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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.

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- chief information officer role
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- information systems management tools
- management of complex projects
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- project environment
- project management life-cycle
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- project execution
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- project manager skills
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- project evaluation
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Correspondence and questions

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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 second number of the eleventh volume of IJISPM. In this issue, readers will find important contributions on digitalization, military information technology projects, software development methods adoption, and agile portfolio management.

The first article, "Digitalization of revenue mobilization in an emerging economy: the new Institutional Theory perspective", is authored by Nora Agyei-Ababio, Eric Ansong and Kwame Assa-Agyei. This article explores how the institutional environment comprising regulative, normative, and cognitive factors influences the use of technology in revenue mobilization in the public sector of an emerging economy. The study used the new institutional theory as a theoretical lens and a qualitative case study as a methodological stance. The study established that regulative, normative and cognitive factors influence the digitalization of revenue mobilization. With regards to the regulative pillar, it was revealed that legislation for a revenue authority with a focus on digitalization, legislation for taxpayer identification and legislation for electronic transactions, were laws that governed the use of the system and played essential roles in ensuring that the system was used effectively to realize its benefits fully. The cognitive pillar, on the other hand, revealed some challenges faced with implementing and using the digital system. The study contributes to the literature on the digitalization of revenue mobilization.

The title of the second article is "The characteristics of successful military IT projects: a cross-country empirical study", which is authored by Helene Berg and Jonathan D. Ritschel. In the armed forces, successful digitalization is crucial to ensure effective operations. Much of the existing literature on project factors during the planning and execution phases of public Information Technology (IT) projects does not focus specifically on military sector projects. The paper aims to provide empirical insights into the characteristics of successful military IT projects. Data from such projects in NATO countries and agencies were collected through interviews and project documents. The findings relating to the main variable of interest, "delivery of client benefit," supported previous findings on IT project performance. Medium-sized projects performed better than small and large projects, and the agile development method delivered more client benefits than traditional methods. Client involvement apparently had a positive effect on project success. Clearly specified objectives had a statistically significant effect on project success in terms of clients' benefits. The paper contributes to the gap in research on military IT projects and broadens the project management literature's focus on time and cost to include delivery of client benefit as a success variable.

The third article, authored by Tanja Elina Havstorm and Fredrik Karlsson, is entitled "Software developers reasoning behind adoption and use of software development methods – a systematic literature review". When adopting and using a Software Development Method (SDM), it is important to stay true to the philosophy of the method; otherwise, software developers might execute activities that do not lead to the intended outcomes. Currently, no overview of SDM research addresses software developers' reasoning behind adopting and using SDMs. Accordingly, this article aims to survey existing SDM research to scrutinize the current knowledge base on software developers' type of reasoning behind SDM adoption and use. The authors executed a systematic literature review and analyzed existing research using two steps. First, they classified papers based on what type of reasoning was addressed regarding SDM adoption and use: rational, irrational, and non-rational. Second, they made a thematic synthesis across these three types of reasoning to provide a more detailed characterization of the existing research. They elicited 28 studies addressing software developers' reasoning and identified five research themes and framed four future research directions.

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"An agile portfolio management model for the insurance sector: the APMI model" is the fourth article and is authored by Vasco Franqueira Dias and Alexandra Tenera. As the authors mention, many insurance companies are seeking to increasingly adopt Agile practices to become more effective, faster, and leaner in their critical processes. On the other hand, several companies are strengthening their planning methodologies by implementing Portfolio Management models. These models enable them to manage their initiatives in a more integrated and efficient manner that is strategically aligned, minimizes complexity, and provides higher flexibility when responding to uncertainty. Given the limited scientific knowledge in combining Agile and Portfolio Management (PfM), particularly in the insurance industry, a new Agile Portfolio Management (APfM) model, the APMI – Agile Portfolio Management for insurers, was designed and tested, showing how Agile and Portfolio Management international practices can be conciliated with current insurance industry-specific practices. Results indicate that the proposed model can foster a greater strategic alignment, increase the organization's strategic focus, promote transversal alignment and visibility, and support the organization's capacity coordination.

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,

João Varajão

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João Varajão is currently a professor of information systems and project management at the *University of Minho*. He is also a researcher at the *ALGORITMI Research Center* 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 related to Information Systems and Information Systems Project Management success. 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 100 Masters and Doctoral dissertations in the Information Systems field. He has published over 300 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 on numerous committees of international conferences and workshops. He is the co-founder of CENTERIS – Conference on ENTERprise Information Systems and ProjMAN – International Conference on Project MANagement.

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Digitalization of revenue mobilization in an emerging economy: the new Institutional Theory perspective

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Digitalization of revenue mobilization in an emerging economy: the new Institutional Theory perspective

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Abstract:
This study sought to explore how the institutional environment comprising regulative, normative, and cognitive factors influences the use of technology in revenue mobilization in the public sector of an emerging economy. The study used the new institutional theory as a theoretical lens and a qualitative case study as a methodological stance. Data was collected from the agency in charge of revenue mobilization in the developing economy through interviews. The study established that regulative, normative and cognitive factors influence the digitalization of revenue mobilization. With regards to the regulative pillar, it was revealed that legislation for a revenue authority with a focus on digitalization, legislation for taxpayer identification and legislation for electronic transactions were laws that governed the use of the system and played essential roles in ensuring that the system was used effectively to fully realize its benefits. The cognitive pillar, on the other hand, revealed some challenges faced with the implementation and use of the digital system. The study contributes to the literature on the digitalization of revenue mobilization, which has arguably seen very few studies conducted in Africa, especially in Ghana, hence calling for more future studies on the use of e-revenue systems in developing economies.

Keywords:
revenue mobilization; institutional theory; developing economy; digitalization; public sector.

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1. Introduction

Developments in Information and Communication Technology are radically changing the way businesses are done as compared to previous times. Knowledge and the use of technology have been deemed important for socioeconomic growth [1]. Digitalization of business processes has emerged as a great phenomenon which has had a transforming effect on society [2]. The growth of digitalization was initially due to private sector interests, but governments have recently developed great interests and are quickly adopting the use of technological advancements in their operations. Governments have been able to develop more sophisticated ways to digitalize their business processes with the help of the revolutionary changes that Information and Communication Technologies (ICTs) have brought to the global society [3]. An "umbrella term that comprises all uses of information and telecommunication technologies in the public sector is broadly referred to as digital government" [4]. The digital economy is one aspect of digitalization that focuses on an economy based on digital computing technologies.

The rapid shift towards the digital economy has an incremental effect on society and forcing many businesses, organizations and governments at large to go digital. Encouragingly, the use of information technology to enable and improve the efficiency with which government services are provided to citizens has seen so many valuable academic studies over the years [1], [5].

Many attempts to study e-revenue have been geared towards its emergence, adoption, and creation of new markets in the digital environment and its development [6], [7]. Turban et al. [8] and Lee [9] also conducted studies on transforming organizations into the digital economy and its cultural acceptance by citizens. On the other hand, further studies examine the relationship that exists between the digital economy and revenue mobilization [1], while others attempt to capture and understand trust issues concerning the adoption of e-revenue [10]. From these studies, it is seen that the emergence of the digital economy, its adoption, development and in-depth understanding of trust issues concerning its application has received thorough research in diverse ways. However, very few studies have arguably been conducted on the use of digitalization, especially with the use of e-revenue systems. As much as the adoption of digitalization is important, its application and use are equally essential. Hence the need arises for further research on the use of digital systems in revenue mobilization.

There seems to be dominance in the study of digitalization from the adoption perspective, and this has, one way or another, created the avenue for the exhaustion of technology adoption frameworks such as the Technology Acceptance Model (TAM) and the Diffusion of Innovation theory, among others. Carter and Belanger [5] studied citizens' adoption of digitalization and its benefits to the US economy and adopted Technology Acceptance Model for the study. The findings of the study revealed that the adoption and use of digitized processes brought about rapid growth in the US economy. The analysis of these studies on the adoption of digitalization in developed countries led to further studies on the continuous existence and development of the digital economy by Yousaf et al. [11], who adopted the Diffusion of Innovation theory to establish ways to enhance the adoption of digitalization. Most of these studies concentrated mainly on the adoption of digitalization, leaving room for further studies on other aspects, such as usage and implementation, among others. Arguably, very few studies have been conducted on the social aspect of digitalization, taking into consideration an appropriate framework that can be used to study the institutional environment affecting the use of digitalized business processes. This calls for the need for the application of the new institutional theory in the study of the institutional environment affecting the use of digitalization in revenue mobilization. The new institutional theory, thus, is regarded essential for explaining how established social structures, which include regulations, norms and cognitive processes, affect social actions and interactions [12]. Its usage in this study helps to explore the institutionalization process of digitalization of revenue mobilization.

In many ways, businesses in developing economies are gradually transforming and operating in a digitally interconnected space [13]. This emphasizes the need for further research on the use of e-revenue systems taking into consideration the institutional environment affecting the use of these systems in revenue mobilization and applying the new institutional theory to bridge the theory gap created. Specifically, this study examines how institutional factors influence the use of information technology in mobilizing revenue within the public revenue agency of an emerging

economy. This study contributes to the limited literature in the area of digital economy from a developing economy perspective. This serves as a stepping stone for subsequent studies. It is envisaged that the study would enable the management of the revenue authority to understand the need for streamlining the automation system and procedures involved in generating increased revenue for the government and enhancing productivity among employees and citizens at large.

2. Literature review

Reviews conducted during research enable the researcher to address unattended issues, fill in research gaps, discover a strong basis for a research topic and also provide justification for the choice of a research approach. A review of the literature enhances the identification of research problems that need to be addressed or studied to provide solutions and as well provides a broad view of existing knowledge.

The review of literature for this study was conducted in five phases, which include the classification of literature, theories applied, the context of research and methodological approach, focus or technology adopted and research issues and challenges discussed. The review consists of some selected articles in the area of ICT and revenue mobilization.

Table 1. Article Distributions on ICT and Revenue Mobilization

Article	Theory	Research Method & Country	Focus or Technology Adopted	Issues & Challenges associated with technology
Zhao et al. [1]	TAM Technology Enactment Theory	Quantitative UK	▪ Adoption of digitalization and e-government development.	▪ Relationship between the digital economy and e-government development.
Nkote and Luwugge [14]	Theory of revenue exaction	Quantitative Uganda	▪ The efficiency of digitalized tax administration.	▪ Increase in cost of tax administration. ▪ Lack of technical know-how.
Carter and Belanger [5]	TAM Diffusion Of Innovation	Quantitative USA	▪ Citizen adoption of digitalization.	▪ Provision of standards for digitalized processes.
Katz et al. [15]	Public-Value of E-Government Model	Quantitative Europe	▪ Measuring the impact of digitalization on socioeconomic growth.	▪ The need for awareness of digitalization.
Liu et al. [16]	Resource-Fit Framework	Qualitative Taiwan	▪ Exploring the development process of digitalization.	▪ Inadequate resources. ▪ Lack of required capabilities.
Preston and Rogers [17]	Techno-social relations	Qualitative Ireland	▪ Challenges associated with digitalization.	▪ Requirement of laws governing digitalization. ▪ Individual characteristics. ▪ Professional values and norms.

Source: Constructed by Author from literature review

The classification of studies conducted on digitalization in Table 1 summarizes the various issues and challenges associated with digitalization as well as technologies that have been adopted for digitalization in mobilizing revenue. Various factors contribute to the successful implementation and use of digitalized processes. Many of the studies revealed that technological issues [16] and the unavailability of infrastructure [3], [18] were barriers to the successful use of digitalized systems. Other studies also emphasized an increase in cost and financial constraints as a hindrance to successful digitalization [14], [19]. Other issues are individually based, such as poor attitudes towards digitalization, lack of required ICT skills and technical know-how, and individual characteristics [18].

However, very few studies captured the organizational context as a challenge in shaping the implementation and use of digitalized systems. Policies, laws, regulations and norms of institutions and countries may also pose barriers to digitalization [17]. To understand the institutional effects of digitalization, the factors discussed above are classified into sub-themes which include regulative factors, normative factors and cognitive factors, as presented in Table 2.

Table 2. Institutional Factors Affecting Digitalization

Sub-Themes	Factors	Studies
Regulative	▪ Standards for digitalized processes.	[1], [5], [17]
	▪ National laws governing digitalization.	
	▪ Firm and industry structures.	
Normative	▪ Professional values and norms.	[1], [15], [17]
	▪ Adoption intention.	
	▪ Demographic and individual characteristics.	
Cognitive	▪ Cultural beliefs and practices.	[1], [14], [16]
	▪ Acceptance of new processes.	
	▪ Knowledge of digitalization.	
	▪ Required skills for digitalization.	

Source: Author's Construction

2.1 The New Institutional theory

The new institutional theory, proposed by Scott [12], was found to be an appropriate theory for this study. This theoretical foundation was adopted because its constructs are deemed suitable for studying the institutional environment of organizations adopting the use of technology and the issues and challenges arising from the use of information technology. These issues are categorized under regulative, normative and cognitive and would be better explained by the constructs of the new institutional theory.

The new institutional theory is regarded essential for explaining how established social structures, which include regulations, norms and cognitive processes, affect social actions and interactions [12]. The concept of institutionalization is structured around the maintenance and diffusion of elements such as regulative, normative and cultural-cognitive processes, thereby referring to an institution as a socio-cultural system that is characterized by either single or multiple traits [20].

The institutional theory acknowledges three key aspects: firstly, variations in institutional contexts arise due to interactions with the environment over time; secondly, organizations in different environments develop distinct institutional structures; and thirdly, these institutional structures tend to endure as they not only provide meaning but also facilitate access to resources from the environment [12], [21], [22].

Prior to the development of the new institutional theory, there existed what was termed the old institutional theory. Barley and Tolbert [23] mentioned that the old institutional theory is structured such that organizational decision-making is based on the rationality of technology and economics. The new institutional theory, however, disregards rationality and posits that social behaviour is controlled by regulations and socio-cultural practices [21], [22].

The new institutional theory, as posited by Scott [12], has three major pillars and their respective constituents. The three pillars include regulative, normative and cognitive, with their elements as presented in Table 3.

Table 3. Constructs of the New Institutional Theory

Theory Element	Regulative	Normative	Cognitive
Basis of Compliance	Expedience	Social Obligation	Taken for granted
Mechanisms	Coercive	Normative	Mimetic
Logic	Instrumentality	Appropriateness	Orthodoxy
Indicators	Rules, laws and sanctions	Certification and accreditation	Prevalence and isomorphism
Basis of legitimacy	Legally sanctioned	Morally governed	Culturally supported and conceptually correct

Source: Scott [12], [22]

2.2 Justification for choice of the new institutional theory

The new institutional theory is adopted for this study because its constructs provide an understanding of the regulative, normative and cognitive factors that affect the digitalization of business processes in organizations. Studies on e-government adoption have explained that international organizations apply several mechanisms through best practices and the provision of information systems assistance to project their ideas in emerging countries [3], [24]. Avgerou [25] mentioned that the new institutional theory is useful for examining technology adoption and its relationship with the institutional environment. The new institutional theory helps to investigate the social factors that affect the adoption and challenges of technological innovations.

Scott [22] further explains that the new institutional theory is relevant when a researcher seeks to explain how interactions and social actions are shaped by the components of social structures, which comprise regulations, norms and the established process of cognition. It was argued that organizations constitute several dependent structures of which technology and resources are not the only aspects of organizational structure [21]. Organizational structure constitutes sound myths, regulations, and knowledge acquired through professionalism, education and community-based opinions [22]. Avgerou [25] also added that technology should not be the only driver in information systems research but should also recognize institutional expectations. Currie [20] emphasized the need for studies on the use of technology and information systems to adopt the new institutional theory for appropriate analysis and also for the understanding of complex social phenomena.

The new institutional theory has been adopted in a number of researches and has aided in empirically examining the existing relationship between the social environment, the organization and innovations that are technologically based. This informed the choice of the new institutional theory as an appropriate framework for this study.

2.3 Conceptual model for institutional factors influencing digitalization of revenue mobilization

Fig. 1 exemplifies the relationships among the institutional factors and how each factor influences the use of technology underpinning revenue mobilization.

The regulative pillar refers to government regulations and industry standards that organizations are expected to comply with, of which failure to comply would attract sanctions [26]. Regulative factors explain the driving force of social actions, which constitutes sanctions and the formulation of rules. Scott [22] stated that regulatory professionals enforce jurisdiction with support from the state. The regulative factors are exerted through force or persuasion. They sanction the legitimacy of organizational structures, processes and outputs [25]. For example, organizations are expected to adopt certain safety measures and practices for both their internal and external environment, and failure to comply with this directive may attract some form of sanctions. Regulations also exist to guide the behaviour of users in technology adoption. Regulative bodies such as governments enforce strict rules to make the implementation and use of information systems better [20]. The logical basis for the regulative pillar is to coerce a uniform response across all organizational fields in order to stimulate organizational isomorphism in terms of environmental compliance [22].

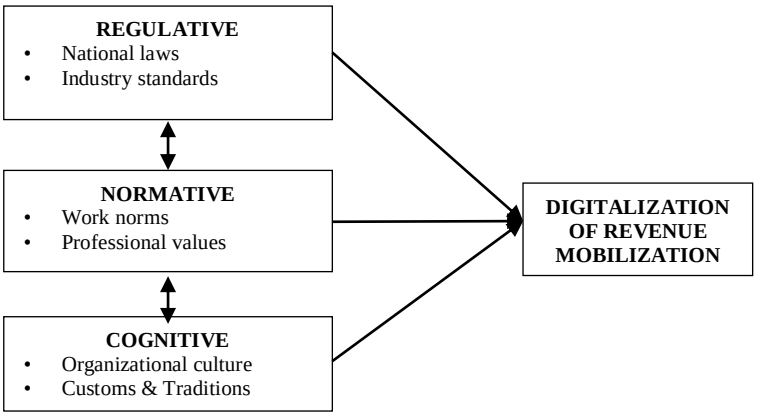

Fig. 1. Conceptual model for Institutional factors influencing use of technology

For this study, the regulatory pillar refers to the national laws and organizational standards governing digitized processes relating to revenue mobilization and its consequences. Based on this, the study posits that:

Proposition 1: Regulative factors influence digitalization in revenue mobilization.

The normative pillar refers to norms and values that determine legal and illegal actions in a particular social context [26]. This pillar includes norms that primarily refer to the effects of professional practice. These norms define what is acceptable or unacceptable to professional practices. Scott [22] mentioned that the normative pillar refers to the guidelines that are used by organizations to establish actions of behavioural patterns.

Normative pressures, which can arise from uncertainties, compel organizations to follow the path taken by successful organizations that are considered role models [1]. Thus, organizations are likely to imitate the practices of other organizations, which are perceived to be more effective and efficient. OReilly and Chatman [27] argued that control systems are based on shared norms and values that influence users' focus of attention and interpretation of events and guide their attitudes and behaviour. In this study, the normative pillar refers to established norms and practices that affect digitalization in revenue mobilization and further posits:

Proposition 2: Normative factors shape the use of technology in revenue mobilization.

The cognitive pillar constitutes taken-for-granted customs and traditions that control the processes involved in organizational decision-making [26]. Its elements explain meaningfully and understood frameworks and conceptions which are shared across an organization [22]. Cognitive factors imply the expertise and knowledge as well as thinking patterns of individuals in a social context. In instances where there are inexperienced individuals with minimal knowledge, organizations tend to learn practices of other organizations perceived to be successful. Mimetic mechanisms refer to the voluntary acquisition of certain characteristics of structure and processes by imitating other organizations seen as successful [25]. Generally, organizations tend to model themselves on other organizations rather than design new structures. In this study, cognitive factors refer to the expertise, technical know-how and thinking patterns of individuals involved in the use of digitized processes in revenue mobilization. Concerning this, the study posits that:

Proposition 3: Cognitive factors influence the use of technology associated with revenue mobilization.

Each of the factors of the institutional theory contains elements that provide an in-depth understanding of the pillar and its contribution to the rationale of the theory. Scott [22], in his study, stated that the three pillars of the new institutional theory are distinctively classified as regulative, normative and cognitive for analytical purposes only. The author explained further that these three pillars could overlap in practical situations.

The operationalization of the components of the new institutional theory in this study is outlined in Table 4. These components serve as exploratory guidelines which enabled the study to obtain and evaluate data on each of the institutional factors affecting the implementation and use of digitalized systems in revenue mobilization.

Table 4. Operationalization of institutional factors affecting digitalization of revenue mobilization

Regulative
National regulations
1. What national laws govern the use of digitalized systems in revenue mobilization?
2. Do these national regulations affect the implementation and use of digitized systems in revenue mobilization?
3. Are there standards existing to support digitalized processes associated with revenue mobilization?
4. Does the institution's policy on the use of technology comply with national laws governing digitalization?
5. Will there be a need for new laws to support the digitalization of revenue mobilization?
Normative
Values and standards of procedures
1. Do the institution's values and norms support digitalization?
2. Are there norms which govern the extent to which digitized processes are integrated into revenue mobilization?
3. What standards and procedures are enforced by the institution to ensure compliance with digitalization?
4. How do institutional norms enforce individual adoption of digitalization?
5. To what extent do individual and demographic characteristics enable or constrain the use of digitalized processes in revenue mobilization?
Cognitive
Cultural beliefs and practices
1. Has digitalization become a necessity in revenue mobilization?
2. Have individuals accepted the new processes being implemented?
3. How informed are individuals on the digitalized processes involved in revenue mobilization?
4. How has the implementation of e-revenue changed the cultural setting of the organization?
5. What measures are put in place by the institution to ensure the easy acceptance of e-revenue implementation?

Source: Scott [12], [22]

3. Methodology

Research is founded on philosophical assumptions, which are related to the researcher's view or perception of what reality is [28]. Critical realism is useful when the researcher seeks to deconstruct and understand the structures and mechanisms underlying the subjective realities that exist [29]. Critical realist research assumes that social reality is constituted and constructed by people and that despite the deliberate effort to change their social and economic circumstances, they are normally limited by social, cultural and political powers [30]. Since the study is aimed at investigating the information technology employed for revenue mobilization and how institutional factors shape the use of information technology, the critical realist paradigm was deemed appropriate for the study to explain the differences between reality and people's perceptions of reality [31]. The purpose of the critical realist is not to predict but to explain social phenomena through examining patterns of association and possible explanation and also aims at seeking insight into key participants rather than drawing on generalization based on statistical significance [30]. By employing the institutional theory and developing propositions and questions to investigate the institutional environment of e-revenue, critical realism is deemed fit to be used as guidance.

The study adopted the qualitative approach to investigate the technology underpinning revenue collection in Ghana and also understand how the institutional environment shapes the use of this technology. The choice of a qualitative approach was a result of its ability to provide insight and gain answers to the "how" and "why" questions about the phenomena that the researcher can either have control of or have no control over [32]. From the critical realist view of

qualitative research, researchers seek to deconstruct and understand the structures and mechanisms underlying the subjective realities that exist [29]. These factors influenced the choice of the qualitative approach for this study.

3.1 Selection of case study

Ghana Revenue Authority (GRA) (hereafter referred to as the Authority) was purposively selected as the case for the study. The selection was because the Authority is in charge of revenue mobilization in Ghana and has implemented e-revenue services in its operations. The collection of data began in January 2019 and was finalized in March 2019. However, follow-up phone calls to personnel at the Authority were made to seek clearer information. In addition, the snowball sampling technique was also used to select people from one stage to the other to get information. This technique was adopted based on confidentiality and anonymity as the investigations went further to gain in-depth information. The breakdown of the participants of the study is presented in Table 5.

Table 5. Breakdown of interviews conducted

Participants	Number of interviews conducted
Project Team Manager	1
Officers from the Operations Department	3
IT Officers of the Authority	3
Project Team Members	4
Total Participants	**11**

3.2 Data collection and analysis technique

Qualitative researchers can gather data from sources including interviews, discussions, documents and observations [32]. Data for the research was collected from multiple sources, including informal discussions, observations and semi-structured interviews. Face-to-face interviews were mostly conducted with participants who were involved in the implementation and use of the technology. A semi-structured interview guide was designed based on the research purpose and propositions developed from the study to identify the various concepts and themes related to the study.

Each interview, including both formal and informal, lasted between 30 and 90 minutes. Notes were taken, and some sessions were recorded after gaining the consent of the participants. Relevant data was also gathered through interviews with some staff at the Authority. The informal discussions were had in situations where clarifications were required after the formal interview sections. The researchers, as a team, carried out the data collection activity. Table 4, which outlines the operationalization of the conceptual framework to study e-revenue, served as the interview guide.

