public organizations.

Finding the optimal balance between formal documentation and informal communication was difficult for Agency. This challenge is related to the conflicting objectives of the waterfall and agile methods. The emphasis of the waterfall approach is to specify a project in detail while one of the founding values of agile methods is to focus on working software over comprehensive documentation [32]. This principle of agile practices is sometimes wrongly interpreted as a goal of minimizing documentation. This finding was also supported by earlier research in the private sector [12], [14]. The documentation challenge was even more serious in Agency, as in public organizations heavy and detailed documentation has traditionally been one of the most salient requirements and expected ways of working.

Personnel education is identified as one of the key tasks for ensuring the successful adoption of agile methods [10]. There was formal training organized by Agency, but it was not enough to make personnel feel that they fully grasped the method and required practices and had the necessary competencies. According to our analysis, this was one of the reasons there was a lack of commitment, especially in the beginning of the project. Conboy et al. [14] argue that formal

training is not enough; people should understand and learn agile values and principles in addition to practices to be motivated and committed. Murphy and Cormican [33] similarly argue that the psychological motivators play a significant role, together with abilities to cope with and manage change, in adopting new technologies and methods. These issues relate to role definition in agile methods, which is different compared to the waterfall method and traditional project management styles [15]. In the case of Agency it was clearly a challenge for some individuals, e.g. product owners, to embrace the roles and responsibilities of agile methods, and this hindered the efficient adoption of agile practices. In addition, Agency implemented a modified version of Scrum, which included an administrative project manager. The existence of multiple and overlapping roles possibly increased the confusion between the old project management model and the agile one. Clear roles are identified to be essential for successful agile implementation [15]. Similarly, the social skills of individuals and well-established social relationships in the project facilitate the problem solving that is so important for an agile approach [14], [34], [35]. Lack of direct communication in the case project was also seen as a barrier for the efficient usage of agile methods. These human-related factors reflect the fact that individuals and organizations need to change their ways of working when they start to adopt agile practices. Moe et al. [36] argue that this change requires a reorientation by project personnel and management, and they add that this change takes time and resources. Our findings support their claim, as the people-related issues comprised the largest single category of challenges in this case study. In Agency, as in many public organizations, there was an established formal mode of operation, which created a challenging environment for adopting agile methods. Consequently, a public organization might even need to revisit its underlying organizational values and culture to be able to adopt agile methods successfully.

Legislation caused challenges in agile adoption in two separate ways for Agency. The first one is specific to the case study organization, although it may represent a problem facing many governmental organizations. Public agencies must develop IT systems for implementing digital services for a public audience. Some of these public services are related to legislation, such as tax legislation, and they need to reflect any changes to the existing legislation. Therefore, the date when a change in a law comes to effect sets a deadline for the project, which conflicts with agile methods. The other challenge in terms of legislation relates to the public procurement act. To guarantee that all companies participating in bidding will be on an equal and impartial basis at all stages, the public procurement act dictates a code of conduct for public agencies regarding bidding. In some specific issues this can restrict the possibility of a public agency acquiring and using all information available, and it can also restrict the possibility for early discussions with companies in the market. Currently, there are some calls, specifically on the European Union level, to revisit regulations regarding agile procurement to address this current situation.

Technical issues can also hinder the adoption of agile methods. Agency faced severe challenges in integrating the software architecture of several related systems with the newly-developed one, and they had difficulties following agile practices to enable continuous integration of sprint releases. These issues lend support to the findings of earlier studies [15], [16], [17]. In our case study and also in earlier research, these problems largely relate to the external environment of the project. In many cases, stakeholders and organizations managing other internal systems are not informed, prepared or committed to support the agile development and related demands. This also relates generally to stakeholder involvement, which may be challenging with an agile approach, especially if the stakeholders are used to following traditional software development processes [15]. Consequently, it requires extra efforts in planning, communication and alignment to synchronize organizations utilizing a traditional development cycle with those using an agile approach.

A public agency generally faces similar challenges in agile methods adoption as private organizations do; however, there is additional complexity related to those challenges because of the characteristics of governmental organizations. A unique finding of this study is that governmental regulation of procurement procedures can introduce more challenges in the adoption of agile methods compared to the private sector. Also, technology dependence on external systems as a hindrance of agile method adoption is rarely discussed, although it must be addressed in large system development.

6. Conclusions

In this paper we presented our findings on the challenges in the adoption of agile methods in a governmental organization. The identified challenges were related to a) documentation, b) personnel education, experience and commitment, c) stakeholder communication and involvement, d) roles in an agile set-up, e) location of the agile teams, f) legislation, and g) complexity of SW architecture and system integration. This research has a few limitations that may present opportunities for further research. As our research was conducted as an exploratory, single case study, further empirical research is needed. It will be important to verify and extend our findings, especially when public software procurement is continuously increasing. We think that it would also be important to have more research specifically on the relationship between the aforementioned challenges and agile project management, as our focus was on the challenges, not on the practices of project management required for agile methods. We would also suggest more research on the management of projects utilizing agile methods. Especially interesting is the evolution from traditional project management into the concept of agile project management. In addition, more empirical research is required on the project role definitions in an agile setup, and the agile forms of organizing in the public sector.

Acknowledgments

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