Regarding the critical realist paradigm adopted for the study, the data collected was analyzed at different levels. Themes such as events, issues, challenges and resolution of challenges were identified, and the data were organized according to these themes [29]. Miles and Huberman's [33] transcendental realism technique guided the conduct of the data analysis for this study. Miles and Huberman’s technique highlights three main stages for data analysis; data reduction, data display and drawing and verifying conclusions. In the first place, the transcribed data was proofread and displayed as quotations for the participants. This was followed by drawing and verifying conclusions which aided the researchers in developing a clear connection between and among the concepts and themes. Based on the constructs of the new institutional theory and research questions, the identified emerging concepts and themes presented diverging views and perceptions of the implementation of e-revenue, which is presented in Table 6.

4. Results

Currently, the information system underpinning revenue mobilization in Ghana is known as the Total Revenue Integrated Processing System (TRIPS), which has been deployed in many of the Authority’s offices to support tax administration. TRIPS supports a total regime of revenue collection and management, including all direct and indirect taxes, with its series of processing modules designed to support the business needs of the Authority.

In this section, there is a discussion on how institutional factors influence the use of the system, including an examination of the underlying propositions stated in the study, which is to understand how cognitive, normative and regulative factors shape the use of the technology in generating revenue at the Authority. Regulative, normative and cognitive effects on the use of the system stem from the institutional environment in which the system is being accommodated and its effect on the actual usage of the system by end-users.

4.1 Regulative effects on digitalization of revenue mobilization

The regulative effects on the use of the system involved the national laws and regulations that demanded compliance and enforcement. The three major national regulations that affected the use of the system were the GRA Act, 2009 (Act 791), the Tax Identification Number (TIN) Act, 2002 (Act 632), and Electronic Transactions Act, 2008 (Act 772). These Acts and how they influenced the use of the system are discussed below.

A specific section under the Act that affected the use of the system was Section 2, which outlined the objects of the Authority. According to Section 2, the Authority is to provide a holistic approach to tax and customs administration, promote the efficient collection of revenue and the equitable distribution of tax burden, ensure greater transparency and integrity, improve information linkage and sharing of information among the divisions of the Authority, provide a one-stop service for taxpayers for submission of returns and payment of taxes and to provide for other matters related to the improvement of revenue administration. These objects of the Authority are required for the use of a holistic system by the Authority. The project team manager explained that;

> *"The use of TRIPS is to enable the Authority to execute the requirements of the Act and hence informed the modules that were developed for the system."*

With this clarification, personnel are compelled to cooperate with the technological innovation that has been introduced to support the operations of the Authority.

In addition to the GRA Act, the TIN Act, 2002 (Act 632), which was established to regulate the TIN system under which taxpayers were given identification numbers, also affected the use of the system. One of the important modules in the system is the taxpayer registration module which ensures the registration of all taxpayers into the system. The Act compels every person who is liable to pay tax or required to withhold tax at source to be issued with a TIN, which is unique by a designated public officer within not more than 14 days from the date of an application. A respondent explained that;

> *"Personnel with the responsibility of issuing TINs to taxpayers are required to use TRIPS for registration and issuance of TINs within the stipulated time given."*

In a nutshell, the TIN Act and other legislation, such as the Electronic Transactions Act of 2008 (Act 772), required effective compliance by personnel and taxpayers to ensure the effective use of the systems.

4.2 Normative effects on digitalization of revenue mobilization

The normative pillar consists of the shared values and standard procedures that affect the use of the system. Both national standards and the values of the institution affected the use of the system. These values and standard procedures demanded compliance but mostly were not mandatory and did not attract strict sanctions when violated. The normative effects are discussed below.

National standards require end-users of a system to be trained. Users are required to be trained on the effective use of a newly adopted system as well as educated on the associated benefits. From the interview, a project team member noted that;

> *"The project team complied with this standard by organizing training sessions on the use of TRIPS and the maintenance of its infrastructure for end-users before the deployment of the system and also dedicating offices as ICT training centres to facilitate periodic training programmes on the use of TRIPS."*

An Information Technology officer at the Authority added that;

> *"Taxpayers were educated on the benefits they can derive from using TRIPS on the website of the institution, and also, taxpayers who wanted to access the e-portal services of TRIPS were given guidelines on the services that they wanted to access on the website. In addition to this, videos illustrating how to access any service on the portal were made available on the website to be easily followed by taxpayers."*

It is also a standard requirement for all end-users to comply with rules and guidelines on the use of the system. There is a need for users to adhere to all regulations associated with the use of the system. Training users on the use of each module of the system require compliance with regulations governing the architecture of the system. The project team manager explained saying;

> *"Not every module of TRIPS can be accessed by all users. Access to GRA officers is limited to modules that support their unit operations, whereas management is given access to the entire system with other unique features. Taxpayers have access mainly to the e-services portal through which they can access all taxpayers' services. These limitations of service are expected to be complied with by all users to avoid any form of sanctions associated with their violations."*

The Authority adhered to a standard requirement of establishing a project team to spearhead the development, implementation and deployment of the system. This was required to undertake thorough studies in the erstwhile systems used, including business processes; ICT infrastructure required; available facilities; and user requirements to ensure effective change management and the inclusion of all stakeholders. The project team was also to supervise and control activation processes, upgrade, set-up, integration and configuration of the software for the various modules required on the platform. According to a project team member;

> *"The project team comprised selected personnel from the former revenue agencies. This was to involve all stakeholders in the use of the system based on their ranks and also to ensure a smooth transition of business processes with the use of TRIPS through effective training sessions."*

In addition, the decision of the government to adopt e-government services affected the development and use of the system. This mandate affected most government institutions and forced them to adopt the use of technology to support their business processes to meet national standards. This, in effect, contributed to the effective use of the system. The institution supported the developmental, implementation and deployment processes of the system and promoted its use by the Authority's officers as well as taxpayers. The aim was to serve customers efficiently, increase revenue generation, improve revenue mobilization and support the government's decision to meet international standards through digitalization. With financial support from the World Bank, the project experienced a speedy developmental process with ease in the acquisition and purchase of required ICT infrastructure, sponsorship with training sessions, construction of conducive office spaces and provision of miscellaneous. Even though non-compliance with the government's decision to go electronic did not attract any form of sanction, it contributed to the adoption and use of the system.

4.3 Cognitive effects digitalization of revenue mobilization

The cognitive effects encompass the customs and traditions that control the processes involved in organizational decision-making. These effects refer to the traditional and historical ways and other related activities that influence the use of technology. The effects of the normative pillar on the use of the system are discussed in this session.

The integration of the three former revenue agencies into one body and their different business cultures affected the use of the system. These former agencies had their business processes defined to meet their goals and aims. However, the integration of these bodies into one Authority redefined goals, business processes and procedures geared toward the achievement of set goals. An officer from the operations department explained that;

> *"Officers had to quickly adjust to new business processes and procedures as well as forms being redesigned to suit information required by all agencies from taxpayers."*

Change management contributed to the use of the system. The process of preparing, managing and re-enforcing change posed a challenge for the Authority. Making staff understand and preparing their minds to accept the change in business processes, managing the change and enforcing change influenced the adoption and use of the system. This was due to the change in people, especially with management, re-engineering of processes, the introduction of new technology and most of all, change in organizational structures. However, with the help of the project team, this challenge was managed using the Awareness Desire Knowledge Ability Reinforcement (ADKAR) model developed by the team. During an interview with a member of the project team, he stated that;

> *"The team ensured that officers were made aware of the need to change, emphasizing its importance, educated to develop the desire to participate and support the change, acquire knowledge about how to change, trained on the ability to adopt new skills and behaviours and also encouraged to embrace the change. The team was able to address issues concerning change mostly with training sessions and forums where stakeholder interaction and sensitization, staff coaching and employee readiness for acceptance were emphasized on."*

Legacy systems also influenced the use of the system. The use of the erstwhile systems and the extent to which staff of the former revenue agencies familiarized themselves with the systems affected the use of the system. As discussed earlier, before the establishment of the Authority, the former three revenue agencies used information systems to support their business processes. After having used these systems for an extended period and becoming accustomed to them, it proved challenging to transition to a new system, especially immediately following the integration of the agencies. An officer from the operations department complained that;

> *"Familiarization with former systems affected the Domestic Tax Revenue Division (DTRD) mostly because the division was an integration of both former agencies. Officers of those agencies had to come to terms with the new ways of going about their business processes and at the same time be abreast with the use of TRIPS."*

Some of the workers required a number of computer literacy training sessions to be abreast with technology to aid their easy acceptance of the system. Computer literacy did not only apply to officers but taxpayers as well. Many of the taxpayers who are computer literate utilize the e-services portal to fully benefit from the system. However, other taxpayers who are computer illiterate continually use the traditional methods of tax filing and payments. The help desk was introduced to assist users with any form of challenge they might encounter with the use of the system so as not to deter them from using the system.

Table 6 summarizes the analysis of the institutional effects on the digitalization of revenue mobilization.

Table 6. Institutional effects on the digitalization of revenue mobilization

Institutional Pillar	Requirements	Effects on the use of the System
Regulative Pillar	*GRA Act, 2009 (Act 791)*	
	- The Authority is to provide a holistic approach to tax administration.	▪ The Authority is mandated to adopt and use the system for all tax administrative duties.
	- Objectives of the Authority.	▪ As a result of the objectives of the Authority, the system is used to achieve its objectives which include an efficient collection of revenue, greater transparency and integrity and improvement in information linkage and sharing among all divisions.
	- Citizen-Friendly Service.	▪ As a result of creating a citizen-friendly service, the e-services portal of the system was configured to enable the institution to provide quality customer service to taxpayers.
	- Compliance.	▪ As a result of compliance, personnel of the Authority are compelled to use the system for business operations to ensure cooperation and compliance with institutional regulations.

Institutional Pillar	Requirements	Effects on the use of the System
	TIN Act, 2002 (Act 632)	
	- Registration and Identification.	▪ The taxpayer registration module of the system ensures the registration and issuance of TINs to taxpayers, which is a national responsibility of all taxpayers.
	- Validation Checks for Confirmation.	▪ Personnel of the Authority are compelled to use the registration module for validation checks with other designated government institutions during registration.
	- Application for issuance of TIN.	▪ Taxpayers are expected to apply for the issuance of TIN, and with the aid of the e-registration feature of TRIPS, taxpayers are allowed to register for TINs online for convenience.
	- Use of TIN.	▪ All TINs used for business and official transactions should be generated by the system only.
	Electronic Transactions Act, 2008 (Act 772)	
	- Legal certainty and confidence in e-transactions	▪ Promotes the use of the e-payments portal and ensures the safety of payments made online.
	- Promotes e-government services	▪ The use of the system received massive support from the government through the e-government project.
	- The authenticity of digital documents	▪ Advocates for the equal treatment of digital signatures hence promoting the use of digitalized processes.
Normative Pillar	Training on the use of the system.	▪ Publicity of the system. ▪ Stakeholder involvement and commitment to the system ▪ Ease of use of the system.
	Rules and guidelines governing the use of the system.	▪ Limits access to all users of the system depending on ranks. ▪ Secures the system and prevents unauthorized intrusion. ▪ Ensures user-comportment with the use of the system.
	Establishment of a Project team.	▪ Aided in the acquisition of ICT infrastructure required for the development, deployment and maintenance of the system. ▪ Smooth transition of business processes onto the system. ▪ Ensured stakeholder involvement.
	E-Government adoption.	▪ The adoption of e-services by the government informed the development and use of the system. ▪ Financial assistance in the development and maintenance of the system.
	Standards and Practices of other organizations.	▪ Ensured the development of an efficient system for revenue mobilization to meet global and international standards.
Cognitive Pillar	Integration of different businesses and cultures.	▪ This resulted in a delayed adoption process and use. ▪ Extension in the period for changeover of business processes onto the system.
	Change Management.	▪ Awareness of the need to change. ▪ Developing the desire to participate in and support change. ▪ Knowledge about how to change. ▪ Ability to adopt new skills. ▪ Reinforcement to embrace change.
	Legacy Systems.	▪ Difficulty in accepting a new system. ▪ Delay in data migration.
	Computer Literacy.	▪ Lack of responsibility and ownership of the system. ▪ Reluctance to accept the new system. ▪ Under-utilization of the system.

Source: Authors' Construction

5. Discussion of findings

This section addresses the research question of the study by discussing the propositions of the study after a thorough review of the literature.

5.1 Proposition one (P1): Regulative factors influence the digitalization of revenue mobilization

From the analysis of findings, the regulative pillar, which refers to government regulations that organizations are expected to comply with, and failure to comply would attract sanctions [26], influenced the use of the system. The regulation on the establishment of the Authority, which mandated the Authority to adopt and use a holistic system for all tax administrative duties, led to the development and, in effect, the use of the system. Section 1 of the GRA Act, 2009 (Act 791) specifically required the Authority to adopt a unique technology that could integrate the business processes of all former revenue agencies to support the integration of these agencies and to ensure a smooth changeover process. This served as a driving force for the action taken by the organization with support from the government.

Another regulative force that influenced the use of the system was the TIN Act [34]. The Act governed the registration and identification of taxpayers with the issuance of TINs. As a national obligation of all taxpayers, the registration process is expected to be completed by all taxpayers resulting in the issuance of TINs.

Again, the Electronic Transactions Act, 2008 (Act 772) contributed to the use of the system. Regulations from this Act governed the legal certainty, confidence and authenticity of digitized documents and signatures. Findings of most studies on digitalization often emphasize the existence of a lack of trust and confidence in digitized documents [1], [5]. The Act promoted the use of digitalization by ensuring users' safety on e-payments as well as advocating for the equal treatment of digital signatures. This Act influenced the use of the system, especially on the part of taxpayers and assured them of their safety concerning accessing certain services provided by the system.

5.2 Proposition two (P2): Normative factors influence the digitalization of revenue mobilization

The normative pillar refers to norms and values that determine legal and illegal actions in a particular social context. This pillar includes norms that primarily refer to the effects of professional practice. These norms define what is acceptable or unacceptable to professional practices. The goal of building end-user capacity to use the digital platform effectively and efficiently influenced the meeting of specific normative standard requirements. This was necessary because of the transition from erstwhile systems to the use of an integrated system which is noted in studies as an aid for the use of information systems [3], [18], [19]. Training end-users on the use of the system was a standard requirement which led to the effective use of the system. Various training sessions were conducted on the use of the system, and as evident from the analysis of findings, it was required of all end-users to use a holistic technological tool in their daily operations at the Authority. The significance of the training sessions was to publicize the system, create awareness of the system, ensure stakeholder involvement and commitment to the system and also ensure ease of use of the system. Training is an essential tool for promoting the use of IS [35]. The training also caused end-users to comply with guidelines and rules governing the use of the system. This was to regulate the extent to which users had access to the system and ensure the security of the system as well as user-comportment.

Another requirement that influenced the use of the system was the establishment of a project team to spearhead the development of the system and to ensure a smooth transition. The team led the acquisition of the ICT infrastructure required for the development, deployment and maintenance of the system. Nonetheless, the project saw massive support from the government and the World Bank financially. Donor support is considered to be very important to the use of IS [36]. This support hastened the developmental process of the system and aided in the deployment of the system in a number of offices within a given period. The decision of the government to adopt e-services informed the development and use of the system by the agency for revenue mobilization. Studies have argued that the government and, to a larger extent, the World Bank can influence the articulation of innovations and policy-making, especially in developing economies [36].

Standards and practices of other organizations also influenced the use of the system. As discussed earlier, the modules of the system were imitated from an already developed system used for revenue mobilization internationally. In view of this, the efficiency of the system was perceived to meet global and international standards. This informed the decision to opt for the system as an integrated system to aid in revenue mobilization in Ghana.

5.3 Proposition three (P3): Cognitive factors influenced the digitalization of revenue mobilization

The Cognitive factors imply the expertise and knowledge as well as thinking patterns of individuals in a social context. E-government studies have argued that there exists a significant relationship between organizational culture and employee attitudes toward the use of Information Systems (IS) [37]. Organizational culture is also considered a significant factor in the adoption and use of IS [38]. The agency had just been established through the integration of the three revenue agencies that already had their own cultures with different business processes. The integration of different businesses and cultures resulted in the delay of the adoption process hence affecting the use of the system. Due to the differences in organizational cultures, the period allocated for the changeover of business processes onto the system across all deployed offices was delayed, and this also affected the use of the system. However, even though timelines set for the implementation and deployment of the system were delayed, the team emphasized the need to embrace the new and emerging organizational culture to ensure a successful changeover of the business process and hence accommodated the slow pace of deployment.

Change management also posed a great influence on the use of the system. Preparing the minds of end-users on the acceptance of new processes with an integrated system was quite a challenge but a necessity to promote the use of digitalization. As noted in the literature, an organizational culture that embraces the assumptions, tenets, practices, and history allows for easy identification with the organization and increases the urge to work to achieve the common goal of the organization [1]. To expedite the change management process and ensure the effective utilization of the system, users were informed about the necessity of change, motivated to develop a willingness to participate and support the change, educated on how to acquire and adapt to new skills, and encouraged to embrace the change. User education was essential to the acceptance and use of digitalization. This was done to enhance the adoption and use of the system.

In conclusion, it is observed from the discussions above that the cognitive pillar brought out most challenges faced with the acceptance and use of the system. Studies have argued that challenges are inevitable in the use of IS, especially in the public sectors [1], [5],[39]. This was noted in the cognitive pillar and its effects on the use of the system.

6. Summary, conclusion and recommendation

The study explored the institutional factors influencing the use of technology in revenue mobilization by a government agency. Specifically, the study sought to examine how cognitive, normative and regulative factors influence the use of information technology in mobilizing revenue at the Ghana Revenue Authority.

To address this objective, the new institutional theory was adopted as a guiding lens to study the institutional environment of information technology usage. The theory was chosen to analyze and understand how the institutional pillars shape the use of information technology. After an extensive review of the literature, appropriate propositions were developed. The study employed semi-structured interviews to collect data from the organization in question, with the new institutional theory informing data analysis of findings.

6.1 Summary of the research findings

Understanding how regulative, normative and cognitive factors influence the use of technology necessitated the use of the new institutional theory to validate the propositions developed in the study. Factors of each pillar were identified and examined to investigate their effects on the digitalization of revenue mobilization in an emerging economy.

In a nutshell, each factor of the institutional environment influenced the use of technology for revenue mobilization. The finalized model is presented in Fig. 2.

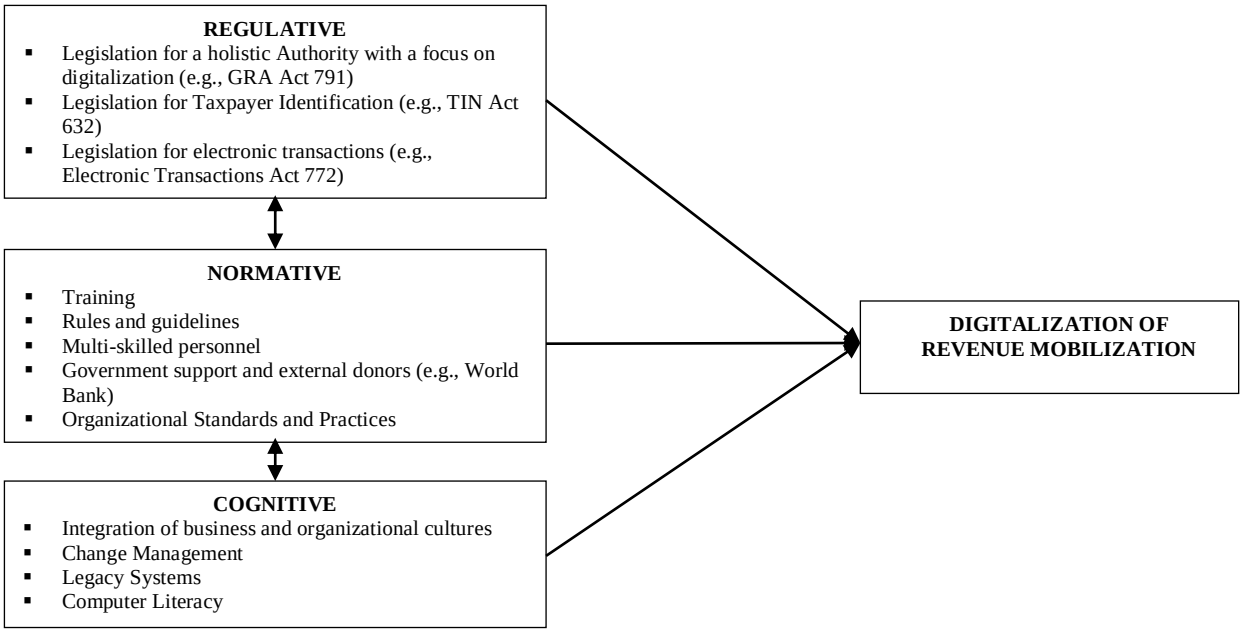

Fig. 2. Model for institutional factors influencing the digitalization of revenue mobilization

6.2 Implications of the study

Significant contributions have been made to research, practice and policy.

Concerning research, this study contributes to the body of knowledge on the emergence of the digital economy by exploring the use of e-revenue systems and procedures, which had received little attention. Secondly, the application of the new institutional theory also encourages researchers to pay more attention to the social aspect of technology acceptance and use with a minimal concentration on the technical aspect. These enhance the understanding of factors which influence the digitalization of revenue mobilization. Information Systems "are" people, and regardless of how robust a system is, it is still a known fact that the views and attitudes of end-users should be considered. However, in situations where there is a need for researchers to look at both the technical and social aspects of the acceptance and use of information technology, the new institutional theory can be combined with other theories. Thirdly, the study establishes the need for IS researchers to extend their studies to other aspects of the digital economy, such as the use, benefits and challenges of e-revenue systems rather than the over-concentrated studies on IS adoption and acceptance.

The study contributes to practice by drawing out social issues that affect the use of information technology. These issues must be critically looked at to promote the digitalization of business processes. There is a need for organizations to build institutional capability and skill through the development, implementation and use of digitalized systems. Periodic training on the use of IS could increase the desire to adopt and use a system.

Concerning policy, there is a need for emerging economies to adequately analyze both national and international legal frameworks that have implications for the use of information technology. The study advocates for government to institute very effective policies and guidelines and ensure compliance to achieve effective use of information technology.

6.3 Limitations and future research directions

Due to time constraints for the completion of this research, the study did not cover all 67 offices of the organization under study, especially offices located in rural areas. Moreover, the newly adopted system was still under further

deployment stages in the rural offices pending completion. This limited the study only to offices where the system had been deployed.

The study also focused on a specific single case phenomenon which was directed by the research title. However, the findings of the study can be applied to other projects on digitalized systems. Furthermore, the findings of this study are limited to the regulative, normative and cognitive factors that influence the use of digitalized systems which focused only on the social aspect of information technology use. The use of the new institutional theory, together with other theories, could project different findings as related to the technical aspects of technology use.

Additionally, future studies can review the effectiveness of each module in the software to ascertain how it enables or constrains the digitalized revenue mobilization process. Other theories can also be used in future research to unearth other pertinent issues related to the use of digitalized systems and to offer more generalizations to the findings of the study.

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The characteristics of successful military IT projects: a cross-country empirical study

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Abstract:
In the armed forces, successful digitalization is crucial to ensure effective operations. Much of the existing literature on project factors during the planning and execution phases of public IT projects do not focus specifically on military sector projects. Therefore, the paper aims to provide empirical insights into the characteristics of successful military IT projects. Data from such projects in NATO countries and agencies were collected through interviews and project documents. The findings relating to the main variable of interest, "delivery of client benefit," supported previous findings on IT project performance. Medium-sized projects performed better than small and large projects, and the agile development method delivered more client benefit than traditional methods. Client involvement apparently had a positive effect on project success. Clearly specified objectives had a statistically significant effect on project success in terms of clients' benefits. The paper contributes to the gap in research on military IT projects and broadens the project management literature's focus on time and cost to include delivery of client benefit as a success variable. The use of cross-country data provided unique insights for academics and practitioners regarding which project characteristics affect the successful development and adoption of new software by the armed forces.

Keywords:
IT projects; project success; client satisfaction; agile development; software development; armed forces; military sector.

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1. Introduction

As in the private sector, countries' armed forces are increasingly dependent on successful investments in Information Technology (IT) products and services to ensure operational efficiency. At the same time, it is well documented that software development projects face challenges and sometimes even total failure [1],[2]. Due to the increasing dominance of software in military systems, the Defense Innovation Board in the US has stated that its ability to adapt and respond to threats is now determined by its capacity to develop rapidly and deploy effective software [3]. In this paper, we aim to contribute to the empirical body of knowledge regarding the characteristics of successful military IT projects.

In order to study success in military IT projects, we need to look beyond just measurements of schedule and budget and include delivery of client benefit/customer satisfaction as a key success parameter. This view of project success aligns with the works of Pinto and Slevin [4],[5], Pinto and Prescott [6], and Ward et al. [7]. A more recent example of client benefit included as a measure of project success can be found in the study by Mohagheghi and Jørgensen [8, p. 753], where the authors define a successful project as follows: "A project that is assessed by its project owners and users as having delivered the expected client benefits or more, and where none of the respondents report large or very large problems on the other success dimensions (time control, budget control, quality, and delivered functionality)."

This paper focuses on success in military IT projects measured by three variables: time, cost, and delivery of client benefit. Different explanations of what is behind IT project success have been reported in the literature. Prior to project start, one key decision that has been documented to affect success in IT projects is the choice of software development method. Examples are the empirical study of IT projects in Norway by Jørgensen [9], where the application of agile development practices was connected to increased rates of success. It has been shown that during project execution phase, a set of critical success factors (CSFs) affect project success [4]. Many of the studies of CSFs in IT projects have focused on IT projects in the commercial sector [8],[10],[11]. Of the few studies that have focused on military IT projects in particular, a natural starting point is the work by Tishler et al. [12]. Several studies highlight human factors as important CSFs to achieve IT project success [8],[13]-[15]. From the similarities between commercial and military CSFs within the category of human factors found during our literature review, we identified the following variables of interest to our study: *requirements*, *objectives*, *expertise*, and *involvement*.

Finally, project size and type of contract are characteristics that can contribute to IT project success [8],[9]. Furthermore, together with other variables, size in the form of monetary investment can be seen as a proxy for projects' complexity [16]. Access to skilled personnel and differences in priority are other factors that arise from differences in project size and can affect project success [8]. Regarding type of contract, the choice often lies between variants of fixed-price contracts on the one hand and per hour or time and materials (TM) contracts on the other hand, hence choosing the appropriate contract can affect the success of the IT project [9].

The research gap and the study

The project management literature is vast. Much of the literature on project factors during the planning and execution phase of IT projects focuses on either civilian IT projects or public IT projects, but not specifically on the public IT projects that are in the military sector. Military IT projects differs from other IT projects in that, for example, their deliveries function on an operational platform and/or they enable communication and interaction across different levels of classification during training and combat. Furthermore, in the project management literature, project success is defined in many ways. We follow the works of Pinto and Slevin [4] and Ward et al. [7] regarding budget control, schedule control, and client benefit as the matters of interest. One decision prior to project initiation that the literature identifies as potentially correlated with project success concerns the development method [9],[14]. The military sector has been slow to adopt methods that are well established in the commercial sector, such as agile [3], and this in turn has resulted in a lack of empirical examination. In this paper, we aim to help to fill that gap. With regard to the project execution phase, few studies have analyzed the relationship of CSFs to project success in military IT projects. Over 20 years has passed since the military sector's CSFs have been comprehensibly studied in IT projects [17]. Therefore, the aim of our study, presented in this paper, aimed to investigate the human factors identified as most important in the CSF

literature, namely *requirements*, *objectives*, *expertise*, and *involvement* [13],[17]. Lastly, project size and contract type have been identified in the literature as key variables that potentially relate to project success, For this reason, we included them in our study.

A further aim of this paper is to contribute more knowledge about what contributes to success in military IT projects. Accordingly, the following overall question guides our analysis: What are the characteristics of successful military IT projects? For the purpose of our analysis, we define three more specific research questions that arise from the identified shortcomings in the literature on military IT projects:

RQ1: How does the choice of software development method contribute to success in military IT projects?

RQ2: How do the critical success factors *requirements*, *objectives*, *expertise*, and *involvement* contribute to success in military IT projects?

RQ3: How do project size and choice of contract type contribute to success in military IT projects?

To answer these research questions, we draw on original first-hand empirical data relating to project characteristics and success from IT project managers within NATO countries and other entities. The projects not only differed in their country of origin, but also in their size, time of completion, and type of acquisition. In Section 2 we present our review of the literature on the relevant parameters that contribute to project success. The review forms the basis for our three research questions and framework of analysis. A description of data and method is then presented in Section 3. Thereafter, the results and discussion are presented in Section 4. Section 5 contains the conclusions drawn from the study, as well as the study's limitations.

2. Literature review

2.1 IT project success

As stated by Atkinson [18], there are many dimensions of success in projects. A wide divergence of opinion in the field of project management can be found in the literature review by Prakash Prabhakar [19]. For IT projects, the traditional starting points for measuring project success are aligned with the three most common criteria in project management: budget control, schedule control, and delivery of the required functionality [13]. Measuring success in military IT projects can be done by using these three criteria. However, with regard to the delivery of technical functionality, one can include whether actual client benefit is delivered from the project. This view aligns with that of Ward et al. [7], who claim that technical functionality alone does not deliver benefit. Rather, it is seen more as an enabler to create benefit in changing how the client works, as argued by Garousi et al. [10, p. 215]. The reported rate of failed and successful IT projects varies greatly in the literature. Emam and Koru found in their review that the cancellation rate varied between studies, and that most were below 20% [20]. When IT projects that had to some extent failed to deliver on the success parameters were also taken into account, 48–55% of the delivered projects were considered successful. In a study of nearly 800,000 IT projects, Jørgensen found that 14% were either cancelled or had a client rating of "poor" or worse [21]. When it comes to success in military IT projects in particular, fewer cases are reported in the empirical literature. One such case can be found in the study of ca. 250 large defense software projects implemented between 1995 and 2004, as Jones found that only 25 were successful in the sense that they were on schedule, on budget, and met quality objectives [22]. The majority of the studied defense software projects (ca. 175) experienced substantial delays and budget overruns or were terminated without completion. Elsewhere, studies based on empirical data from defense software projects have focused on themes such as the estimation of effort in software testing [11] and conceptual contributions to why software projects fail [23].

2.2 Software development method

One key decision project managers make prior to project initiation is which development method to employ. Options range from traditional methods, such as waterfall or spiral development, to newer agile methods. The private sector has widely adopted agile methods in IT projects since the online publication of the Manifesto for Agile Software

Development (shortform: the Agile Manifesto) in 2001 [24],[25]. However, the public sector in general and militaries in NATO countries in particular have only recently begun to embrace agile methods.

The cost and schedule benefits of agile method over traditional development methods is hotly debated. For example, Mazazinius and Feldt [26] found the success in terms of cost and time was not significantly different between agile and non-agile companies. By contrast, Serrador and Pinto [14] found positive impacts on efficiency (defined as cost, time, and scope goals) due to increased use of agile methods. Resolving this debate is beyond the scope of this paper. Instead, we focus on the *identification of development method* as a variable for investigation.

Customer satisfaction benefits from agile projects are possibly less controversial than cost and schedule benefits. Agile's iterative nature, flexible change management, and continual customer feedback lead to customer satisfaction. For example, Serrador and Pinto examined 1002 projects spanning multiple countries and industries and found that agile methods had a positive effect on customer satisfaction in private sector projects [14]. Similarly, Jorgensen [6] found that projects employing agile methods had positive effects on project success in the form of client benefits.

While the commercial sector has employed agile methods for over 20 years, the adoption of agile methods in the public sector has been slow [25]. Worldwide, military acquisitions have tended to rely more on traditional development methods such as the waterfall method. However, that tendency is slowly changing, and the change is seen in government reports, such as McQuad et al.'s discussion of agile as a preferred approach to software development [3]. Additionally, outcomes in a limited number of military projects have contributed to the change. For example, the ISPAN program shortened cycle time by 45 months [27], while Kessel Run's tanker planning tool has saved in terms of logistics and fuel costs [28]. While these individual projects are sources of anecdotal evidence that seems promising, the need for larger studies comparing the military sector's agile and non-agile project outcomes is readily apparent. This paper is intended to help fill that gap.

To summarize thus far, the chosen development method may be an important factor for project success. While the private sector has long since shifted to agile methods in IT projects, the public sector in general and the military in particular have lagged behind in the adoption of such methods. Data from multiple NATO projects are now available to explore the impacts of this change. Consequently, it is now possible to analyze military IT projects that employ traditional methods in comparison with those using agile methods. In the next section, we shift our attention to the execution phase of the project by examining critical success factors.

2.3 Critical success factors

The program management literature on critical success factors (CSFs) supports and informs the development of several independent variables that are analyzed in this study. While "success" has been interpreted by researchers in various ways in the program management literature, this paper follows the works of Pinto and Slevin [4],[5] and Pinto and Prescott [6] (as mentioned in Section 1, the Introduction), in which success is regarded as meeting project budgets, schedules, and customer satisfaction/client benefit. Identification of CSFs facilitates focus on elements that are key to a project's success. These factors vary across businesses and industries. However, identification of commonalities in commercial and military CSFs allows for a comparison baseline for investigating the unique IT military projects in this study. Thus, this study incorporates CSF findings from the literature into the formulation of independent variables for analysis of cost, schedule, and client benefit.

The ubiquity of CSFs is well documented in the literature. CSFs have been shown to be important in a wide range of commercial industries, from biotechnology [29] to manufacturing [17]. CSFs in the software and IT industries are germane to this article. The literature contains many conceptual models of software CSF, such as those by McLeod and MacDonell [15], Ahimbisibwe et al. [30], and Purna Sudhakar [31]. In addition, empirical studies of software project CSFs have been conducted in various countries, including Turkey [10] and Norway [8],[9], as well as many other countries for which datasets have been generated, such as the data held by the International Software Benchmarking Standards Group (see also Lavazza et al. [32]). This multicountry, IT-specific CSF literature is particularly relevant for this study, which examines a cross-section of NATO country projects.

The vast amount of research conducted on commercial IT project's CSFs to date has resulted in meta-analyses that summarize the literature. In one such study, Nasir and Sahibuddin [33] analyzed 43 research articles in an attempt to understand the critical factors that influence IT project success. They identified 26 CSFs, which they divided into three categories: people factors (7), process factors (16), and technical factors (3). Of these, five factors were observed in more than 50% of the researched literature and therefore deemed the most important factors (Table 1).

In contrast to the robust literature from the commercial sector, there is a relative dearth of CSF literature reporting analyses of military IT projects. This limited literature includes CSF contributions by Goljan [28, p. 261] on evolutionary acquisition and May [34] on military software project failure characteristics. However, perhaps the most robust analysis is by Tishler et al. [12], who identified CSFs from an analysis of 110 military projects executed in the 1980s and 1990s. Of these, the five most common CSFs are listed in Table 1. To the best of our knowledge, there has not been an update on military IT project CSFs since the work of Tishler et al. in the 1990s [12]. Filling that gap of more than 20 years was part of the motivation for this study.

Table 1. Key CSFs in commercial and military projects

Commercial CSFs (source Nasir and Sahibuddin [33])	**Military CSFs** (source: Tishler et al. [12])
1. Clear requirements and specifications	1. The more critical the perceived need, the greater the chance of success
2. Clear objectives and goals	2. Amount of customer follow-up
3. Realistic schedule	3. Clear and reasonable scope
4. An effective project manager	4. Clear requirements early in the project
5. Support from top management	5. Professional qualifications and high motivation of the development team

Table 1 highlights the similarities between the CSFs in studied commercial and military projects. In the 1990s, there was significant overlap between the CSFs for commercial software projects military development projects [12],[33]. Thus, the literature points to the following common CSF independent variables: *requirements*, *objectives*, *expertise*, and *involvement*. They are the CSF variables of interest in this study. In summary, while there is a vast body of literature on commercial IT project's CSFs, there is a relative dearth of CSF literature on military projects in general and even less on military IT projects in particular.

Moreover, within the existing literature, it is important to note that *human factors* [7],12],[20] are identified as the most important for IT process success. This means that CSFs are within the control of the project team. However, the extent to which NATO countries are incorporating these CSF into their IT projects is an open question. We identify the top human factors from the literature as *requirements*, *objectives*, *expertise*, and *involvement*, and we seek to investigate their effect on military IT project success.

2.4 Project size and contract type

Military projects are often complex. Quantifying the complexity of a project with a universal metric can be difficult. For example, technology readiness levels (TRLs) are a metric used by some military organizations as a maturity assessment tool and hence as an indicator of complexity [35]. Cost and schedule growth have been found in projects that attempted to integrate technologies before they were mature [36],[37]. This makes TRLs an appealing variable for investigating complexity. Unfortunately, the documented issues with TRLs [33], and perhaps more importantly, the lack of consistent TRL reporting by military project managers, made their usage in our research unfeasible.

Another proxy for complexity is size [16]. In IT projects, the sheer number of software lines of code is one such measure of size [38]. A Defense Science Board report [38] published in 2018 discusses this relationship between complexity and growth in lines of code. The report illuminates the dramatic increase in avionics lines of code from 135,000 for the F-16A in 1974 to over 29.5 million for the F-35 joint strike fighter in 2017. Given that the greater the amount of code, the more dollars a project can typically be expected to cost, project size was examined as an independent variable examined in the study.

A final variable frequently discussed in the project performance literature is contract type. Project success may be achieved in part by selection of the appropriate contract type [9],[39],[40]. In military projects, the contracting options range from fixed price to time and material. While fixed-price contracts theoretically should contain costs and schedule more effectively than cost plus and/or time and material contracts, the empirics are often at odds with the theory in previously studied military projects [39],[41].

Narrowing focus the literature review to software projects provided further insights into the relationship between contract type and project success [42]. Jørgensen [6] found that avoiding fixed-price contracts was connected to success in the delivery of client benefit. Kalnins and Mayer [43] found that when estimating costs prior to the award of a contract was difficult, a time and material contract was preferable. Dey et al. [44] found that time and material contracts performed better in complex projects when monitoring was efficient, but fixed-price contracts were better suited to simple software projects with short durations. Thus, due to the prominence of contract type in the literature it is included as an investigated variable in this study.

3. Method

3.1 Data collection and the selected projects

We held interviews with 25 project managers (PMs) with in-depth knowledge of selected projects. These interviewees were selected according to their availability. The interviews were held in 2020 and 2021, and all were held in English except for those with the PMs of Norwegian projects. The latter were later translated from Norwegian to English by the Norwegian researcher with assistance of native English researchers in the research team. We developed an interview guide, together with the help of an extended group of researchers, many of whom had more than 10 years of experience from different roles within IT projects and cost estimation of software development. To avoid any risk of bias towards either the most successful or largest and most noticeable IT projects in our study sample, we asked the interviewees to select the last IT project they were involved in and that had been completed. The role of the PM had thus been to secure the success of the IT project. To limit any incentives to exaggerate the success, the researcher emphasized the confidentiality of the study, especially in the case of senior management. In order to study actual relationships between project characteristics and success, we needed to address specific projects. The focus on specific projects also enabled a strengthening of the analysis due to additional information from those projects (e.g. information obtained from other project personnel and/or project documentation). The interviews lasted 1–2 hours and were conducted digitally or in person when possible. Although the short questions could have been sent by email to be filled in, the sit-down interviews allowed us to clarify points in the interview guide and to ask follow-up questions on topics of particular interest. The interview guide consisted of both short answer questions, to enable quantitative comparisons, and follow-up questions for the interviewees to provide longer answers on topics in cases when they were unsure or had additional remarks. To ensure comparability in the interviewees responses we used a drop-down menu in Excel with pre-defined categories for the short-answer questions. One of the fixed items in the menu was “don’t know or fill in,” which was intended to capture responses outside our pre-defined categories. Given the increasing prevalence of agile software development methods in military IT projects, we included specific questions regarding development methods in our interview guide. The interview guide is provided in Appendix A.

The projects selected by the interviewees (i.e., the last project they had been involved in) and that formed our dataset were all IT projects within either a NATO country or a NATO agency. The represented NATO countries were Norway, the USA, Canada, and the UK. Additionally, there were four projects from two NATO agencies. In total, 25 projects were studied. The size of the projects was in the range of 0.8–351 million USD, and all projects were either in their

finalization phase or had recently been completed when the data were collected in 2020 and 2021. One of the projects was cancelled during the execution phase and failed to deliver any client benefits. As our approach was to ask about the last IT project in which the interviewees had been involved, we decided to include the cancelled project as a failed IT investment for the relevant part of the general population. The projects in our dataset had the special feature of being military IT projects in which the aim was to function on an operational platform and/or to enable communication and interaction across different levels of classification. An overview of the projects is presented in Table 2.

Table 2. The studied projects

ID	Project information	Budget* USD million
1	NATO agency, software acquisition, agile (communications)	12
2	NATO agency, software acquisition, agile (communications)	3
3	NATO agency, hardware with software acquisition, waterfall (communications)	15
4	NATO agency, hardware with software acquisition (bespoke), agile	0.8
5	Norwegian, hardware with software acquisition, agile (communications)	44
6	Norwegian, hardware with software acquisition, waterfall (commodity IT)	45.2
7	Norwegian, hardware with software acquisition, waterfall (communications)	36
8	Norwegian, software acquisition, COTS** with configuration, waterfall (commodity IT)	71.6
9	Norwegian, hardware with software acquisition, waterfall (commodity IT)	45.9
10	Norwegian, software acquisition, COTS with configuration, waterfall (commodity IT)	12.9
11	Norwegian, hardware with software acquisition, waterfall (commodity IT)	8.3
12	Norwegian, software acquisition, COTS with configuration	5.5
13	Norwegian, hardware production acquisition (communications)	40.9
14	Norwegian, bespoke software acquisition, incremental (communications)	36.7
15	US, software acquisition, COTS with configuration, waterfall	6.5
16	US, software acquisition, COTS with configuration, waterfall	22
17	US, software acquisition, COTS (specialized IT)	10
18	US, hardware with software acquisition, waterfall (commodity IT)	67
19	US, software acquisition, waterfall	45
20	NATO agency, software acquisition, agile	2
21	NATO agency, hardware acquisition (communications)	351.5
22	Canadian, software acquisition (configuration)	97.2
23	Canadian, hardware with software acquisition, agile (communications)	286
24	Canadian, software acquisition, agile (COTS with configuration)	128.4
25	Canadian, software acquisition	35.9

*For comparison across time and countries/agencies, all monetary amounts are indexed to USD millions in 2020; **Commercial off-the shelf

3.2 Source triangulation

Information on the IT projects was mainly sourced from the interviews and recorded in an Excel spreadsheet. Additionally, notes were taken in the case of longer answers. In addition to the interviews, project documentation was used, and other relevant project personnel were asked follow-up questions when needed. At least two researchers went through the collected information in order to detect and solve problems of ambiguity in the answers. For the analysis, quantitative data were gathered and recorded in an Excel spreadsheet. This allowed the researchers to analyze the spread of the short answers, together with the documentation of the longer answers.

3.3 The analyses

For the main part of our analysis we adopted an exploratory approach wherein our goal was to learn more about how to identify what project characteristics affect success. The analysis of quantitative data from the interviews was based on descriptive statistics, as well as on formal statistical testing when deemed appropriate. For relationships of special interest, we applied the Fisher's exact test to determine whether there were non-random associations between two categorical variables. In our dataset this was, for example, differences in the proportions of our success variables across our categorical variables on project characteristics. The Fisher's exact test was considered suitable because of our limited number of observations ($n = 25$). Significant findings above a threshold of 95% ($p < 0.05$) are reported in Section 4.

For our three success variables of benefit, cost, and time, we analyzed the interviewees' perceptions of the project performance, not an overall objective measure of the project's success. For the variables time and cost, it was to some extent possible to check statements compared with project documentation, but no such objective and precise measures were documented for delivery of client benefit. However, we advocate the usefulness of considering the three success variables together. A project that delivers the planned amount of client benefit but with a cost overrun of 30% will perform better overall than a project that stays on budget but delivers only 50% of planned client benefit. According to Ward et al. [7], sit-down interviews enable researchers to clarify terms such as client benefit and ask follow-up questions to understand whether, for example, the client has actually used the software in operations. In the next section (Section 4), we supported the findings with statements given as part of the longer answers in the interviews, where relevant.

4. Results and discussion

4.1 Project success

The overall results of the analysis are presented in Table 3. The results relating to cost and time performance with a negative sign indicate an "underrun" (i.e., the projects were finalized either at a cost lower than the budget or before the schedule). The interviewees were able to choose from several categories (see Appendix A for the full questionnaire) when stating the percentage that constituted the best fit for their project. The main emphasis in the presentation of our results is on the main motivation for the IT investment, which was the delivery of client benefits. The mean project delay in our dataset was substantial (28%). The mean cost overrun (8%) was lower than found in previous studies of public investments [45]–[4648 and studies of IT projects, especially one reported by Flyvbjerg and Budzier [49], for which an average cost overrun of 27% was found. The following quotation from one interviewee illustrates the possible difference between accuracy of cost estimation and estimation of project schedule: "This is acquisition of civilian IT solutions and the cost estimation should therefore be easy. It is the operation and management phase that is the challenge."

With regard to the success variable "client benefit delivered," the mean projects delivered just over 80% of planned benefit, a share that corresponds closely to some previous findings concerning success in the delivery of client benefit [9],[50]. Our mean percentage was somewhat higher than the percentages reported by Flyvbjerg and Budzier and [49], for which IT projects experienced a mean shortfall of 29.3% of planned benefit. For all three variables, the spread was quite wide over the maximum and minimum values, as reflected in the standard deviation (SD) shown in Table 3. Our overall finding that the military IT projects experienced challenges on all three success variables fits well with previous findings relating to challenges in IT projects in the public and private sectors. This is also illustrated by the following quotation from one of our interviewees regarding possible optimism bias when planning such projects: "[The] Government does a poor job of understanding the full scope of the effort. This [underestimating the full scope] is often done to buy into the project to get it approved."

Table 3. Results of the analysis of three success variables: time, cost, and client benefit delivered

Success variable	Mean	Median	Max.	Min.	SD
Client benefit delivered, n = 21	82%	100%	110%	0%	28%
Cost deviation (cost overrun), n = 24	8%	0%	50%	-50%	26%
Time deviation (delay), n = 22	28%	40%	50%	-50%	26%

The distribution of answers relating to our main success variable of "client benefit delivered" is shown in Figure 1. The largest portion of projects (24%) was in the category of "All client benefits were delivered as planned." One of the interviewees in this category stated the following regarding how their project was planned and organized: "Team size is set by expert judgement of best delivery mechanism. Then, duration is set by the architect and agile expert, and Dev[elopment] team. During project implementation, we evaluated velocity and backlog size quarterly."

For 20% of the projects, the interviewees indicated that more than planned benefits were delivered, and we set this finding as a 110% result for those projects, to differentiate between the projects for which the interviewees indicated that all planned client benefits were delivered (100%). For the projects in which more than planned client benefits were delivered, one of the interviewees stated that they had made changes in scope to add extra functionality in the project. However, as shown in Figure 1, a large percentage of the projects experienced a shortfall in delivery of client benefits. Also, for four IT projects in our dataset (16% in Figure 1) the interviewees were unable to state how much client benefit had been delivered. When asked to elaborate, some interviewees pointed to lack of maturity in the technological solutions provided and/or that the project had been cancelled before finalized.

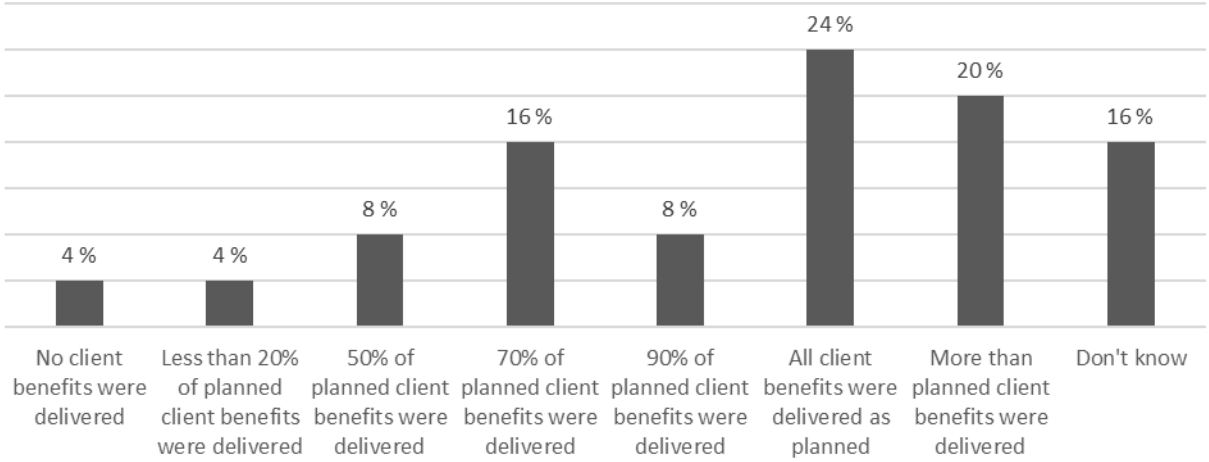

Figure 1. Distribution of delivery of client benefits in the studied projects (n = 25)

The relationship between cost overruns and delays in projects has previously been discussed the literature [51]. For our three success variables, the strongest correlation was found between time and cost (0.31), as shown in Table 4. This was a positive correlation, implying that cost deviations increase with time deviations (delays). it should be noted that this correlation does not imply any causation between the variables. The correlation between delivery of client benefit and cost was weakly positive (0.10). Similarly, the correlation between client benefit and time was low, but in the opposite direction (-0.11), meaning that client benefit increased with a shorter delay. A similar low correlation between delivery

of benefits and budget control (0.2) is reported by Jørgensen [9]. Together, both our findings and Jørgensen's finding highlight the importance of including delivery of benefit when analyzing project success. In this regard, note that our finding of low correlation between the three success variables does not necessarily imply that they were not connected, and therefore they should be seen in relation to each other when discussing overall project success. Accordingly, we include all three as relevant in our discussion of success in military IT projects in this paper.

Table 4. Correlation between success variables

Success variable	Client benefit delivered	Cost deviation (cost overrun)
Cost deviation (cost overrun)	0.10	–
Time deviation (delay)	-0.11	0.31

Since our three success variables did not appear to have a large impact on each other, we focused on other parameters and characteristics that might affect success in military IT projects. These are discussed in the following Subsections 4.2–4.5.

4.2 Software development method and project type

The choice of agile as a software development method has previously been found to have a positive effect on project success [9]. The projects in our dataset were divided roughly equally according to which PMs reported the use of the agile development method and which PMs reported the use of traditional methods, such as waterfall. The decision to use the agile method entails some changes and more frequent involvement of stakeholders in the project, such as the end client, compared with the use of traditional methods. This is illustrated by the following quotation from one PM: "[There are] varying roadmaps in agile. All stakeholders must be engaged up-front and roadmaps aligned. Cannot meet expectations of 'delivered to OUR customers' if there's another process before it can be used operationally." Another interviewee pointed out that agile practices are still quite new to many parts of the military sector in NATO countries: "It is important to stick to the civilian market, to keep up with the civil industry, since agile practices are more adopted there."

On average, a project with agile as the development method delivered 14 percentage points higher client benefits (Table 5). Although the delay was 7 percentage points lower, the agile projects had on average almost 10 percentage points higher cost overruns. This finding might illustrate that the fundamental challenge faced by the PM, which is to score well on all three success variables at the same time, is also present when choosing agile development methods in IT projects.

Table 5. Development method and project success

Development method	Client benefit delivered (mean), n = 19	Cost deviation (cost overrun, mean), n = 21	Time deviation (delay, mean), n = 20
Agile	86%	10%	25%
Traditional methods (e.g., waterfall)	72%	0.4%	32%

When we applied a two-sided Fisher's exact test to identify differences in proportions in our success variables, we found a statistical difference between agile and non-agile methods on cost deviation ($p = 0.023$), which meant we could reject the null hypotheses of the means being equal.

A large portion of military IT projects have deliveries in the form of both software and hardware. In our dataset, these "combination" projects constituted 44%. As shown in Table 6, projects with a hardware component had on average higher mean client benefits delivered, as well as better budget performance, but they were delayed more compared with other projects. One way to interpret this result is to take into consideration that software components can be more challenging to estimate up front compared with hardware. Examples from the defence sector are the US Air Force's F-35 program and the substantial growth in software coding reported by the US Government Accountability Office [51]. In addition, in a previous study of military IT by Berg et al. [53] found that bespoke solutions were as high as 65% within the Norwegian portfolio. A high rate of new development can affect the risk of shortfall in success. Tangible goods such as hardware can be more straightforward to procure, as can commercial off-the-shelf (COTS) solutions.

Table 6. Project type and success

Project type	Client benefit delivered (mean), n = 21	Cost deviation (cost overrun, mean), n = 24	Time deviation (delay, mean), n = 22
Software only	65%	12%	25%
Hardware with software	99%	1%	34%

4.3 CSF: projects' requirements and objectives

Mohd and Shamsul [54] list clear requirements and objectives as the first two critical success factors regarding software. To see how these characteristics affected military IT projects, we asked whether the projects' requirements and objectives were clear, as these can be seen as prerequisites for successful projects. The results are shown in Table 7.

Table 7. Projects' requirements and objectives

Were the projects' requirements clear and well specified?	Client benefit delivered (mean), n = 20	Cost deviation (cost overrun, mean), n = 22	Time deviation (delay, mean), n = 21
Yes	82%	-8%	23%
No	81%	21%	32%
Were the projects' objectives clear and well specified?			
Yes	92%	6%	23%
No	52%	11%	45%

Clear requirements seemed to have more effect on cost and time deviations than delivery of client benefit. The projects' requirements were more concerned with the technical deliveries of the project and possibly less in relation to achieving overall benefits for the client. The need for clear objectives was stated by one interviewee: "We always start from scratch with the new demands from the military user. A lot to gain from establishing a common demand/need and requirements. We don't share experiences. The experts are to be used everywhere. We lack resources." When applying a two-sided Fisher's exact test to identify differences in proportions for a 2 × 2 contingency table, we found a statistical difference between clear objectives (yes/no) on delivery of client benefit ($p = 0.05$).

4.4 CSF: expertise and involvement

Process characteristics in the form of expertise on how the project is followed up by the relevant stakeholders has been found to affect the success of IT projects [21],[55]. To capture how experience and expertise could influence the success of military IT projects, we asked the PMs to state their amount of relevant experience (years of experience

within areas such as project work/IT/military acquisitions). We also asked the PMs to evaluate the expertise and degree of involvement of both the clients in the armed forces and the suppliers of the IT solutions. The results are in Table 8.

Table 8. Project managers' experience and project success

Project manager's experience (years)	Client benefit delivered (mean), n = 21	Cost deviation (cost overrun, mean), n = 20	Time deviation (delay, mean), n = 21
1–10	78%	18%	25%
10+	83%	13%	36%

We found an average increase of 5 percentage points in the delivery of client benefits in cases where the PM had over 10 years of experience. The following statement from one of the interviewees supports the possible beneficial effect of having an experienced PM: "The PM must understand functionality of system and have experience, have a gray beard, [and] technical understanding."

Also, cost overruns were reduced by an average of 5 percentage points in the group of projects with more experienced PMs. However, when we looked at our third success criterion (time deviation) in that group, we found that the mean delay had increased by 11 percentage points. Together, these results do not suggest any clear learning effects where increase in PMs experience would improve overall project success. Since our focus was on the PM, the result might be different if we had included the experience of the entire team in our analysis.

Theoretically, the inclusion of clients throughout the project and their previous experience with similar IT projects is important for project performance. The emphasis on enhancing this connectivity is part of the reason agile software development has been adopted as a primary approach in the commercial sector. Regardless of the software development method, it is important to examine the dimension of client involvement [3],[56]. Therefore, to capture this part of the software development process and how it might affect success, we asked the PMs how they perceived the degree of expertise and involvement from the client. The results are shown in Table 9.

Table 9. Degree of clients' expertise and involvement related to project success

How good do you consider the clients' expertise was in terms of similar experience and general track record?	Client benefit delivered (mean), n = 21	Cost deviation (cost overrun, mean), n = 22	Time deviation (delay, mean), n = 22
Poor/very poor	88%	4%	30%
Acceptable	88%	4%	31%
Good/very good	77%	8%	25%
Did the client follow up sufficiently throughout the project?			
No	74%	16%	31%
Yes	88%	-1%*	26%
How good do you consider the supplier's expertise is in terms of similar experience and general track record?			
Poor/very poor**	90%	0%	25%
Acceptable	73%	7%	15%
Good/very good	84%	6%	33%

*A negative number means a cost underrun (i.e., final costs below the initial budget); **There was only one observation in this category and therefore the results should be interpreted with considerable caution

The projects with good or very good client expertise (as considered by the PM) had a lower mean delivery of client benefit and a higher mean cost deviation compared with the projects in which the client expertise was "acceptable" or "poor/very poor." This is a somewhat surprising result, since we had expected client expertise would have a positive

influence on project success. One point for discussion concerning this result is the case of "gold plating" resulting in highly bespoke solutions in military IT projects, and how it can have a negative effect on success. According to findings from the study of IT project management by Nelson [57], this phenomenon can apply both to requirements and to the developer. In our data, the risk of "gold plating" of requirements might have been higher if the client expertise was good.

The results relating to our question of how the actual follow-up was from the client revealed a clear positive tendency for all three success variables. We observed a 14-percentage point increase in the delivery of client benefits for the group of projects in which the clients followed up throughout the project compared with the projects in which the client did not follow up. Only one interviewee stated that the supplier's expertise was poor/very poor. When we compared results for projects in the two remaining groups ("acceptable" and "good/very good"), we found that projects with "good/very good" supplier expertise had an 11 percentage points higher mean delivery of client benefits and performance on cost was close to equal, but the projects were more delayed.

4.5 Project size and contract type

The management of larger projects can involve a higher risk of underperformance [58]. To see how our success variables were distributed between projects of different sizes, we divided them into five groups according to monetary value. The results listed in Table 10 show a tendency towards increased cost overruns and delays for larger projects. For delivery of client benefit, the distribution was quite similar among the groups, with the exception of the mean of 90% for projects in the range of 10–50 million USD. In other types of military investments, a large project can simply mean that the acquisition consists of a large quantity of new material and that the project itself is not categorized as high risk. With regard to IT, the results in Table 10 show that the projects over 100 million USD delivered the lowest amount of client benefit. It might be that the effort needed to produce client benefits increases with the size of projects due to complexity in the form of increased amount of stakeholders and organizational changes needed. Still, our analysis did not reveal a clear answer as to whether complexity explained the results shown in Table 10.

Table 10. Project size and project success

Project size	**Client benefit delivered (mean), n = 21**	**Cost deviation (cost overrun, mean), n = 24**	**Time deviation (delay, mean), n = 22**
< 10 million USD	72%	0%	25%
10–50 million USD	90%	9%	30%
50–100 million USD	76%	13%	25%
> 100 million USD	70%	17%	40%

One characteristic previously reported for successful software projects is the avoidance of fixed-price contracts [9]. In general, acquisitions of military materials can face challenges when beneficial contracts are negotiated, due to market regulations and either monopolistic or few suppliers of military materials. When it comes to IT, the possibility to benefit from more suppliers from the private sector exists, also with a possible increase in bargaining power to prepare the best type of contract for the armed forces. For all success variables in our study, there was an approximately equal distribution of 50% of the projects using firm-fixed-price (FFP) contracts and 50% using time and material contracts. Not surprisingly, cost deviations were almost zero for firm-fixed-price contracts (Table 11), but those projects also experienced more delays. The difference in delivery of client benefit was smaller between the two types of contract, but in contrast to previous findings [9], fixed-price contracts performed on average better than time and material-based contracts in our dataset.

Table 11. Contract type and project success

Contract type	Client benefit delivered (mean), n = 21	Cost deviation (cost overrun, mean), n = 23	Time deviation (delay, mean), n = 22
Firm-fixed-price	84%	0.4%	35%
Time and material (per hour)	79%	13%	20%

5. Conclusion

Military IT projects deliver solutions that need to perform flawlessly under hard real-time constraints in military operations and training, in contrast to commercial sector projects, where failures have financial and organization consequences, but national security and lives are not directly at stake. Commercial sector best practices and critical success factors (CSFs) therefore inform the military sector, but adaptation in the military arena may require changes along some dimensions. Articulating the specific changes between the two sectors is beyond the scope of this paper, as the focus is on a higher level of analysis in order to identify the characteristics of successful military IT projects themselves. The results provided in this study are a novel contribution to the body of knowledge within a less studied area of public IT acquisitions.

We started our empirical investigation of data by looking at the correlation between our three success variables—time, cost, and delivery of client benefit—and we found the correlation was low. Regarding delivery of client benefit, the military IT projects in our dataset delivered on average 82% of planned benefit. This finding is in accordance with previous findings reported in the literature on civilian and public IT project performance. With respect to our first research question (How does the choice of software development method contribute to success in military IT projects?), our findings support those of previous studies in which the use of the agile method delivered client benefits "better" than did traditional methods.

With regard to our second research question (How do critical success factors *requirements*, *objectives*, *expertise*, and *involvement* contribute to success in military IT projects?), we found supporting evidence that CSFs reported in the literature were of importance for project success in the military IT projects in our dataset. In particular, project manager experience and how much the client followed up during project implementation seemed to have a positive effect on project success. Lastly, clear and well-specified objectives in the project had a statistically significant effect on project success in the form of delivery of client benefits.

Regarding our third and final research question (How does project size and choice of contract type contribute to success in military IT projects?), we found that medium-sized projects performed better on delivery of client benefits compared with both large and small projects. The military IT projects in our dataset delivered better regarding cost and client benefit on fixed-price contracts, but they were more delayed than the projects that were on time and the material contracts.

Our review of the literature revealed a consistent set of critical success factors. The presence (or lack thereof) of the same factors in our study was empirically found to be a driving force in the success of the military IT projects, and we can therefore suggest some practical implications. First, in projects where client benefit is the first priority, the selection of a project manager with vast experience is recommended. Second, our study revealed that clear and stable requirements remain crucial to project success in military IT projects. The practical implication is simply that taking the time in advance to define requirements pays dividends in controlling cost and delivering on schedule. Similarly, the third practical implication relates to client follow-up. Functionality that is not performing or requirements that are not being properly developed need early client feedback. Garnering this feedback early (and iteratively) improves project performance. Thus, requirements and client feedback go hand-in-hand in terms of improving performance.

The above discussion focuses on practical steps that can be taken *during* the project. There is, however, one other practical implication of our empirical study and it involves an activity *prior to project initiation*, namely the strategic decision as to what development method to employ. As discussed in Section 2, there is a movement toward agile software development in military projects. The findings from our empirical study support the call for more agile development. The projects that applied agile principals had better results in terms of client benefit and schedule. Hence,

we suggest that military IT projects should be approached by using agile methods when the aforementioned attributes (client benefit or schedule) are most important to the organization.

5.1 Future research

The focus of this study is the characteristics of successful military IT projects. Project success and project work are both established areas within project management. At the same time, many military operations involve project work to a large extent. When new software is adapted in a military organization, one interesting question for future research that arises is whether or not the principles that guide more conventional military work are compatible with the principles applicable to modern IT projects. Although this study adds more knowledge of the adaption of agile development methods in a military context, military IT acquisitions have been more likely to rely on traditional development methods such as waterfall, in contrast to the commercial sector. Given that the adaptation of agile is relatively new in the military environment, there is a need for more empirical work comparing the military sector's agile and non-agile IT project outcomes.

5.2 Limitations

The data in our study were derived from a limited number of military IT projects, and the interviewees were selected based on availability. Therefore, our results should only with great caution be transferred to other contexts. Furthermore, IT projects are complex processes involving different stakeholders, as well as different types of competence and deliveries. To address our research questions, we chose a number of characteristics that we considered relevant, but our analysis had limitations in that important elements might have been omitted, and/or we simplified correlations between cause and effect.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available, due to military restrictions and classifications applying to the IT projects studied. Upon request, a subset of the data in which classified information has been removed can be provided.

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Appendix A. Survey questions

The survey questions were divided into groups A to F, according to the part of the research to which they related. Some questions had several sub questions, each with a unique question identity. To ensure the answers would be comparable, each question had a drop-down menu with standardized choices. All questions had an "other" or "don't know" option, as well as an option to give a more detailed answer in addition to the standardized short answers.

Question Group A: Project characteristics

Question ID	Interviewee	Question
A-1	PM	What was the planned monetary size of the project/what PM can distribute (budget)
A-2	PM	What type of IT acquisition was this project?
A-2-1	PM	If your answer is "Software," please specify
A-2-2	PM	If your answer is "Hardware only—Development," please specify
A-2-3	PM	If your answer is "Hardware only—Production," please specify
A-2-4	PM	If your answer is "Hardware only—COTS," please specify
A-2-5	PM	If your answer is "Hardware with Software," please specify
A-3	PM	If the IT acquisition contained software, what type of software development method was used in this project?
A-3-1	PM	If the IT acquisition contained software development and the development method was agile, did you have working software delivered to clients in each iteration?
A-3-2	PM	If the IT acquisition contained software development and the development method was agile, could the development team change the requirements based on client feedback?
A-4	PM	Do you consider this a complex project? The project must contain *one or more* of the following four characteristics: (1) laborious (the amount of novel (as opposed to routine) work required), (2) a large number of unknown quantities, (3) a large number of systems—in particular, legacy systems—with which the project has to integrate, (4) the project has to achieve a large number of objectives.
A-5	PM	How well did the project perform regarding costs?
A-6	PM	How well did the project perform regarding time schedule?
A-7	PM	How well did the project perform regarding client benefit (outcome)?

Question Group B: Expertise/knowledge

B-1	PM	How good do you consider the clients' expertise?
B-2	PM	How good do you consider the *supplier's* expertise in terms of similar experience and general track record?

Question Group C: Cost method

C-1	PM	What type of method was used to estimate the costs of this project?
C-2	PM	What tool was used to estimate the cost of this project?
C-3	PM	How do you consider the data availability for conducting the cost estimation (i.e., was it sufficient)?
C-4	PM	Do you consider the O&M costs to be accounted for in a satisfactory manner when the acquisition started (the milestone, when one started spending money)?

Question Group D: Critical success factors (CSFs)

D-1	PM	Were the requirements clear and well specified?
D-2	PM	Were the objectives and goals of the acquisition clear?
D-3	PM	Was the schedule realistic?
D-4	PM	Did the client follow up sufficiently throughout the project?
D-5	PM	Was the project considered as critical?

Question Group E: Other relevant factors

E-1	PM	Did the acquisition have a clear plan for benefit management (BM)?
E-2	PM	If yes, was the BM plan followed in practice?
E-3	PM	What type of contract was used?
E-4	PM	Was there any change in scope/requirements?

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Software developers reasoning behind adoption and use of software development methods – a systematic literature review

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Abstract:
When adopting and using a Software Development Method (SDM), it is important to stay true to the philosophy of the method; otherwise, software developers might execute activities that do not lead to the intended outcomes. Currently, no overview of SDM research addresses software developers' reasoning behind adopting and using SDMs. Accordingly, this paper aims to survey existing SDM research to scrutinize the current knowledge base on software developers' type of reasoning behind SDM adoption and use. We executed a systematic literature review and analyzed existing research using two steps. First, we classified papers based on what type of reasoning was addressed regarding SDM adoption and use: rational, irrational, and non-rational. Second, we made a thematic synthesis across these three types of reasoning to provide a more detailed characterization of the existing research. We elicited 28 studies addressing software developers' reasoning and identified five research themes. Building on these themes, we framed four future research directions with four broad research questions, which can be used as a basis for future research.

Keywords:
systems development method; software development method; systematic literature review; use; adoption.

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1. Introduction

Inefficient Software Development (SD) is a perennial problem in many organizations where SD projects have had difficulties in meeting their targets [1-3]. As a result, organizations have placed reliance on adopting and using Software Development Methods (SDM). An SDM is a set of standardized activities to design, build, implement, and maintain software, including how these activities are accomplished and structured, the frequency of these activities, and the goals and value behind them [4]. Decisions to adopt and use SDMs can occur "at three different levels" [5]. At the individual level, a software developer chooses an SDM, or part thereof, to support specific SD tasks. A wider agreement can be reached at the project level to adopt and use a specific SDM. Finally, at the organizational level, an SDM "can be chosen as the organization-wide "standard" method to be used in all projects" [5]. Managers are involved in coordinating the decisions to achieve the two latter levels. Thus, adopting and using SDMs are non-trivial tasks. Furthermore, it is well-recognized that SDMs are not used literally [6-8], i.e., exactly as described in textbooks. Instead, software developers modify SDMs. Researchers [9, 10] have found that some of these modifications are beneficial, creating a better fit between the SDMs and the tasks at hand. In other situations, misconceptions or malpractices have been reported [11, 12].

Although SDMs are not followed literally, it is still important that the executed activities align with the method's rationale, i.e., goals and values. SDMs are the result of design efforts, where specific design goals are set out to improve effectiveness and efficiency in SD. The Agile Manifesto [13] is one prominent example. It includes "a set of values and associated goals (referred to as principles)" [9] that guide activities found in agile SDMs. Jayaratna et al. [14] stressed the importance of SDMs' rationale, arguing that "if […] the rationale for the action is implicit then by definition the activity set cannot be considered a methodology." Similar thoughts are found in Brinkkemper [15] and Russo and Stolterman [16]. Consequently, a method's rationale is an important part of an SDM, and goals have been suggested as a vehicle to tailor SDMs to actual SD projects [e.g., 5, 17, 18]. That said, Karlsson [7] concluded that "it [the tailored method] should, at the same time, align with the basic philosophy of the original method […]. Otherwise, there is a risk of losing the method's core idea." For example, if an organization's use of an agile SDM, such as Scrum, deviates from the Agile Manifesto, there is a risk of the organization not being agile. Consequently, to understand SDM adoption and use, it is important to trace whether, and how well, executed activities align with the rationale of the SDM. According to Havstorm et al. [19] software developers' reasoning behind SDM adoption and use can be rational, irrational, or non-rational. Rational reasoning means that the intentionally chosen and executed activities align with the method's rationale, while irrational reasoning means that the intentionally chosen and executed activities misalign with the method's rationale. However, activities can also be non-rational, which means software developers have no awareness of why the activities are chosen and executed and how they align with the method's rationale.

As shown from the number of scholarly review articles in Section 2, SDM adoption and use have attracted significant research interest over the years. These reviews include the classification of SDM literature [20] and granular reviews that focus on subsets of the SDM literature, such as the benefits and limitations of agile SDMs [21] and agile smells [22]. Taken as a collective, these reviews do not provide any overview of SDM research that addresses software developers' reasoning about method rationale when adopting and using SDMs. Thus, it is difficult for researchers and practitioners to comprehend the current state of knowledge regarding this part of the SDM domain. Therefore, we submit that it is time to take stock of the SDM literature and provide an overarching representation of the this literature and software developers' reasoning about method rationale. Accordingly, the aim of this paper is to survey existing SDM research to scrutinize the current knowledge base on software developers' type of reasoning behind SDM adoption and use. We are interested in how large the existing knowledge base is in absolute terms and to understand in relative terms the extent to which the reasoning aspect behind SDM adoption and use has received any focus in SDM research. Moving beyond the quantitative measure, we are also interested in the patterns, if any, found in existing research, i.e., research themes, to characterize the knowledge base.

We pose, therefore, the following research questions (RQ):

RQ 1: To what extent has previous research investigated software developers' reasoning behind SDM adoption and use?

RQ 2: What research themes have previous research investigated concerning software developers' different types of reasoning behind SDM adoption and use?

Our results are based on a structured literature review [23] of SDM research published until 2022. The study is based on an initial search consisting of 1,619 unique research papers. Of these, 111 papers were singled out for further analysis, where we finally identified 28 relevant studies. We have developed and used an analytical framework anchored in Weber's [24] work on social actions to analyze these papers, classifying them as analyzing rational, irrational, and/or non-rational reasoning (see Section 3.3.1). Furthermore, we used thematic synthesis [25] to identify research themes across these three types of reasoning. Thus, our review contributes to a systematic understanding of what is known about software developers' type of reasoning behind SDM adoption and use and pinpoints four areas for future research.

This paper is structured as follows. Following the introduction, Section 2 describes existing SD and SDM literature reviews addressing SDM adoption and use. Section 3 presents the research method adopted for our systematic literature review. In Section 4, we present the results of our review. In Section 5, we discuss our findings and their implications for SDM research. We end the paper with a short conclusion in Section 6.

2. Related research

Given the long history of SDM research, it is not surprising that several SD and SDM literature reviews have been carried out. Table 1 summarizes existing reviews, showing the aims and how they have been categorized. For example, already in 1994, Walters et al. [26] examined "the historical development of ISDMs [Information Systems Development Method]." They also analyzed different themes of SDMs and problems with SDMs. One identified type of problem was the use of SDMs. However, as the rightmost column shows, very few reviews provide results that can be related to software developers' reasoning behind the adoption and use of SDMs.

We found five studies whose results border on our study [20-22, 27, 28]. Abrar et al. [27] reviewed research on agile SDM and large-scale development teams to identify the de-motivator factors while scaling agile. A few identified factors, such as "traditional organizational culture" and "lack of agile experts," can lead to reasoning that deviates from the chosen SDM's rationale. However, the authors did not study software developers' reasoning as such. Dybå and Dingsøyr [21] reviewed empirical papers on agile SDMs, reviewing what was currently known regarding the benefits and limitations of agile SDMs in the industry. They categorized reviewed papers into four themes, and one of them included adoption. Although Dybå and Dingsøyr [21] did not give explicit attention to software developers' reasoning behind adopting agile SDMs, their detailed description reveals that some papers have addressed why the methods have been adopted.

Iivari et al. [20] developed a framework for classifying the understanding of SDMs in previous literature and provided a structure of the intellectual core of SDMs. This framework could help practitioners understand the rationale behind their SDM practices. However, they did not compile studies on practitioners' actual understanding of the rationale. Onwujekwe and Weistroffer [28] reviewed SD literature on implementing agile SD projects in the public sector to understand how bureaucratic organizational cultures impact the use of agile SDMs. Although they address the fit between specific cultures and agile SDMs, they do not address software developers' reasoning behind adopting and using agile SDMs. Finally, Telemaco et al. [22] developed a catalog of agile SDM malpractice called "agile smells." Although the catalog is a valuable contribution to identifying malpractices in other contexts, they did not link such malpractices to software developers' reasoning.

Table 1. Overview of existing SD and SDM literature reviews

Study	Study aim	Content addressing software developers' reasoning
Abrar et al. [27]	"[I]dentify the de-motivators while scaling agile at large, from management perspectives."	Some identified factors can lead to differences in reasoning.
Alqudah and Razali [29]	Review and compare scaled agile SDMs, identifying similarities and differences.	No
Campanelli and Parreiras [30]	"[E]valuate, synthesize and present aspects of research on agile methods tailoring."	No
Dingsøyr et al. [31]	"[D]elineate the conceptual structure underlying agile scholarship."	No
Dybå and Dingsøyr [21]	"[I]nvestigates what is currently known about the benefits and limitations of, and the strength of evidence for, agile methods."	Some identified papers have addressed why the SDMs have been adopted.
Gall and Pigni [32]	Develop a conceptual framework for DevOps.	No
Gandomani et al. [33]	Assess the relationship between agile SDMs and open-source SDMs.	No
Goldkuhl and Karlsson [34]	Investigate to what extent "research literature claiming to develop or adapt ISDMs" has adopted empirical inquiries.	No
Gutiérrez-Ríos et al. [35]	Suggest factors to consider when adopting agile and/or lean practices.	No
Hassan and Mathiassen [36]	Identify the field traditions by mapping canonical SD literature.	No
Hirschheim et al. [37]	Developed a framework showing that the SD field was rightly called a "fragmented adhocracy."	No
Iivari et al. [20]	Propose a framework for classifying SDMs in literature.	The framework could help to understand the rationale behind the SDM practices used.
Matalonga et al. [38]	Identify "factors that affect the adoption of agile practices in distributed projects."	No
Mihailescu and Mihailescu [39]	"Identify theoretical perspectives applied in the conceptualization of ISDM."	No
Moloto et al. [40]	Investigate "the impact that agile method use has on project success in organizations."	No
Onwujekwe and Weistroffer [28]	Survey literature on SD projects in the public sector and how the bureaucratic nature impacts the use of agile SDMs.	Addresses the fit between specific cultures and agile SDMs.
Sambamurthy and Kirsch [41]	"This paper reviews prior research on ISD processes and identifies the different types of contributions that have been made to our growing knowledge."	No
Telemaco et al. [22]	Define a catalog of agile smell "to denote the issues and practices that may impair the adoption of the agile approach."	They catalog malpractices.
Walters et al. [26]	Examine "the historical development of ISDMs."	No

Based on the above, we conclude that there is no existing literature review on software developers' type of reasoning behind SDM adoption and use. Consequently, we have limited knowledge about the frontline of research on this aspect of SDMs.

3. Research method

Our research method followed the systematic literature review [23, 42], where we surveyed existing SDM research referred to as primary studies. The identified need for a review is accounted for in the Introduction and Related research sections, and the specified research questions are found in the Introduction. Below, we explain how we identified research, selected primary studies, and extracted data from these studies.

3.1 Identification of research

Research on SDM adoption and use appears in conference proceedings and international journals. Therefore, we aimed for an inclusive selection of papers. We used the Scopus database, the largest "database of peer-reviewed literature" [43], which includes IEEE and ACM papers. The search included papers published until April 2022. In practice, the search started in 1972 when the earliest article was published in Scopus. Our search included journal papers, conference papers, and book chapters, regardless of the geographic region. Search fields include the paper title, abstract, and keywords. Appendix A shows the total list of search queries (72 combinations of keywords). The following is an example of one of the search queries: "Software Development Method" AND "Implementation." Our combination of keywords evolved based on our reading of papers, where we identified the need for additional keywords. For example, we noticed that some well-referenced papers on SDMs, which appeared in the reference list of retrieved papers, did not appear in our search results. We decided, therefore, to add keywords used in these missing papers to extend our search. One such example is adding the keyword "diffusion."

3.2 Selection of primary studies

We did not filter any results in Scopus, which meant that all generated results were included in our selection process. As shown in Figure 1, the selection process includes four stages. The first stage employed the search queries described above and resulted in a gross list of 3,227 papers, including duplicates. In the second stage, we removed duplicates, resulting in 1,619 unique papers. In the third stage, the list of papers was divided between the authors for a screening based on reading the abstract. We used the inclusion and exclusion criteria in Table 2, and papers were classified as "potentially relevant," "need to discuss with co-author," or "not relevant." The "potentially relevant" papers were fed into the next stage without further assessment. The "need to discuss with co-author"-papers were read once more by both authors, and they made decisions on the papers based on the criteria in Table 2. All conflicts were satisfactorily resolved during the joint assessment. We had a net list of 516 papers at the end of this stage.

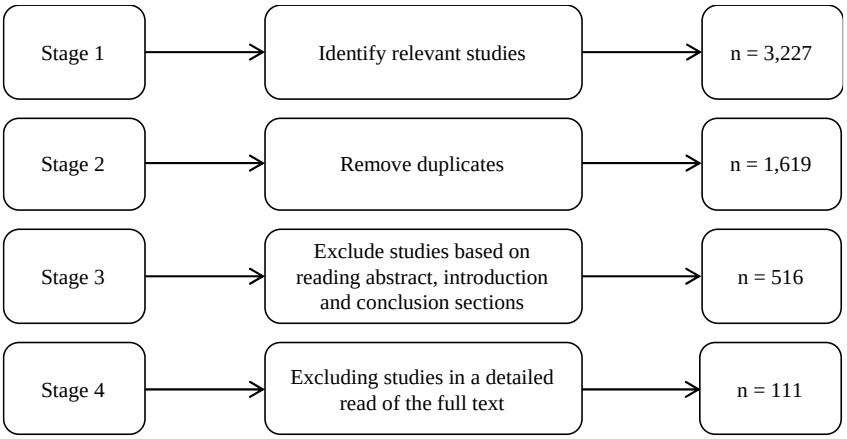

Fig. 1. Selection process

Table 2. Inclusion and exclusion criteria for primary studies

Inclusion criterion	**Exclusion criterion**
I1. The paper is written in English.	E1. The paper is an editorial.
I2. The paper is a peer-reviewed journal paper, conference paper, or book chapter.	E2. The paper is an introduction to a conference proceeding.
I3. The paper focuses on SDM as a study object.	E3. The paper is a literature review.
I4. The paper provides an empirical account, i.e., data, measurements, observations, or descriptions about adoption and/or use of SDMs.	

Papers classified as "potentially relevant" entered stage four, where both authors read and analyzed the full text of each paper. The details are provided in Section 3.3. If we found during this detailed analysis that a paper did not meet the inclusion and exclusion criteria in Table 2, it was excluded. As shown in Figure 1, we ended up with 111 papers included in the detailed analysis. The sharp reduction in potentially relevant papers was due to our inclusive search strategy. Thus, papers were included in the first dataset if they were related to SDMs. For example, an extensive number of non-empirical papers were included, papers that fall short of the inclusion criteria. Still, we chose the abovementioned search strategy to ensure we would not miss any papers by setting the search parameters too narrow.

3.3 Data extraction and analysis

The data extracted from each study were (1) Full reference (author, year, title, source name), (2) Source (journal, conference, book chapter), (3) Research question/aim, (4) Research method as classified by the authors of the paper, (5) Phases addressed (adoption, use), (6) Type of reasoning (rational, irrational, non-rational, unable to identify), and (7) Research themes addressed. The classification framework and procedures for extracting the more complex data (5 to 7) are explained in Sections 3.3.1 and 3.3.2. An overview of the assessed papers and the data extraction (1, 5, 6, and 7) is found in Appendix B; a summary is presented in Section 4.

We carried out an integrated thematic synthesis [25] to extract and analyze the data, i.e., we employed both a deductively generated framework and inductively generated codes to organize the extracted data. Cruzes and Dybå [25] argue that the integrated approach "is the most relevant in systematic reviews as they tend to be done on the basis of the theoretical interests guiding the research questions of the review." In our case, the integrated approach enabled us to be guided by our interest in software developers' reasoning and at the same time explore different directions that existing research has taken.

3.3.1 Framework to extract phase and type of reasoning addressed in primary studies

To address to what extent software developers' reasoning behind SDM adoption and use has been investigated in previous research, we need to classify the phases and the type of reasoning addressed in the primary studies. Therefore, both authors actively devised the framework shown in Table 3; the framework was reviewed informally by an external reviewer before we started our data extraction [44].

A paper could address the SDM adoption, SDM use phases, or both. Vavpotič and Hovelja [45] argue that research on SDM adoption often focuses on how and why the SDM or some of its parts are spread among potential software developers. Aligning with this view, we define SDM adoption as one or several SDMs (or parts thereof) that have been introduced into an organization or an SD team as a new way of working with SD. Regarding SDM use, we draw on Fitzgerald et al. [46] and the focus on how the software developers apply the SDM. Thus, we define SDM use as a selection or all activities of one or several SDMs that software developers have applied to develop an information system. These two definitions are ideal phases related to SDMs in organizations, although the phases often overlap in practice. An organization's adoption of an SDM means that software developers gradually start to use the method, and eventually, the adoption ends, and regular use takes over. Also, we use an inclusive definition of software developer, referring to individual software developers', an SD team's or an organization's adoption and use of SDM.

Our classification of types of reasoning takes Weber's [24] work on social actions as a point of departure. According to Weber [24], it is possible to distinguish between two types of social actions: rational and non-rational. Still, the existence of rational actions also makes it relevant to discuss irrational actions [47]. Compared to rational social action, irrational ones are flawed reasoning, resulting in, for example, misconceptions or miscalculations. In both rational and irrational reasoning, it means that such primary studies analyze arguments behind the executed activities and compare them with a reference point, i.e., the claimed method rationale. Finally, non-rational social actions are not anchored in any method rationale. Instead, these actions are based on deeply rooted habits where the software developer no longer considers rational reasons or where software developers are driven by emotional conditions [24].

Table 3. Classification of the type of reasoning addressed in the primary studies

	Phase	
Type of reasoning	**SDM adoption**	**SDM use**
Rational	Researchers in the primary study analyze whether the choice and execution of adoption activities align with the rationale (e.g., goals) of the chosen adoption approach and the adopted SDM.	Researchers in the primary study analyze whether the choice and execution of SD activities align with the rationale (e.g., goals) of the chosen SDM or some parts of this method.
Irrational	Researchers in the primary study analyze whether the choice and execution of adoption activities deviate from the rationale (e.g., goals) of the chosen adoption approach and the adopted SDM.	Researchers in the primary study analyze whether the choice and execution of SD activities deviate from the rationale (e.g., goals) of the chosen SDM or some parts of this method.
Non-Rational	Researchers in the primary study analyze whether the adoption activities are chosen and executed without awareness of the rationale (e.g., goals) of the chosen adoption approach and the adopted SDM.	Researchers in the primary study analyze whether the SD activities are chosen and executed without awareness of the rationale (e.g., goals) of the chosen SDM or some parts of this method.
Unable to identify	Researchers in the primary study analyze activities to adopt an SDM. However, the analysis does not attempt to connect these activities to the rationale (e.g., goals) of the chosen adoption approach and the adopted SDM.	Researchers in the primary study analyze SD activities. However, the analysis does not attempt to connect these activities to the rationale (e.g., goals) of the chosen SDM or some parts of this method.

The first row of Table 3 focuses on rational reasoning, where the social actions are based on rational reasoning and result, in our case, in adhering to the intended goals with either the SDM adoption or SDM use. Rational reasoning means the primary study has investigated whether the reasons behind the executed activities align with the claimed rationale. For example, if software developers claim to use Daily Scrum meetings, the claimed method rationale is "to create a shared understanding of the project status, create short term planning and achieve better interaction within the ISD team" [48]. Thus, rational reasoning is about choosing and executing activities that support these ends, such as discussing what the team members will do today. The second row in Table 3 addresses irrational reasoning. In these cases, the primary studies have investigated software developers' misconceptions or miscalculations in the SD adoption or SDM use and the misalignment with the claimed method rationale. For example, identifying the use of the Daily Scrum Meeting as a problem-solving meeting and software developers' arguing that this activity supports the ends of such a meeting.

The third row in Table 3 addresses non-rational reasoning. Primary studies are classified as non-rational when they have addressed SDM adoption or SDM use without the software developers being aware of the reasons for their activities. For example, in the case of SDM adoption, the researchers of the primaru studies have addressed whether the adoption activities are chosen and executed without awareness of the rationale of the chosen adoption approach and the adopted SDM. Finally, the fourth row in Table 3 contains the category "Unable to identify." Studies fall in this category when the analyzed primary study has addressed SDM adoption and use without investigating any connection between executed activities and any type of reasoning (rational, irrational, or non-rational).

3.3.2 Extraction of phases, type of reasoning, and research themes in primary studies

We carried out the integrated thematic synthesis using the five steps put forth by Cruzes and Dybå [25] to extract phases, types of reasoning, and research themes in the existing research. Below we discuss our tailored version of these steps, highlighting the deductive and inductive parts.

Step 1: Extract data. We familiarized ourselves with the existing research by individually reading the papers. We focused on the context descriptions (SDM and settings) and what type of analysis of the SDM adoption and/or use that existing research addressed. We made brief notes about these aspects. We also captured data extracts, i.e., quotes or text sections in the papers, that contained ideas for our characterization of the research themes. All extracted data and notes were organized in a spreadsheet.

Step 2a: Code data – deductively: We individually read the papers once more to extract the type of reasoning the primary studies addressed (if any) when investigating software developers' adoption and use of SDMs. We used an iterative approach to classify shared subsets of papers using the framework in Table 3. We discussed our individual classifications and together made a final classification. By executing the analysis on subsets of papers, we could learn from each other and develop a shared understanding of how to use the classification framework [44].

Step 2b: Code data – inductively. When reading the papers in Step 2a, we also created initial inductive codes for each of the papers included in the three topmost rows in Table 3. The reason for not creating inductive codes for papers classified as "Unable to identify" is our specific interest in the type of reasoning behind software developers' adoption and use of SDMs. One example of our inductive coding is the paper by Häggmark and Ågerfalk [10], which received the codes "Different rationalities behind method use" and "How method has been adjusted." Thus, we allowed ourselves to associate a paper with one or more codes because papers can have multiple purposes. Like step 2a, our work was highly iterative, comparing the codes generated by our individual reads of the papers. The purpose was to improve our reading and develop a shared understanding of the initial codes for the upcoming search for research themes [44]. The spreadsheet documented our collection of inductive codes, linking them to the extracted data. We also added additional quotes or summaries when necessary.

Step 3: Translate inductive codes into themes. We used our collection of inductive codes from Step 2b as input for workshops in which both authors participated. These workshops aimed to develop a set of themes, so we iterated our codes and searched for what they had in common. We organized our research themes using mind maps and traced how the inductive codes could potentially be linked to research themes. These mind maps allowed us to scrutinize the congruence of the research themes and move codes when necessary. For example, the inductive code "Different rationalities behind method use" introduced above was included in the research theme "Competing rationalities." It again meant an iterative work pattern, constantly comparing inductive codes, data extracts, and candidate research themes. The iterative work resulted in both moving inductive codes and collapsing research themes into each other to better reflect the underlying papers.

Step 4: Create a model of higher-order themes. Given our interest in different types of reasoning behind SDM adoption and use, we combined the identified research themes with our deductive classification of papers in Step 2b. Consequently, this meant identifying if and to what extent different types of reasoning had been studied for the identified research themes. Thus, we created higher-order themes, or patterns, for each research theme. Furthermore, we also settled on a description of each research theme that captured its essence; it meant summarizing the papers and providing coherent and internally consistent accounts. For the research theme exemplified above, we decided to keep the name "Competing rationalities," which we defined as how software developers deal with and prioritize conflicting rationalities during the adoption and use of SDMs.

Step 5: Assess the trustworthiness of the synthesis. Both authors reviewed the research themes during a second set of workshops. First, we analyzed the fit between the claims made about the research themes and "what the evidence shows" [25], i.e., what the data extracts show. Sometimes, it also meant returning to the actual papers and rereading paragraphs. Second, we analyzed the fit between the research themes and the overall focus of our analysis. We made minor adjustments to the synthesis; a couple of papers were moved to create a better fit. Completing our running example discussed above, we identified eight papers for the candidate research theme "Competing rationalities."

4. Results

In this section, we present a summary of our systematic literature review, structured according to our two research questions. The first subsection addresses to what extent the reasoning behind SDM adoption and SDM use has been investigated in previous research. In the second subsection, we detail the research themes and how reasoning – rational, irrational, and non-rational – behind SDM adoption and use has been addressed in existing research. The overview of the analysis is found in Appendix B.

4.1 RQ1 – To what extent has previous research investigated software developers' reasoning behind SDM adoption and use?

The analysis of the extent to which research has addressed the reasoning behind SDM adoption and use is presented in Figure 2 using a bubble chart. A bubble chart shows three dimensions of the data. The horizontal axis contains the two phases, SDM adoption and use. The vertical axis shows whether a primary study has addressed any type of reasoning behind the studied activities. The bubble size is proportional to the frequency of primary studies in the pair of categories corresponding to the bubble coordinates.

Starting on the horizontal axis in Figure 2, we see that SDM adoption has received more research attention than SDM use, 54.5 percent versus 45.4 percent. In addition, it should be noted that eight primary studies address both SDM adoption and use. The vertical axis in Figure 2 shows that most primary studies (76.4 percent) do not investigate software developers' reasoning behind SDM adoption or SDM use. Thus, 23.6 percent of all studies addressed software developers' reasoning behind their SDM adoption or SDM use.

The intersections in Figure 2 show that the largest share of studies addresses SDM adoption without focusing on the reasoning behind these activities. These primary studies give accounts of activities and experiences from adopting one or more SDMs without any inquiry into the reasoning during the adoption. Thus, these studies do not analyze how the software developers' reasoning aligns with the rationale of the adoption approach and the adopted SDM. We identified studies addressing, for example, diffusion of SDMs [e.g. 45, 49, 50], challenges with SDM adoption [e.g. 51, 52, 53], factors that affect SDM adoption [e.g. 54, 55, 56] and experiences of SDM adoption [57-59].

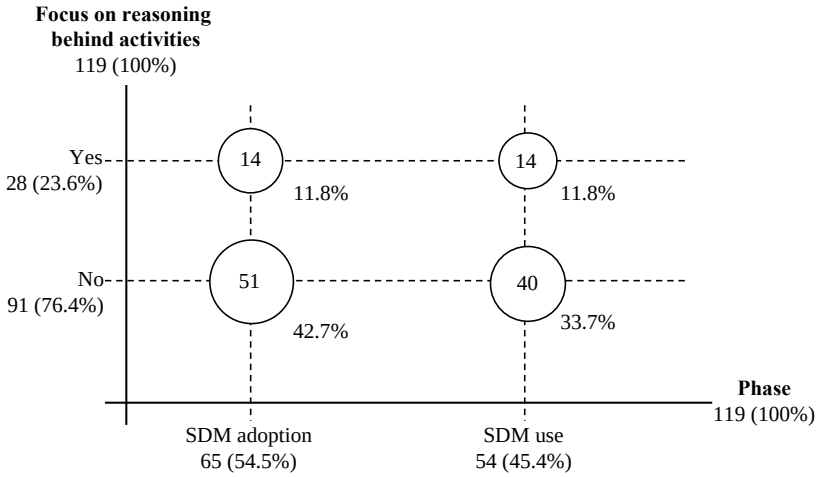

Fig. 2. The focus of existing research on the reasoning behind SDM adoption and use

Note: Please note that papers can address both SDM adoption and use, which means that the total number of primary studies that address the phases exceeds the actual number of primary studies.

The next largest share of primary studies addresses SDM use without focusing on the reasoning behind the SD activities. Topic-wise, these studies are similar to the SDM adoption papers; they give accounts of activities and experiences from using one or more SDMs. We identified studies addressing what SDMs are used [e.g. 60, 61, 62], the experience of SDM use [e.g. 63, 64, 65], non-rigors use of SDMs [e.g. 66, 67, 68], and factors that affect SDM use [69, 70]. Yet again, these studies do not include any analysis of how the software developers have reasoned about the SDM during use and how their reasoning aligns with the rationale of the used SDM.

Turning our attention to the research that has addressed the reasoning behind SDM adoption and use, as the vertical axis in Figure 2 shows, we identified 28 primary studies. The number of primary studies that analyzed software developers' reasoning behind SDM adoption and use is similar; 14 papers addressed SDM adoption, and 14 papers addressed SDM

use. In these primary studies, researchers have identified some method rationale that has been used as a reference point for analyzing SDM adoption and/or SDM use. Thus, these reference points made it possible for us to analyze what types of reasoning have been addressed. We scrutinize these papers in more detail in the next sub-section.

4.2 RQ2 – What research themes have previous research investigated concerning software developers' different types of reasoning behind SDM adoption and use?

Table 4 presents an overview of how the 28 primary studies were distributed across the research themes, two phases, and types of reasoning. It is important to note that primary studies can address multiple research themes and types of reasoning; however, we did not find any primary studies that addressed both phases. The bottom row in Table 4 shows that we identified 21 primary studies addressing rational reasoning, 11 primary studies addressing irrational reasoning, and three primary studies addressing non-rational reasoning. Below we present our analysis using the identified research themes. We present how the different types of reasoning have been addressed in combination with SDM adoption and use for each research theme.

Table 4. Overview of research themes and types of reasoning

		Type of reasoning			
Research theme	**Phase**	**Rational**	**Irrational**	**Non-rational**	**Total**
Choice of SDM	Adoption	5	0	0	5
Competing rationalities	Adoption	1	3	0	8
	Use	4	1	0	
Method deviation	Adoption	0	0	2	10
	Use	6	2	0	
Understanding operationalization	Adoption	2	1	0	7
	Use	1	2	1	
Achieved contribution	Adoption	0	3	0	5
	Use	2	0	0	
Total		21	11	3	35

4.2.1 Choice of SDM

The research theme, Choice of SDM, captures existing research focusing on how the rationale of the chosen SDMs fits the situation at hand. Each SDM comes with its own rationale, and this rationale can align with what the software developers want to achieve to varying degrees. A well-suited choice means an SDM that provides support, whereas an ill-suited SDM provides less support or, in the worst case, creates obstacles. Table 4 shows that five primary studies belong to this theme. All these studies address SDM adoption and rational reasoning behind the choice of SDMs [71-75]. Thus, existing research has not focused on investigating misconceptions made when choosing methods or, if choices are made, without awareness of the chosen SDM's rationale.

SDM adoption – rational reasoning. Vejandla and Sherrell [71] described practitioners' experiences from adopting eXtreme Programming and test-driven development. For example, they described how the goals of test-driven development fit the situation at hand, i.e., providing means-end reasoning. Mishra and Mishra [72] illustrated how agile methods could be adopted in complex SD projects. They gave an account of the choices made regarding the combination of method parts and how these choices were consciously anchored in the goals behind the SDMs. Taylor et al. [73] illustrated how risk assessment could be combined with the rationale behind agile practices to guide the adoption of an SDM and to create a situational fit. Tripp and Amstrong [74] carried out a high-level analysis of how agile practices were matched with organizations' intentions to improve software quality and improve SD efficiency and effectiveness. They argued that a misfit between intentions and the agile practices utilized might decrease the overall success of the adoption. Finally, Alt et al. [75] developed an agile DevOps framework and described the goals they wanted to reach. They described a transformation plan, consistent with these goals, and provided lessons learned from the method transformation. Based on the transformation process, they identified both success factors and challenges, which includes an awareness of why the different practices were selected and adopted.

4.2.2 Competing rationalities

The research theme, Competing rationalities, includes primary studies that address how software developers deal with and prioritize conflicting rationalities during the adoption and use of SDMs. These studies show that SDM adoption and use take place in a context. Software developers interact with other parts of the organization or with other organizations, which means that there are other goals and values at play at the same time. More importantly, sometimes, different goals and values compete, and software developers must choose between them. Thus, software developers' choices can be rational, irrational, or non-rational in relation to the goals and values they prioritize. As shown in Table 4, eight primary studies are found in this research theme, divided across rational and irrational reasoning behind SDM adoption and rational and irrational reasoning behind SDM use.

SDM adoption – rational reasoning. We identified one primary study analyzing rational reasoning when competing rationalities were encountered during SDM adoption. Sauer and Lau [76] analyzed how different rationalities come into play in SDM adoption. They highlight the role of business managers in bringing the adoption of the Structured Systems Analysis and Design Method (SSADM) to a halt, where business pressure influenced and overrode the SDM goals. Although software developers were aware of the potential contribution that the SDM could make, they did not persist in pursuing the started adoption activities. The study shows software developers' awareness of the reference point and activities that indicated an understanding of the SDM and its potential contributions. However, because software developers and business managers have competing rationalities, the SDM adoption did not unfold as planned.

SDM adoption – irrational reasoning. We found two primary studies that focus on irrational reasoning concerning competing rationalities and SDM adoption [77, 78]. McAvoy and Butler [77] examined the failure to change from a traditional SDM to an agile SDM. They analyzed how software developers' initial commitment to user stories changed over time, going from commitment to resisting the change. They found that loyalties to the team, in this case, hierarchical groupthink and a need to please the project managers, made the team members deviate from the rationale of user stories. In the end, the team abandoned its adoption of user stories. McAvoy and Butler [78] studied factors needed to succeed with the implementation of method values and how learning occurred in the introduction of an SDM. They found that even though software developers individually understood and agreed on the values of a selected method part, power factors in the team made them deviate from the SDM when introduced. Thus, these power factors resulted in executed activities not being in line with the stated goals.

SDM use – rational reasoning. We found four primary studies that address rational reasoning when competing rationalities were encountered during SDM use [10, 79-81]. Strode et al. [79] studied the extent to which the organizational culture (values and assumptions) matched the values of used agile methods. They built on the idea "that the organizational culture in which the agile method is embedded could have an impact on its use." Their study suggested that organizations with an external focus and preferences for flexibility align with the rationale of agile SDMs. Dennehy and Conboy [80] showed how different interests can be a source of tension when software developers are using an SDM and when introducing tools to support features of the SDM. Häggmark and Ågerfalk [10] did an "empirical enquiry into why engineers do not keep to the principle of separating business logic from display." These software developers provided arguments for the tailored version of the assessed SD principle, prioritizing other goals than prescribed by the SDM. Mohan et al. [81] have studied individuals' attachment to and identification and involvement with prescribed SDM activities, i.e., an inquiry into software developers' buy-in to the rationale behind SDMs. They divided SDM use into three categories, committed use, compliant use, and resistant use, and investigated how an SDM's relative advantage, complexity, and combability affect these use categories. For example, they found a positive effect of combability, i.e., that the SDM is consistent with the "social cultural values, and past experiences of potential users" on committed use. Thus, if the rationale of the SDM fits the cultural values of the organization, the likelihood increases that actual execution will build on and be in line with the rationale of the SDM.

SDM use – irrational reasoning. We identified one primary study that analyzed irrational reasoning. Mohan et al. [81] found that software developers' attachment to and identification and involvement with the prescribed SDM activities could result in committed use and resistance use. When software developers feel inequity in executing the prescribed SDM activities, they oppose them. They found that the less the compliance between the chosen SDM and the cultural

values in the organization, the more likely is resistance use. In other words, it might result in software developers resorting to other ways of working that are not in line with the rationale of the chosen SDM.

4.2.3 Method deviation

The research theme, Method deviation, organizes studies that identify and explain deviations from the adoption approach and the adopted SDMs, or the used SDM. These studies show that software developers do not introduce or apply SDMs as they are presented in the textbox. Thus, the enacted versions deviate from what is described. Studies in this research theme go beyond identifying the deviations as such; they address how the deviations relate to the rationale of the SDM. As shown in Table 4, ten primary studies belong to this research theme, covering non-rational SDM adoption, rational SDM use, and irrational SDM use.

SDM adoption – non-rational. We found two primary studies that addressed non-rational reasoning [82, 83]. Patanakul and Rufo-McCarron [82] identified six challenges in an agile implementation program. One of these challenges was change management. They concluded that effective change management is needed to avoid actors sticking to a specific mindset that can lead to destructive behaviors where the rationale of the practices is not met. Berger and Beynon-Davies [83] studied the unbundling, i.e., adoption, of an SDM in a large-scale development project. In this public-sector project in the UK, an external company suggested using "their own in-house commercial RAD-like development approach" during SD work in the client organization. Although, over time, the adoption resulted in the successful diffusion of "certain SDM practices with the case organisation," the adoption itself was problematic. Berger and Beynon-Davis found that the actors paid limited attention to how the SDM rationale differed from culture in the case organization, showing an unawareness of the fit of the SDM and its rationale. For example, the organizational culture stressed "individuality and individual accountability," which made organizational stakeholders unwilling to commit to fast decision-making in the iterative development process prescribed by the adopted SDM.

SDM use – rational reasoning. We identified six papers that addressed rational reasoning behind method deviation during SDM use [10, 11, 84-86]. Heikkilä et al. [11] studied the phenomenon of "ScrumBut," which refers to mismatches between the prescribed and the actual use of Scrum. They identified a couple of deviations from how Scrum is prescribed, and some of these were conscious improvements to Scrum in line with the goals of the SDM. Häggmark and Ågerfalk [10], discussed above, studied how software developers deviated from the SD principle of separating business logic from display. They found that some of the software developers "had a more conscious departure from the strict tier-separation, with clear arguments of why they did what they did." Thus, the software developers showed awareness of the principle and its goals. At the same time, they provided arguments for their deviation showing a conscious means-end decision to tailor the SDM.

In their study of SSADM, Middleton [84, 85] and Middleton and McCollum [86] concluded that, in most of the projects they investigated, the SDM was tailored "beyond recognition" and altered the SDM's foundation. However, in some of these projects, the modifications resulted from limitations in the SSADM and not a lack of understanding of the method rationale of the SDM. For example, Middleton [84, 85] described SSADM's type of user involvement as superficial, and, therefore, modifications were made to the SDM to reach the user involvement goals. Thus, these modifications were based on rational reasoning, where the software developers moved beyond the rigid use of the SDM. Chen et al. [87] analyzed the use of a modified version of Scrum that implemented unified modeling language diagrams. Thus, they give an account of a planned method deviation and how the used SDM aligned with the modified rationale.

SDM use – irrational reasoning. We found two papers that captured irrational reasoning behind method deviation during SDM use [11, 88]. In their study of ScrumButs, discussed above, Heikkilä et al. [11] identified changes to two Scrum practices that could not be fully explained by a real need and a deep understanding of what makes Scrum work. For example, they found user stories that were active over several sprints because of competence issues and not planning according to the sprint's actual resources. Thus, such activities contradict the intended goal of the SDM. Saarinen [88] studied how prototyping strategies had been used and whether use in actual SD projects was in line with the high-level recommendations of the method. He found, for example, that prototyping strategies had been employed when requirements were easy to specify. He also found that prototyping strategies were used regardless of the uncertainty level, which is inconsistent with high-level recommendations.

4.2.4 Understanding operationalization

The research theme, Understanding operationalization, captures primary studies that address the driving actors' understanding of how the SDM activities implement the rationale of the SDM. These studies focus on software developers' awareness and understanding of the method rationale plays a role in how the SDM adoption and use unfolds. It is shown that software developers both show awareness of the chosen SDM's rationale, how the chosen activities align with the rationale, and where misconceptions result in misalignment. Furthermore, existing research on this theme also shows that software developers sometimes are unaware of why they carry out activities and how they relate to the claimed SDM's rationale. As shown in Table 4, this theme consists of seven primary studies, which address rational, irrational behind SDM adoption and rationale, irrational, and non-rational reasoning behind SDM and use.

SDM adoption – rational reasoning. In total, we identified two primary studies that analyzed rational reasoning during SDM adoption [89, 90]. Andersson and Nilsson [89] studied several SDM adoption projects in a large SD organization. They assessed whether the adoption projects paid attention to the rationale of the chosen SDM and to what extent the rationale was used for monitoring and evaluation. The authors drew lessons learned from the mixed results in the studied projects. They found that projects defined clear goals but differed in communicating and evaluating them. Consequently, they concluded that these latter activities are important to improve future SDM adoptions. To improve adoption, Hazzan and Dubinsky [90] studied how the awareness of the principles behind an SDM was used by a "task force" to introduce an SDM lifestyle in an organization. Thus, the task force used the underlying goals and values of the SDM in a conscious design of the adoption process, showing an understanding of the method rationale.

SDM adoption – irrational reasoning. We found one primary study that analyzed irrational reasoning during SDM adoption. The previously discussed study by Andersson and Nilsson [89] on SDM adoption came across irrational activities. In their assessment of how adoption projects' paid attention to the rationale of the chosen SDM, they found that two out of the four studied projects failed due to deviations from stated goals, i.e., by executing irrational activities. Although these failed projects had clear goals, they were not communicated and resulted in deviation from the rationale of the SDM adoption.

SDM use – rational reasoning. We found one primary study that analyzed rational reasoning behind SDM use. Mäki-Runsas [91] studied software developers to identify potential SDM cargo cult behavior. She investigated the extent to which the executed activities in an SD team's Daily Scrum Meetings corresponded with the intended goals of such meetings. She found that the software developers focused on what each developer had done, current hindrances, and what they would do in the current day. Thus, these activities were in line with the SDM's rationale.

SDM use – irrational reasoning. We identified two primary studies that analyzed irrational reasoning during SDM use [91, 92]. Mnkandla and Dwolatzky [92] studied an SD organization that tried to adhere to a set of agile principles, although they did not follow a specific SDM. Although the project was, to some extent, found successful, it was not due to these principles. They found that the organization's way of working, in some cases, contradicted the agile principles. Thus, the analysis showed a lack of understanding of the agile principles; that is, the actual implementation of these principles can be viewed as irrational. In Mäki-Runsas' [91] study about potential SDM cargo cult behavior, discussed above, she also addressed irrational activities. In her analysis of an SD team's Daily Scrum Meetings, she found irrational activities due to malpractices. It means that the SD team carried out these meetings incorrectly in relation to the goals. For example, the SD team used Daily Scrum Meetings to "discuss reports from a long-term perspective or discuss technical solutions."

SDM use – non-rational reasoning. We found one primary study that addresses non-rational reasoning. Mäki-Runsas [91] identified activities in an SD team's Daily Scrum Meetings that were non-rational. These non-rational activities were old habits that the SD team had kept after the studied organization had adopted Scrum as their way of working. For example, the Scrum master informed about and introduced new requirements from upper management during Daily Scrum Meetings. Thus, these new requirements changed priorities "in the middle of an ongoing sprint"; the activity could be traced back to unawareness of continuing old practices.

4.2.5 Achieved contribution

The research theme, Achieved contribution, includes primary studies that focus on to what extent the potential contribution of a chosen SDM has been reached during adoption and use. These studies relate the rationale of the SDM to the achieved results and assess to what extent and how the introduction or applied activities have contributed or not. As shown in Table 4, this research theme includes five primary studies that addressed irrational reasoning behind SDM adoption and rational reasoning behind SDM use. Thus, studies on SDM adoption have focused on why goals are not reached, whereas studies on SDM use have focused on the customization of the SDM and its method rationale.

SDM adoption – irrational reasoning. We identified three primary studies that analyzed irrational reasoning behind SDM adoption [82, 93, 94]. Roberts Jr et al. [93] found SDM practices that contributed less than expected. They argued that organizational actors do not always align with the stated goals. Instead, passive resistance misuse was mixed into the SDM adoption, which means deviating from the rationale of the SDM. Therefore, they called for more research that "move[s] beyond the rational model" of SDM adoption. Mohallel and Bass [94] found that some SD teams had difficulties adhering to the adopted practices' agile principles, which resulted in the SDM not contributing as expected. For example, they identified a "lack of cadence in sprint planning meetings, inadequate use of effort estimation and product quality issues." Thus, they found signs of irrational SDM adoption, where teams chose dynamic sprint lengths without understanding the consequences of such a choice, for example, its impact on estimates. Patanakul and Rufo-McCarron [82] identified six challenges in the transition from traditional SDMs to agile SDMs. One reason present in several of these challenges is that those project actors did not fully understand what the introduced practices could contribute to, i.e., the goals. They conclude that it can lead to destructive behaviors, where the intentions with the practices are not met and executed activities do not follow the SDM's rationale.

SDM use – rational reasoning. We identified two primary studies that addressed rational reasoning behind SDM use [95, 96]. Soundararajan et al. [95] investigated how a customized agile SDM contributes to organizational objectives. Therefore, they proposed a framework for this type of analysis using three concepts: adequacy, capability, and effectiveness. Regarding rational reasoning, two of these concepts, adequacy and effectiveness, are interesting. Adequacy means an assessment of the "sufficiency of the method with respect to meeting its stated objectives," i.e., a possibility to analyze how tailored instances of SDMs meet its stated objectives. Effectiveness addresses "how well the adopted method actually achieves its stated objectives," and the concept was used to assess the achievements of stated objectives. The framework has been implemented as a survey, and preliminary findings were presented on the adequacy of SDMs. Clark et al. [96] presented a modified version of Scrum to infuse medical research into the SD process. They provided a rationale for the added method steps, showing what type of additional understanding the new steps contribute. Furthermore, they provided an account for their use of the added method steps that align with the provided rationale.

5. Discussion

SDMs have been on the research agenda for several decades [97]; however, there is no systematic literature review on software developers' types of reasoning behind adopting and using SDMs. Although some existing literature reviews have resulted in different types of SDM frameworks [e.g., 20, 39, 98], none include or address the reasoning aspect. Thus, our study contributes to a systematic overview of primary studies on this part of the SDM domain.

5.1 RQ 1 - To what extent has previous research investigated software developers' reasoning behind SDM adoption and use?

In our analysis of existing research on SDM adoption and use, we identified 111 empirical SDM studies. Of these studies, 28 papers addressed software developers' reasoning behind SDM adoption and use. Consequently, as shown in Figure 2, this group of papers constitutes a significant part of the knowledge base, with an equal focus on adoption and use. Still, the details in Table 4 show that most of these studies have investigated rational SDM adoption and use; much less attention has been given to irrational types of activities, and almost no attention has been given to non-rational

activities. This finding is somewhat surprising and unexpected since SDM research has such a long history, and SDM use was identified as a challenging area very early [26].

In most cases, the choice to adopt and use SDMs is associated with significant organizational investments. Such investments should lead to interest among researchers and practitioners in understanding software developers' irrational and non-rational SDM adoption and use. In addition, it is a well-known fact that software developers use their situational knowledge when adopting and using SDMs [46], which means that SDMs are not followed literally. However, research on the adoption and use of SDMs seems to have considered rational activities predominantly, something that has not been evident from existing literature reviews on SDMs. For example, Abrahamsson et al.'s [99] review focused on successful stories, making it reasonable that they did not address irrational and non-rational SDM adoption and use activities.

Taken collectively, our results show that existing empirical research on SDM adoption and use provides limited advice and guidance on identifying and dealing with irrational and non-rational adoption and use activities. The rather limited attention to these types of activities indicates that previous research might have missed one important aspect when analyzing successful as well as flawed SDM adoption and use. Indeed, at the general level, this finding points toward a knowledge gap in empirical SDM research and provides an important opportunity for future research: to explore irrational and non-rational SDM adoption and use activities. Such research is important for understanding and improving future advice to practitioners on how to adopt and use SDMs.

We do not claim that stressing the importance of understanding the rationale behind SDMs is new in SDM research. In their literature review of SDMs, Iivari et al. [20] discussed the importance of understanding the philosophy of the chosen SDM to be able to reach the method's intended goals and values. In addition, they discussed how their framework could help practitioners understand the rationale behind the SDM practices they are using. Otherwise, the software developers will have a "professional blind spot" [20] and thus run the risk of irrational or non-rational SDM adoption and use. However, our results show that researchers have made limited contributions to knowledge about the existence of this professional blind spot in practice and its consequences on SDM adoption and use. Of course, SDMs have advanced since Iivari et al. [20] compiled their framework, making the covered SDM content outdated. Nevertheless, the fundamental idea of understanding and working in line with the chosen SDM's rationale is still valid.

5.2 RQ2 – What research themes have previous research investigated concerning software developers' different types of reasoning behind SDM adoption and use?

Our thematic synthesis of existing research revealed five research themes in previous research: 1) Choice of SDM, 2) Competing rationalities, 3) Method deviation, 4) Understanding operationalization, and 5) Achieved contribution. As shown in Table 4, four of these research themes – Competing rationalities, Method deviation, Understanding operationalization, and Achieved contributions – span both the adoption and use of SDM. Table 4 also shows a detailed view of how the three types of reasoning have been investigated across the identified research themes. We found that all the research themes have covered rational reasoning, which is not that surprising given our discussion about SDM adoption and use being predominantly treated as rational activities. A more scattered pattern is found in analyses of software developers' irrational and non-rational reasoning. Thus, these results indicate that the research community knows less about software developers' irrational and non-rational reasoning behind SDM adoption and use, where a knowledge gap in one research theme can impact the understanding of another research theme.

To identify gaps and develop them into tangible opportunities for future research, we outline a series of theoretical relationships in Figure 3. Thus, the model in Figure 3 proposes new links between the research themes and highlights specific future research directions. To aid in framing these directions for researchers, we further develop a series of possible broad research questions that could be explored.

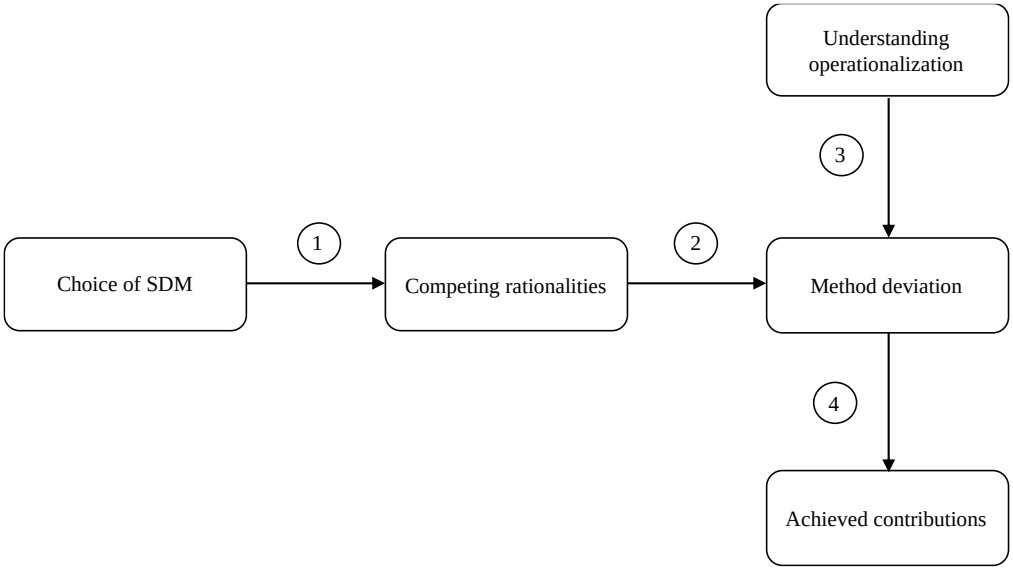

Fig. 3. Identified relationships between the research themes

Relationship #1: Consider how the rational, irrational, or non-rational choice of SDM impacts competing rationalities in SDM adoption and use. The research theme, Choice of SDM, focuses on how software developers connect the SDM rationale to the organizations' goals, which becomes the motives for choosing a particular SDM or part thereof. When choosing an SDM to adopt, the rationale of the method must fit the organization and the situation at hand. Thus, existing research has focused on investigating these choices as rational decisions [71-75]. However, if the rationale of the chosen SDM does not align with organizational goals, the method will add conflicting rationalities that have to be resolved later [e.g., 76, 79]. Our results show that we lack knowledge of whether and to what extent software developers make irrational choices, where the SDM rationale will not contribute to the organizational goals, or make non-rational choices, where there is now awareness if the SDM rationale aligns with the organizational goals. An opportunity exists to develop an increased understanding of how rational, irrational, or non-rational SDM choices impact competing rationalities in SDM adoption and use. Future research could, therefore, consider questions such as: To what extent do rational, irrational, or non-rational SDM choices lead to competing rationalities in organizations?

Relationship #2: Consider how competing rationalities in SDM adoption and use drive rational, irrational, or non-rational method deviation. Existing studies in the research theme of Competing rationalities show how software developers address and prioritize conflicting goals and values during the SDM adoption [76] and use [10, 79-81]. In order to manage such conflicts, first of all, it requires awareness of them, and second, that chosen adoption and use activities align with the prioritized rationale, i.e., to implement the choices rationally. Moreover, when software developers are placed in situations where they must prioritize between different goals, the result might not be what the organization expects [77, 78, 81]. Our results show that the Competing rationalities research theme focuses on how to deal with conflicting rationalities as rational and irrational choices. Thus, less attention has been given to unawareness of these conflicts that result in non-rational choices. At the same time, we found studies in the Method deviation research theme showing that rational [10, 11, 84-86], as well as irrational [11, 88] and non-rational [82, 83], deviations from the chosen SDM are made. We do not argue that these two research themes have been researched independently; the opposite is shown in, for example, Häggmark and Ågerfalk [10]. Still, there is a need to develop a deeper understanding of competing rationalities as a driver for SDM deviations, in particular, related to irrational and non-rational method deviations. Therefore, future research could pose questions such as: How do software developers deal with competing rationalities doing rational, irrational, and non-rational tailoring of SDMs?

Relationship #3: Consider how software developers understand SDM impacts method deviations. Existing studies in the research theme Understanding operationalization contribute to an increased understanding of how software developers operationalize SDM activities to achieve claimed goals. Our findings show that, in the research theme Understanding operationalization, existing research has covered all three types of reasoning, i.e, rational [89-91], irrational use [91, 92], and non-rational [91] reasoning. Thus, such results provide an important understanding of why software developers deviate from SDMs [10, 11, 84-86]; that is, there is an important relation to the Method deviation research theme. Although research in Understanding operationalization covers all three types of reasoning, we still see opportunities to research how the software developers understanding of the SDMs impacts method deviations. Because if software developers can avoid misconceptions, they can potentially reduce irrational method deviations. Such research could pose questions such as: How does software developers' understanding of SDM contribute to rational, irrational, and non-rational method deviations during adoption and use?

Relationship #4: Consider how consequences of rational, irrational, and non-rational method deviations impact achieved contributions. At the end of the day, the achieved contributions from adopting and using SDMs are important since organizations adopt and use SDMs to improve their SD. We found that studies in the Achieved contribution research theme covered rational [82, 93, 94] and irrational [95, 96] reasoning. We could not identify research investigating non-rational aspects of the achieved contribution. At the same time, it is not an extensively researched theme. Moreover, the achieved results should depended on the method deviations made [e.g., 10, 11, 88]. Of course, we do not argue that all method deviations result in negative contributions and that SDMs should be used rigorously. Such a view would be at odds with existing research on how SDMs are used [6-8]. Instead, and as shown in Figure 3, we suggest that more complex mechanisms are at play – competing rationalities and understanding operationalization – leading to (lack of) the achieved contributions; these mechanisms are materialized in method deviations that can be rational, irrational, or non-rational.

An increased understanding of how method deviations impact achieved contributions can be reached by posing questions such as: How do software developers' rational, irrational, and non-rational method deviations impact achieved contributions of SDM adoption and use?

5.3 Limitations

As with all studies, our study design has limitations. First, our findings rely on our search strategy and our selection of papers. We have been transparent with our selection of papers based on searches in the Scopus database. Of course, other search strategies could have been possible, such as the ones used by Goldkuhl and Karlsson [34] or Dybå and Dingsøyr [21]. Thus, we do not claim to have identified all empirical studies on SDM adoption and use.

Second, using our analytical framework in Tables 2 and the thematic synthesis involved subjective judgment. Classifying papers into different research themes and types of analyzed reasoning was not always an instrumental task. Due to the iterative nature of our coding process, we achieved reliability in our results by comparing and combining the author's individual analyses. Furthermore, we have tried to make the analysis as transparent as possible by providing the complete classification of papers in Appendix B, making it possible to scrutinize the analysis in detail.

Third, using an inductive categorization of existing research means a limitation when it comes to identifying avenues for future research. We have used the rear mirror to explore how much attention the identified research themes have received. Naturally, our strategy provides limited possibilities to identify blind spots in existing research, i.e., problems in practice that have not been addressed. Thus, we do not claim that the less researched areas identified in Table 4 and the research directions outlined above are the only potential avenues for future research on software developers' type of reasoning behind the adoption and use of SDMs.

6. Conclusion

This paper aimed to survey existing Software Development Method (SDM) research to scrutinize the current knowledge base on software developers' type of reasoning behind SDM adoption and use. To this end, we have used an analytical framework anchored in Weber's [24] work on social actions, classifying studies as analyzing rational, irrational, and/or non-rational reasoning. We identified 111 empirical studies on SDM adoption and SDM use, of which 28 addressed software developers' reasoning behind these activities; 14 addressed SDM adoption, and 14 addressed SDM use. Consequently, research on software developers' reasoning constitutes a significant part of the knowledge base. We also conclude that research on software developers' reasoning has predominantly considered SDM adoption and use as rational activities.

Our inductive analysis of empirical studies that addressed software developers' reasoning behind SDM adoption and SDM use resulted in five research themes: 1) Choice of SDM, 2) Competing rationalities, 3) Method deviation, 4) Understanding operationalization, and 5) Achieved contribution. More importantly, we used these themes to frame four future research directions together with a set of broad research questions summarized in Table 5. Although our results do not highlight an exhaustive listing of future research directions, they represent a series of notable examples of gaps that currently exist in the SDM field.

Table 5. Future research directions and research questions

No	Research direction	Research question
1	Consider how the rational, irrational, or non-rational choice of SDM impacts competing rationalities in SDM adoption and use	To what extent do rational, irrational, or non-rational SDM choices lead to competing rationalities in organizations?
2	Consider how competing rationalities in SDM adoption and use drive rational, irrational, or non-rational method deviation	How do software developers deal with competing rationalities when doing rational, irrational, and non-rational tailoring of SDMs?
3	Consider how software developers understand SDM impacts method deviations	How does software developers' understanding of SDM contribute to rational, irrational, and non-rational method deviations during adoption and use?
4	Consider how consequences of rational, irrational, and non-rational method deviations impact achieved contributions	How do software developers' rational, irrational, and non-rational method deviations impact achieved contributions of SDM adoption and use?

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Appendix A. Search queries and results

Table A1 shows the search queries that were used for searching in Scopus and the results from our searches. For searching in the database, a combination of search query 1 and search query 2 was used. For example, as the first row in the table shows, the result of searching "Systems Development Method" and "Use" in Scopus generated 192 papers.

Table A1. Combinations of search criteria that generated search results

Search query 1	Search query 2	Number of papers
Systems Development Method	Use	192
Systems Development Method	Utilizing	7
Systems Development Method	Usage	11
Systems Development Method	Adoption	25
Systems Development Method	Implementation	79
Systems Development Method	Method Rationale	6
Systems Development Method	Rationality Resonance	0
Systems Development Method	Customize	0
Systems Development Method	Diffusion	7
Systems Engineering Method	Use	116
Systems Engineering Method	Utilizing	6
Systems Engineering Method	Usage	5
Systems Engineering Method	Adoption	7
Systems Engineering Method	Implementation	48
Systems Engineering Method	Method Rationale	1
Systems Engineering Method	Rationality Resonance	0
Systems Engineering Method	Customize	1
Systems Engineering Method	Diffusion	1
Systems Development Methodology	Use	195
Systems Development Methodology	Utilizing	3
Systems Development Methodology	Usage	28
Systems Development Methodology	Adoption	29
Systems Development Methodology	Implementation	92
Systems Development Methodology	Method Rationale	0
Systems Development Methodology	Rationality Resonance	0
Systems Development Methodology	Customize	0
Systems Development Methodology	Diffusion	8
Systems Engineering Methodology	Use	120
Systems Engineering Methodology	Utilizing	9
Systems Engineering Methodology	Usage	7
Systems Engineering Methodology	Adoption	9
Systems Engineering Methodology	Implementation	76
Systems Engineering Methodology	Method Rationale	0
Systems Engineering Methodology	Rationality Resonance	0
Systems Engineering Methodology	Customize	0
Systems Engineering Methodology	Diffusion	1
Software Development Method	Use	342
Software Development Method	Utilizing	2
Software Development Method	Usage	33
Software Development Method	Adoption	93
Software Development Method	Implementation	152
Software Development Method	Method Rationale	1
Software Development Method	Rationality Resonance	0
Software Development Method	Customize	4
Software Development Method	Diffusion	9
Software Engineering Method	Use	225
Software Engineering Method	Utilizing	2
Software Engineering Method	Usage	20
Software Engineering Method	Adoption	28
Software Engineering Method	Implementation	92
Software Engineering Method	Method Rationale	0
Software Engineering Method	Rationality Resonance	0
Software Engineering Method	Customize	2
Software Engineering Method	Diffusion	2
Software Development Methodology	Use	433

Search query 1	Search query 2	Number of papers
Software Development Methodology	Utilizing	16
Software Development Methodology	Usage	47
Software Development Methodology	Adoption	90
Software Development Methodology	Implementation	220
Software Development Methodology	Method Rationale	0
Software Development Methodology	Rationality Resonance	0
Software Development Methodology	Customize	3
Software Development Methodology	Diffusion	12
Software Engineering Methodology	Use	174
Software Engineering Methodology	Utilizing	5
Software Engineering Methodology	Usage	13
Software Engineering Methodology	Adoption	13
Software Engineering Methodology	Implementation	102
Software Engineering Methodology	Method Rationale	0
Software Engineering Methodology	Rationality Resonance	0
Software Engineering Methodology	Customize	0
Software Engineering Methodology	Diffusion	3
Total		*3,227*

Appendix B. Papers included in the detailed analysis

Table B1 presents a detailed analysis of the papers that we could access. The leftmost column contains the authors. The next two columns show the classification according to the two investigated phases; the result is presented in Figure 2. Columns four to six present the classification of the investigated type of reasoning. Finally, the rightmost column shows the result from our thematic analysis, i.e., the identified research themes. The identified research themes and papers are presented in Table 4.

Table B1. Detailed analysis

	Phase		Type of reasoning			
Authors	**Adoption**	**Use**	**Rational**	**Irrational**	**Non-rational**	**Research theme (included in Table 4)**
Abdul et al. [100]		X				
Ahmadzai and Bakhsh [101]	X					
Abrahamsson [63]		X				
Alt et al. [75]	X		X			Choice of SDM
Altuwaijri and Ferrario [102]		X				
Andersson and Nilsson [89]	X		X	X		Understanding operationalization
Avison et al. [66]		X				
Ayed et al. [103]	X					
Babb et al. [51]	X					
Bannerman et al. [104]	X	X				
Barrow et al. [105]	X					
Barrow et al. [106]	X					
Berger and Beynon-Davies [83]	X				X	Method deviation
Bygstad et al. [49]	X					
Chen et al. [87]		X	X			Method deviation
Chevers and Whyte [107]		X				
Clark et al. [96]		X	X			Achieved contribution
Coleman and Verbruggen [108]	X					
Dada and Sanusi [109]		X				
De Sousa et al. [110]	X					
Dennehy and Conboy [80]		X	X			Competing rationalities

	Phase		Type of reasoning			
Authors	**Adoption**	**Use**	**Rational**	**Irrational**	**Non-rational**	**Research theme (included in Table 4)**
Fitzgerald [67]		X				
Fitzgerald [68]		X				
Fruhling et al. [59]	X					
Fruhling and De Vreede [58]	X					
Fruhling and Zhang [111]		X				
Gandomani et al. [55]	X					
Gandomani et al. [112]	X					
Gandomani et al. [113]	X					
Ganis et al. [114]	X					
Gannon [115]	X					
Ghani and Bello [116]	X	X				
Hajjdiab and Taleb [117]	X					
Hajjdiab et al. [52]	X					
Hardy et al. [61]		X				
Hazzan and Dubinsky [90]	X		X			Understanding operationalization
Heikkilä et al. [11]		X	X	X		Method deviation
Häggmark and Ågerfalk [10]		X	X			Method deviation, Competing rationalities
Iivari and Huisman [69]		X				
Iivari and Maansaari [62]		X				
Jayakody and Wijayanayake [118]		X				
Jamil and Al-Hajry [50]	X					
Jones and Kydd [119]	X					
Joseph et al. [60]		X				
Karlsson [120]		X				
Käpyaho and Kauppinen [121]		X				
Laanti et al. [54]	X					
Lagerberg et al. [122]	X	X				
Licorish et al. [123]	X	X				
Livermore [124]	X					
Livermore [125]	X					
Lui and Chan [126]		X				
Mahadevan et al. [127]	X					
Mannaro et al. [128]	X					
Marks [129]	X	X				
Masrek et al. [130]		X				
Maulana and Raharjo [131]	X					
McAvoy and Butler [77]	X			X		Competing rationalities
McAvoy and Butler [78]	X			X		Competing rationalities
McAvoy et al. [56]	X					
Middleton [84]	X	X	X			Method deviation
Middleton [85]		X	X			Method deviation
Middleton and McCollum [86]		X	X			Method deviation
Mishra and Mishra [72]	X		X			Choice of SDM
Mnkandla and Dwolatzky [92]		X		X		Understanding operationalization
Mohagheghi and Lassenius [132]	X					
Mohallel and Bass [94]	X			X		Achieved contribution
Mohan et al. [81]		X	X			Understanding operationalization
Mäki-Runsas [91]		X	X	X	X	Understanding operationalization

	Phase		Type of reasoning			
Authors	**Adoption**	**Use**	**Rational**	**Irrational**	**Non-rational**	**Research theme (included in Table 4)**
Nelson and Teng [133]		X				
Patanakul and Rufo-McCarron [82]	X			X	X	Achieved contribution1, Method deviation2
Poston et al. [53]	X					
Procter et al. [64]		X				
Quelal et al. [134]		X				
Rahim et al. [135]	X	X				
Rezgui et al. [136]	X					
Rezgui et al. [137]	X					
Ribeiro and Domingues [138]	X					
Rindell et al. [139]		X				
Roberts Jr et al. [93]	X			X		Achieved contribution
Roberts Jr et al. [140]	X					
Roberts et al. [141]	X					
Roberts et al. [142]	X					
Rowlands [143]		X				
Saarinen [88]		X		X		Method deviation
Salo and Abrahamsson [65]		X				
Sauer and Lau [76]	X		X			Competing rationalities
Schindler [144]	X	X				
Serour and Winder [145]	X					
Snook and Harrison [146]	X	X				
Šochová [147]		X				
Soundararajan et al. [95]		X	X			Achieved contribution
Strode et al. [79]		X	X			Competing rationalities
Taylor et al. [73]	X		X			Choice of SDM
Tekbulut et al. [148]		X				
Toleman et al. [57]	X					
Tripp and Amstrong [74]	X			X		Choice of SDM
Tudor and Walter [149]	X					
Vavpotic and Bajec [150]	X					
Vavpotič et al. [151]	X					
Vavpotič and Hovelja [45]	X					
Vejandla and Sherrell [71]	X		X			Choice of SDM
Vijayasarathy and Turk [70]		X				
Vrhovec [152]		X				
Weiss and Brune [153]	X					
Yli-Huumo et al. [154]		X				
Yoshii and Higa [155]		X				

Note: [1]Irrational, [2]Non-rational

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An agile portfolio management model for the insurance sector: the APMI model

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An agile portfolio management model for the insurance sector: the APMI model

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Abstract:
Nowadays, the increasing uncertainty and instability make it crucial for traditional companies to become more agile and able to act fast on consumer needs and expectations. Therefore, many insurance companies are seeking to increasingly adopt Agile practices to become more effective, faster, and leaner in their critical processes. On the other hand, several companies are strengthening their planning methodologies by implementing Portfolio Management models. These models enable them to manage their initiatives in a more integrated and efficient manner that is strategically aligned, minimizes complexity, and provides higher flexibility when responding to uncertainty. Given the limited scientific knowledge in combining Agile and Portfolio Management (PfM), particularly in the insurance industry, a new Agile Portfolio Management (APfM) model, the APMI – Agile Portfolio Management for insurers was designed and tested, showing how Agile and PfM international practices can be conciliated with current insurance industry-specific practices. Results revealed a high satisfaction level with the model implementation, indicating that the proposed model can foster a greater strategic alignment, increase the organization's strategic focus, promote transversal alignment and visibility, and support the organization's capacity coordination.

Keywords:
agile; portfolio management; insurance industry; strategic planning.

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1. Introduction

Today, the increasing uncertainty and instability brought by new competitors and ways of doing business make it crucial for traditional companies to become more agile and able to act fast on consumer needs and expectations [1], [2]. However, this is traditionally not an easy task for many insurance companies as they typically operate with functional and hierarchical organizations that only enable them to succeed in more stable environments. Therefore, many financial institutions, such as banks and insurers, are seeking to increasingly transform themselves towards Agile and its principles to become more effective, faster, and leaner in their critical processes [3].

Another common factor in many financial companies is that they typically develop multiple and complex strategic initiatives simultaneously. Moreover, these initiatives usually cascade into several strongly correlated projects that are developed by numerous development teams in short development cycles [4]. In this context, many insurers adopt Portfolio Management (PfM) models that enable them to manage their initiatives in a more integrated and efficient manner that is strategically aligned, minimizes complexity, and provides higher flexibility when responding to uncertainty [5]–[10].

As shown by a recent PfM literature review [10], the combination of Agile and Portfolio Management comes from the 2010s onwards, which can be considered relatively recent. In this sense, the existing literature still offered limited knowledge and guidance on the results and impacts that can be achieved with the integration of Agile and Portfolio Management in the insurance sector.

To combine and integrate Agile approaches and Portfolio Management, a new agile portfolio management model, the APMI - Agile Portfolio Management for Insurers, was designed, tested, and evaluated in a leading insurance group operating in the Portuguese market. The APMI intends to be a PfM model suitable for insurance companies, aligned with the current PfM main standards like the ISO standard 21504-*Guidance on Portfolio Management* [6], the PMI's *Standard for Portfolio Management* [8], and the APM's *Portfolio Management practical guide* [9], and with the agile principles for insurance companies.

The present paper has the following structure. First, section 2 explores Agile Portfolio Management (APfM) in the insurance industry. Then, section 3 describes the study's research method. After that, section 4 details the proposed APfM model. Next, section 5 describes the implementation and evaluation impacts of the proposed model, the APMI, in an insurance company. Finally, section 6 provides the study's conclusions and describes the study's main limitations and most significant future developments.

2. Agile portfolio management in the insurance industry overview

2.1 Portfolio management in the insurance and banking industry

Regarding the application of Portfolio Management (PfM) in the insurance and banking industries, it was found that having a robust PfM process in place is the most important to maximize an insurer's performance [11]. In this sense, PfM processes strongly support an insurance company in defining, selecting, and monitoring its strategic initiatives in an organized and efficient manner [5].

Prioritization and adaptability were also described as significant attributes of PfM systems. PfM frameworks can embody robust prioritization methodologies that evaluate all initiatives qualitatively and quantitatively, ensuring that the most impactful ones are chosen right from the beginning [10]–[13]. In addition, PfM processes have cyclic revisions that enable a cadenced (re)focus and (re)selection of the most impactful strategic initiatives. These priority reviews enable the organization to rapidly respond to changing conditions and guarantee that everybody keeps following the same strategic direction [5], [10]. In other words, to make an organization more effective in the right direction [6], [8], [12] as a company can be more effective by being more focused and less multitasked, which reduces waste, optimizes resource usage, and makes the initiatives more value-oriented. A company goes in the right direction because the selected initiatives are more clearly linked with the strategic direction.

2.2 Agile in the insurance and banking industry

The values and principles established in the Agile Manifesto [14] continue to be the baseline for any insurer or bank wanting to adopt Agile methodologies or Agile Portfolio Management (APfM) models. In particular, key values such as "responding to change over following a plan" or "valuing individuals and interactions over processes and tools" must be embedded in APfM models, that have cyclical reviews and promote greater interaction and collaboration between all parts involved.

Another topic greatly analyzed in the literature is the concept of ambidexterity [15]–[17], which can be the cause of failure for many companies transforming to Agile as they cannot manage changeability and agility without losing stability and structure. However, embracing agility should not bring this kind of paradoxical tension as the Agile methodologies are, in their essence, ambidextrous [15].

In addition to ambidexterity, many other fundamental aspects, such as strategic agility [1], [2], [18], operational agility [19], [20], and an agile organizational structure [21] have been found in companies from the insurance and banking industry. However, changing people's mindsets and cultures is known as one of the most challenging aspects of agile transformations [10], [18], [19], [22], as it is an endeavour that can only be accomplished in a top-down and bottom-up effort to reach all levels of the organization [2], [23], [24].

2.3 Portfolio management standards and agile frameworks overview

Standards such as ISO 21504 [6], the PMI's *The Standard for Portfolio Management* [8], and other references such as APM's *Portfolio Management practical guide* [9] have been available for organizations from many industries, providing a referenced basis to establish a portfolio management process. However, they do not detail specific solutions as they aim to be applied universally in any organization. Instead, they intend to provide a high-level approach to deal with several vital topics in Portfolio Management, such as portfolio strategic planning and alignment, portfolio optimization and prioritization, and capacity and capability management.

Several Agile scaling frameworks, such as SAFe (Scaled Agile Framework), LeSS (Large-Scale Scrum), and DA (Disciplined Agile), can also be widely found. These frameworks are being used to provide methods and structures for organization-wide agile transformations and offer insights for developing a portfolio management process supported by agile principles. In this perspective, they all refer to Lean and optimizing customer value as fundamentals for any successful company. Agile Portfolio Management processes need to be lean and agile to not suffocate the organizations with overly bureaucratic processes that decrease teams' autonomy, slow the organization, and bring no considerable added value to the customer [25]–[28]. As an example, SAFe suggests a framework where high-performance teams are created in a customer-centred manner that maximizes and optimizes the value streams of solutions provided to the clients. These value streams have increased autonomy as they are funded holistically and not through traditional budgeting and project cost accounting methods [27], [28].

Table 1, shows a summary of the main strengths and weaknesses of the reviewed PfM Standards and Agile Frameworks that were identified and considered for the design of an APfM model for the insurance industry.

Horlach et al. [29] provide design goals and principles specific to APfM and offers some remarkable insights. However, many of these insights are also shared by the other frameworks. For example, they all share key concepts like customer centricity, budgeting teams instead of projects, and firmly aligning IT and business development.

Nevertheless, Horlach et al. [29] provide a basis for achieving agility in PfM, describing OKRs (Objectives and Key Results) and Purposes as two valuable artefacts for an APfM process. The OKRs should help the organization to achieve the challenging "aligned autonomy," by empowering teams to set their own Key Results, which will enable the organization to achieve an overarching Objective derived from its strategy. In addition, Purposes would be a helpful way of aligning different teams contributing to the same solution, strengthening the commitment of each team member by demonstrating the impactful contribution each one has to the organization.

Table 1 - Portfolio Management Standards and Agile Scaling Frameworks - Main strengths and weaknesses for designing an Agile Portfolio Management model in the insurance industry

	Strengths	Weaknesses
Portfolio Management Standards *(ISO, PMI, APM)*	▪ Global recognition and adoption across all industries ▪ A solid basis for establishing an Agile Portfolio Management model	▪ Very high-level approach with a low level of detail ▪ Addresses Portfolio Management broadly and not Agile Portfolio Management in specific ▪ Not specific to the insurance industry
Agile Scaling Frameworks *(SAFe, LeSS, DA)*	▪ Solid frameworks for organization-wide agile transformations ▪ Interesting insights for establishing an Agile Portfolio Management process	▪ Do not cover Portfolio Management in detail (especially LeSS) ▪ Not specific to the insurance industry

Other recent PfM proposals available in the literature can also provide relevant insights for APfM development in insurance companies. For instance, Bai et al. [30] describe a strategy-oriented methodology for selecting project portfolios that can be divided into three main procedures: elimination of projects by resource constraints, determination of project functional value, and modelling simulation of the system dynamics. In addition, this methodology also considers the dynamic synergies to improve the accuracy of the project selection. Şahin Zorluoğlu & Kabak [31] also describe a project portfolio selection model that takes into account conditions and restrictions such as the mutual exclusive relations between projects or the progress of the projects in a given period. Silvius & Marnewick [32] propose a framework that connects sustainability with organizational strategy, PfM, and project management.

3. Research Study Design

Although several insights and best practices proposals can be identified and collected from the current knowledge, a clear and direct proposal for an agile portfolio management model suitable for insurance companies was not identified. Therefore, the purpose of this research study was to develop an agile portfolio management (APfM) model suitable for insurance companies. In this sense, the research design was divided into three major phases.

In the first phase, the literature was reviewed, 1) to collect the best PfM practices that could support the application of APfM in the insurance industry. Then, considering the major insights identified in the APfM literature review, the second phase was dedicated to 2) designing the proposed APfM model for insurance companies. Finally, following an initial diagnostic of the company's current strategic planning processes, 3) the model was then implemented using an orthodox case study approach [33] and the implementation impacts were evaluated through a survey by questionnaire within the case company to check its perceived suitability (see Appendix A).

As shown in Figure 1, after conducting the literature review, the second phase of the research design was the development of a new APfM model that would be aligned with current international PfM standards and Agile practices and would be suitable for insurance companies.

The APMI (Agile Portfolio Management for Insurers) design details are next exposed, divided into three key blocks. The first block provides the main goals of the model. Then, the second block, briefly introduces and details the organizational perimeter, namely the created clusters. Finally, the third block details the APMI six major steps.

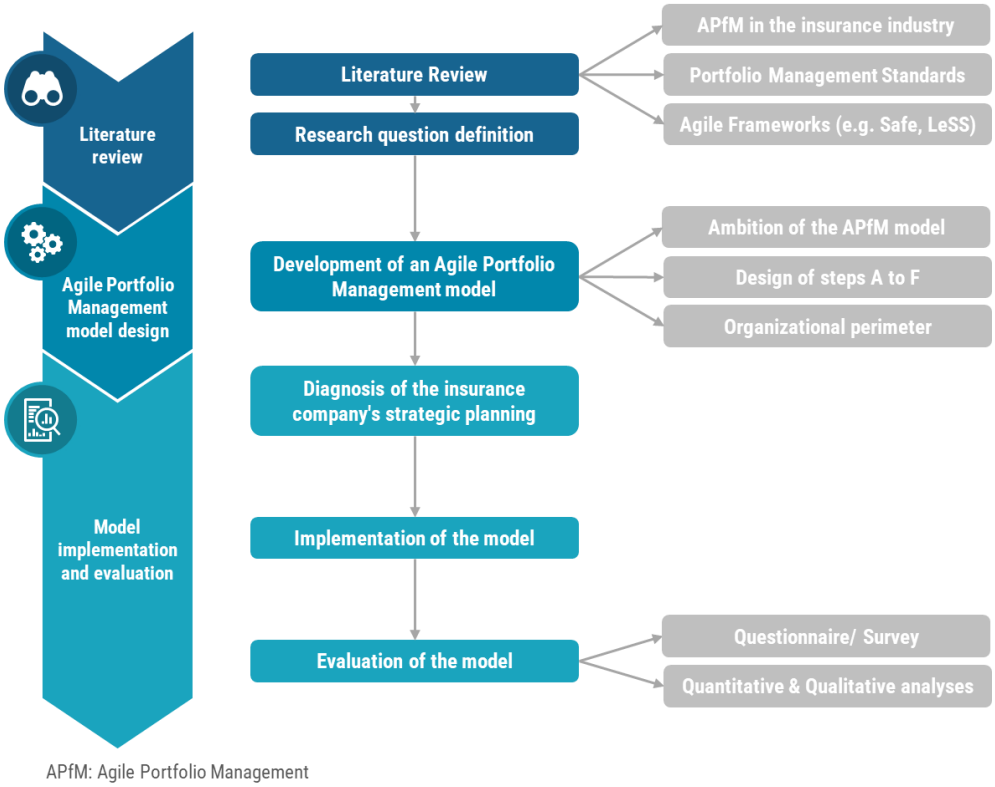

Figure 1 – The study research design

Figure 2 - Four main goals for the design of the APMI

3.1 The APMI model ambition

Typically, insurance companies divide their planning processes across a value chain with three major phases: Strategic Reflection, Annual Business Planning, and Execution and Monitoring. The APMI model is inserted in the middle stage (Annual Business Planning) and has four main goals shown in Figure 2.

These four goals represent the ambition for the development of the APMI and are consistent with the best practices identified in the literature review for an Agile Portfolio Management (APfM) process, namely the ISO TC258, PMI, and APM Portfolio Management (PfM) standards. They are also aligned with Agile values such as "responding to change over following a plan" (APMI goals 1, 2 and 4) or "valuing individuals and interactions over processes and tools" (APMI goal 3).

These goals aim mainly at ensuring the initiatives' alignment and adherence to strategy, being focused when selecting initiatives, fostering transversal visibility between units, and strengthening the activity planning by ensuring consistent capacity coordination.

3.2 The APMI model organizational perimeter

The APMI model requires engaging different sets of stakeholders along the process, capturing a holistic and integrated view of the organization in which it is implemented. As exposed in Figure 3, nine clusters were considered in the APMI model design to facilitate the planning process and promote a greater alignment between business units. The clusters join sets of units that have synergies and similar goals and 1) provide a holistic view of the proposed purposes and ambition, 2) allow for prioritization of actions to achieve certain common business objectives, and 3) facilitate the identification of dependencies and alignment of capacity requirements in the cluster. Additionally, the clusters also promote Agile values such as greater collaboration and interaction between individuals and foster key principles like face-to-face conversation and feedback loops.

In this sense, eight of the nine proposed clusters will gather units sharing the same insurance Line of Business (LoB), and the remaining one (Sales & Servicing) will bring together the commercial and marketing units.

Besides these cluster units more related to the company's business activity, a typical insurer also possesses several other units that do not participate directly but support the business activities. These supporting units are transversal and were left outside the cluster structure as they are not LoB-specific. Instead, they were gathered in another group called "Support units," as seen in Figure 3. Examples of typical support units in an insurance company could be the IT, actuary, accounting, or human resources units.

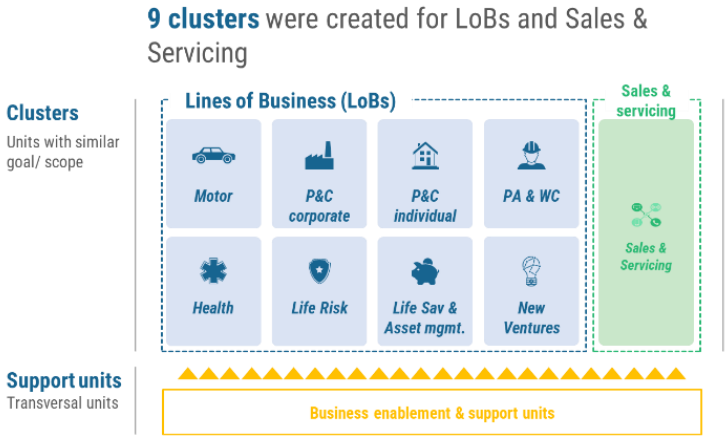

Figure 3 – APMI clusters' structure

3.3 The APMI model's fundamental steps

For the APMI model's design, it was decided to adopt a W-shaped approach [34] for strategic planning (Figure 4).

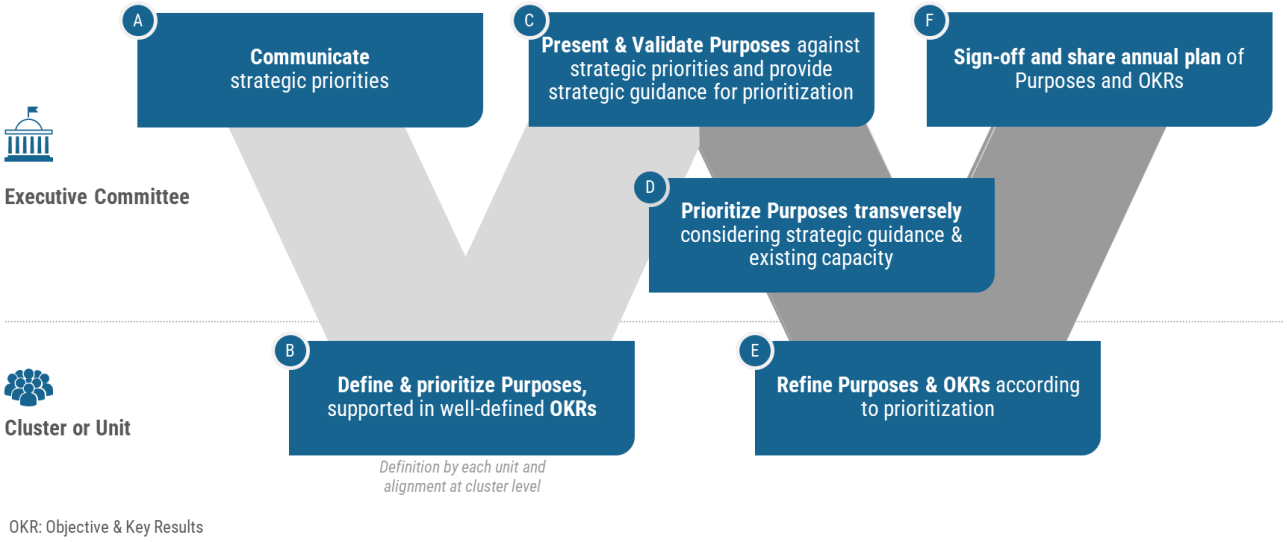

Figure 4 - Overview of the APMI model developed with a W-shaped approach

The W-shaped approach was considered suitable as it involves different levels of the organization and allows for a top-down and bottom-up alignment between the board (Executive Committee) and the several units or clusters of units underneath.

The proposed model has as primary input the company's strategy. The strategic priorities originated in the strategic reflection should be the fundamental reference guiding all decisions taken throughout the process. In this sense, the process of the designed model will be sequentially performed within six major steps, from A to F (as seen in Figure 4).

3.3.1 The APMI process: Step A - Communicate strategic priorities

Step A was designed mainly to kick off the APMI W-shaped process. This step aims to provide the primary business objectives and strategic guidelines that will support the identification of the unit's Purposes, Objectives and Key Results (OKRs) during step B.

Step A will have as its main stakeholders the Executive Committee (ExCo), all the company Executives, and the Planning Team (a team responsible for orchestrating the entire process and assuring its operational suitability).

Its primary input is the strategic reflection exercise, and the main outputs are the business objectives and the strategic guidelines to be followed (see details in Figure 5).

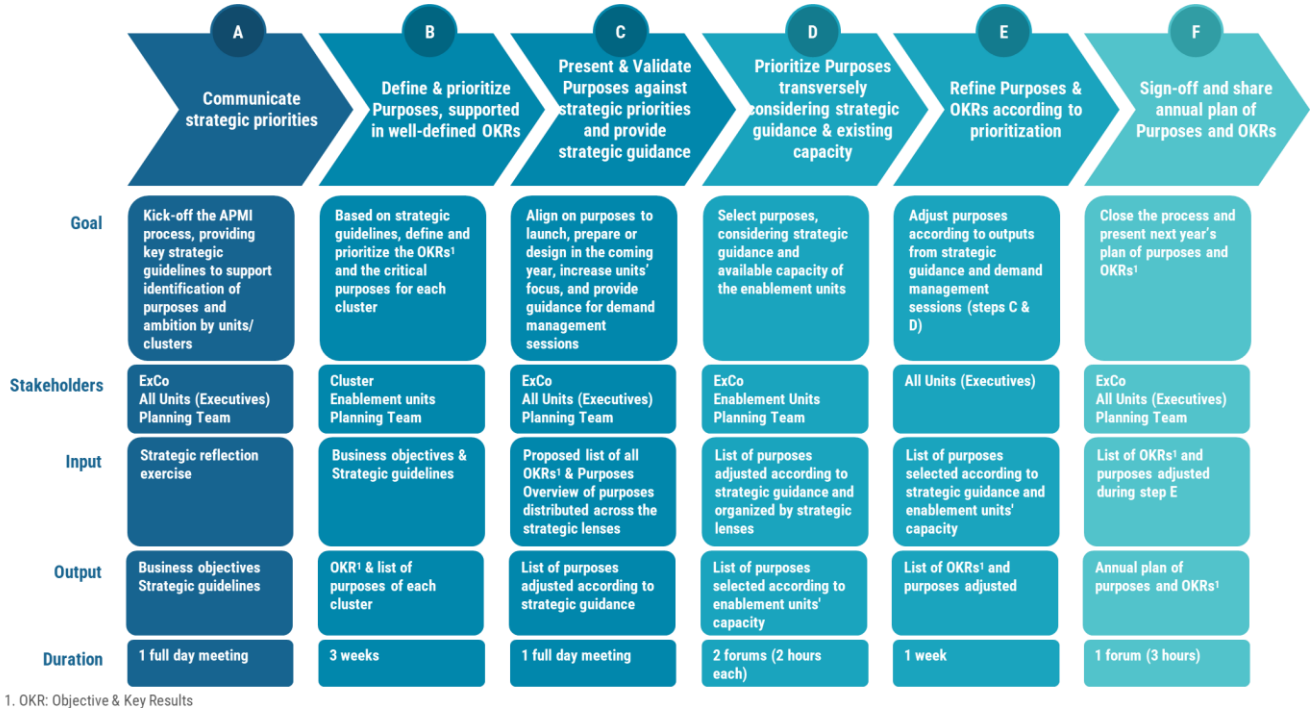

Figure 5 – Overview of the APM I's six steps

3.3.2 The APMI process: Step B - Define & prioritize Purposes, supported by well-defined OKRs

In Step B, each unit starts by defining its Purposes supported by well-defined Objectives and Key Results (OKRs) for the upcoming year, based on the strategic guidelines and business objectives shared before (in Step A). The Cluster units will then present and prioritize their Purposes and OKRs in the Cluster meeting sessions.

This choice of including Purposes and OKRs in the process design was majorly influenced by the Horlach et al. [29] study and was considered suitable since they both contribute to the fundamental Agile principles of empowering and enabling teams to be self-organized, building projects around motivated individuals and having aligned autonomous portfolio decision-making.

This is critical since agile processes often struggle to guarantee alignment across the organization while at the same time promoting the autonomy of each unit in its decision-making. OKRs are helpful to achieve that "aligned autonomy," as they empower units' teams to autonomously set their own Key Results but also ensure that they contribute to achieving a specific Objective derived from the company's strategy.

On the other hand, Purposes are also helpful in this matter as they align teams from different units in contributing to the same solution. Moreover, purposes demonstrate each individual's impactful contribution in unlocking a clear outcome for the customer, the agent, and/or the insurance company, as summarized in Figure 6.

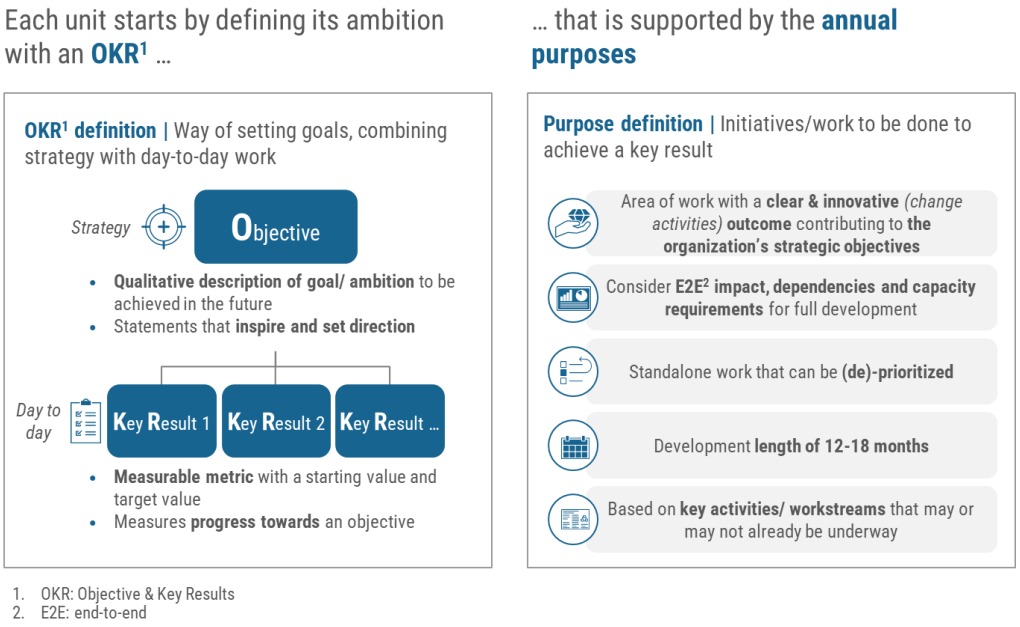

Figure 6 - OKRs and Purposes' definition in the APMI

To better evaluate the overall picture of purposes being proposed by all units, a set of labels – the Strategic Lenses – was designed to catalogue each purpose. Therefore, depending on the purposes' operational field and focus, they will be grouped into one of four major types of lenses: Product, Commercial Channels, Operations & Customer Journeys, and Corporative.

This lens classification can be useful, for example, in the next step C for the ExCo to grasp whether or not the path that the purposes are leading to is consistent with the company's strategy. It might be, for example, that there are too many purposes focusing on creating new products and offers (Product lens) when the strategic priority is to increase operational efficiency (Operations & Customer Journeys lens). In this case, the ExCo will likely deprioritize some of the purposes in the Product lens and prioritize the ones in the Operations & Customer Journey lens.

After defining their individual OKR and list of Purposes, each cluster unit must align in a forum with the remaining units from its cluster on the cluster's OKR and critical purposes. The cluster OKR should be developed based on each cluster unit's individual OKR and should set the core ambition for the cluster line of business. The critical purposes will be chosen from all cluster units' lists of purposes and should be the urgent and high-impact purposes that will impact the cluster most and, therefore, need to be dealt with quickly and in-depth.

In this sense, the cluster sessions induce a "funnel" effect where each unit presents its individual OKR and list of purposes, and one OKR and a set of critical purposes are identified for the whole cluster (see Figure 5 and Figure 7). Since these sessions are made through face-to-face conversations and discussions, they also promote greater interaction and collaboration between all parties involved, which is a fundamental Agile value.

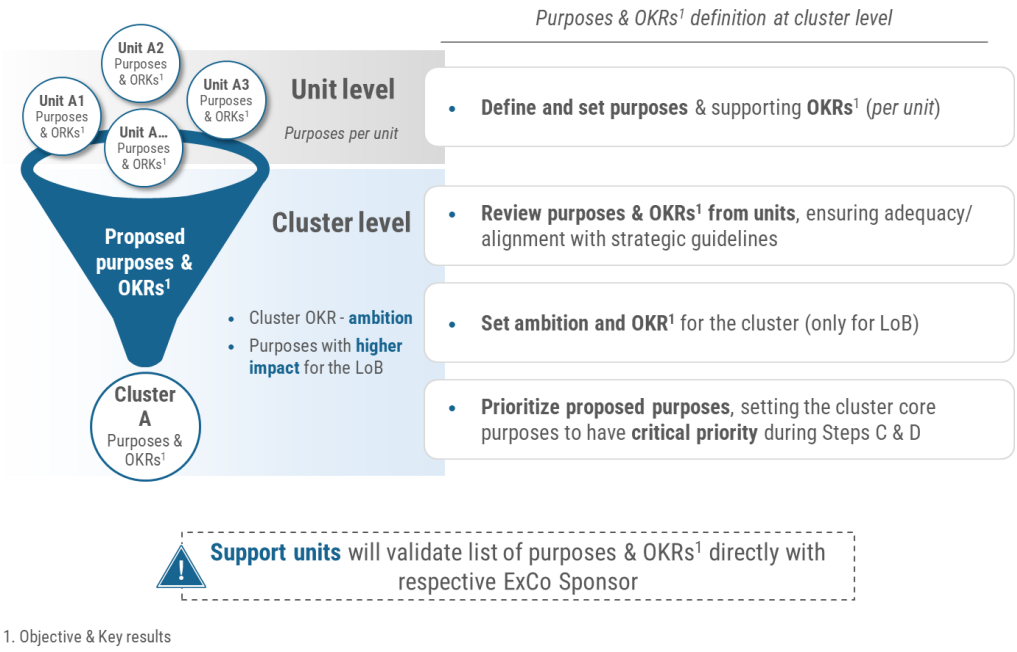

Figure 7 – "Funnel" effect of APMI's Step B

This part of the APMI model is one of the most critical as it is where the actual portfolios of purposes of every cluster are created. These portfolios should be consistent with what is found in the literature as a "standard" portfolio. According to the standards analyzed, a portfolio should be a collection of programs, projects, or operations that can be measured, ranked, and prioritized to achieve particular strategic objectives [6], [8], [9]. In the APMI model, each cluster portfolio has a set of purposes that are measured and prioritized to achieve certain strategic objectives translated into the OKR. Finally, the cluster's OKR and purposes will naturally reflect the organizational strategy as they are linked with the identified strategic priorities.

3.3.3 The APMI process: Step C - Present & validate Purposes against strategic priorities and provide strategic guidance for prioritization

The APMI's Step C will start with a forum, the APMI Alignment Forum, that will present and validate the Purposes and OKRs developed during Step B with all the executives and the ExCo of the insurance company. This forum should also provide an overview of all purposes distributed across the strategic lenses (see Figure 5).

After this moment of transversal alignment on the purposes proposed to be developed during the coming year, the ExCo will then analyze them in more detail and decide whether they are a priority considering the company's overall strategy and the distribution of purposes across the strategic lenses.

In this sense, Strategic Guidance sessions should take place during step C. These sessions will aim to filter the volume of proposed purposes before they move on to the demand management sessions in the following APMI step (Step D - Prioritize Purposes crosswise). This step C is considered relevant since, in step D, the prioritization will be mainly driven by the existing capacity of the enablement units to execute those purposes and not by their actual strategic fit. Therefore, taking a step back and analyzing and prioritizing those purposes by comparing them against the company's strategic priorities and other variables, such as the market and client dynamics or the existing commercial space, is of the most importance.

Therefore, in the strategic guidance sessions, the purposes should be classified across three main levels: *Launch in N*; *Prepare in N, launch N+1*; and *Design & Proposal*.

The purposes classified as *Launch in N* address top priorities for the company. Therefore, these purposes are those where a high effort and focus must be put in from both the owner and all remaining units involved in the purpose development. These priority purposes will move on to the demand management sessions in step D, where they will be prioritized based on the existing capacity of the enablement units (IT, Marketing, Analytics, and Actuary - the units that typically face more demand in insurance companies).

The second level of priority is *Prepare in N and launch N+1*. The purposes classified at this level also address essential priorities for the company but are not as urgent as the previous ones, and their launch can be delayed for year N+1. Nevertheless, the definition and development of these purposes must be initiated in the upcoming year (year N) to ensure that they are launched in the year after that (N+1). Therefore, these purposes will also require high effort and focus from all units involved, and they will move on to the demand management sessions in step D as well.

Finally, the last priority level is *Design & Proposal*. The purposes classified at this level are those that ExCo does not consider a critical priority for the company at the time. In addition, these purposes may still lack a certain level of maturity and need to be further assessed and designed by the owner unit before a decision to develop, and launch can be taken. Therefore, the effort and focus put on these purposes by the involved units should be reduced, and they will not move on to the demand management sessions in step D.

3.3.4 The APMI process: Step D - Prioritize Purposes transversely, considering strategic guidance & feasibility/capacity

Step D of the APMI model was designed to select purposes considering the strategic guidance provided by the ExCo during step C and the existing capacity of the enablement units (IT, Marketing, Actuary, and Analytics).

This purpose selection will involve the enablement units and should occur in demand management sessions. In these sessions, the ExCo should analyze the areas from the enablement units that are capacity-constrained and prioritize the purposes involving them across three main levels: *Priority*, *Backup*, and *Deprioritized*.

The purposes included in the first level (*Priority*) will be the ones selected to be implemented in the next planning year (year N) and should have higher strategic relevance and impact.

The second level will be the *backup* purposes, which can be considered the second priority. For these purposes, the enablement units will not have enough capacity to implement them. However, if the *priority* purposes are completed or suffer a delay, the *backup* purposes will be the next in line to be developed.

Finally, the last priority level belongs to the *deprioritized* purposes. These purposes cannot be implemented considering the existing available capacity and will likely be the ones with less strategic value for the company.

3.3.5 The APMI process: Step E - Refine Purposes & OKRs according to prioritization

Step E was designed for each unit and cluster to refine their purposes and OKRs after the strategic guidance and the demand management sessions. Since these sessions will deprioritize some purposes, the units and clusters will likely need to refine their remaining purposes and OKRs accordingly.

3.3.6 The APMI process: Step F - Sign off and share an annual plan of Purposes and OKRs

The final step was designed to close the APMI (Agile Portfolio Management for Insurers) model. It consists mainly of a forum, the APMI Closing Forum, where each cluster and support unit will present next year's plan of purposes and OKRs.

This final forum with all the executives and ExCo will be an excellent opportunity to look ahead to next year's plan and ensure that all units are aligned with it and know each other's priorities. In addition, giving the stage to each cluster and unit in this forum should encourage their accountability to accomplish the purposes and OKRs plan.

4. The APMI (Agile Portfolio Management for Insurers) model evaluation

After designing and developing the APMI model, the proposed model was then implemented and evaluated in the real-life context of an insurance company. As a result, a leading insurance group operating in the Portuguese market was chosen to implement and test the APMI model.

Given this group's considerable dimension and leading position in the insurance market, the group was considered to be a reference of the insurance industry and, therefore, a suitable case to implement and test the APMI model as exposed. For that, a previous diagnostic was first conducted at the insurance group that found several improvement opportunities in the group's planning that were considered coincident with the APMI major goals (see Figure 2). In this sense, the APMI model could be considered a highly suitable model to implement in the group and address its most significant needs.

An online digital tool was created to support the implementation of the model in the insurance company. This tool was created using only Microsoft tools, such as SharePoint lists and Power Apps, enabling all units to fill in its purposes and OKRs live, mitigating the circulation of different documents and versions. The tool also allowed each unit to be aware of other units' purposes that they will need to be involved in, facilitating the alignment between all involved in the development.

Following the implementation of the APMI model's six fundamental steps (see steps details in sub-section 3.3), the models' impacts were evaluated. For this, a questionnaire (see Appendix A) was sent to all the executives of the insurance group that participated in the APMI implementation test. This questionnaire included five main questions and was developed to address 1) the level of satisfaction with the process, 2) assess to what extent the initial goals have been accomplished, 3) measure the level of preparation for a future edition, 4) identify significant improvement opportunities left to be accomplished, and 5) collect other comments and feedbacks on the APMI. The questionnaire form was then sent to the 36 executive participants having a participation rate of 75%, with 27 received replies.

The APMI evaluation test survey's main results retrieved from questions 1, 2, 3, and 4 on the questionnaire can be seen in Figure 8.

The first question was intended to measure the overall level of satisfaction with the tested model. The survey found that 96% of the respondents (26 out of 27) felt between satisfied or extremely satisfied with the designed APMI process.

The second question aimed to assess if the process's initial goals have been met or not. In this sense, the participants were asked whether they agreed or not with four statements that described the goals of the APMI, namely: strategic alignment, focus, transversal visibility, and capacity coordination. The results found that most of the participants agreed with the used goal statements and that, therefore, the APMI model successfully supported the accomplishment of those goals.

The third question was designed to assess the level of preparation of the group's executives for a future APMI implementation. Since much effort was dedicated to training and supporting all units during this first implementation of the proposed APMI model, this question wanted to evaluate whether the executives feel well prepared for the next implementation edition, particularly in defining their units' objectives and purposes. The survey results found a preparedness score of 3.8/5, with most of the executive participants (62%, 17 out of 27) considering themselves well prepared or very well prepared for a future model implementation, which indicates that the level of support and training that was given was adequate and recognized.

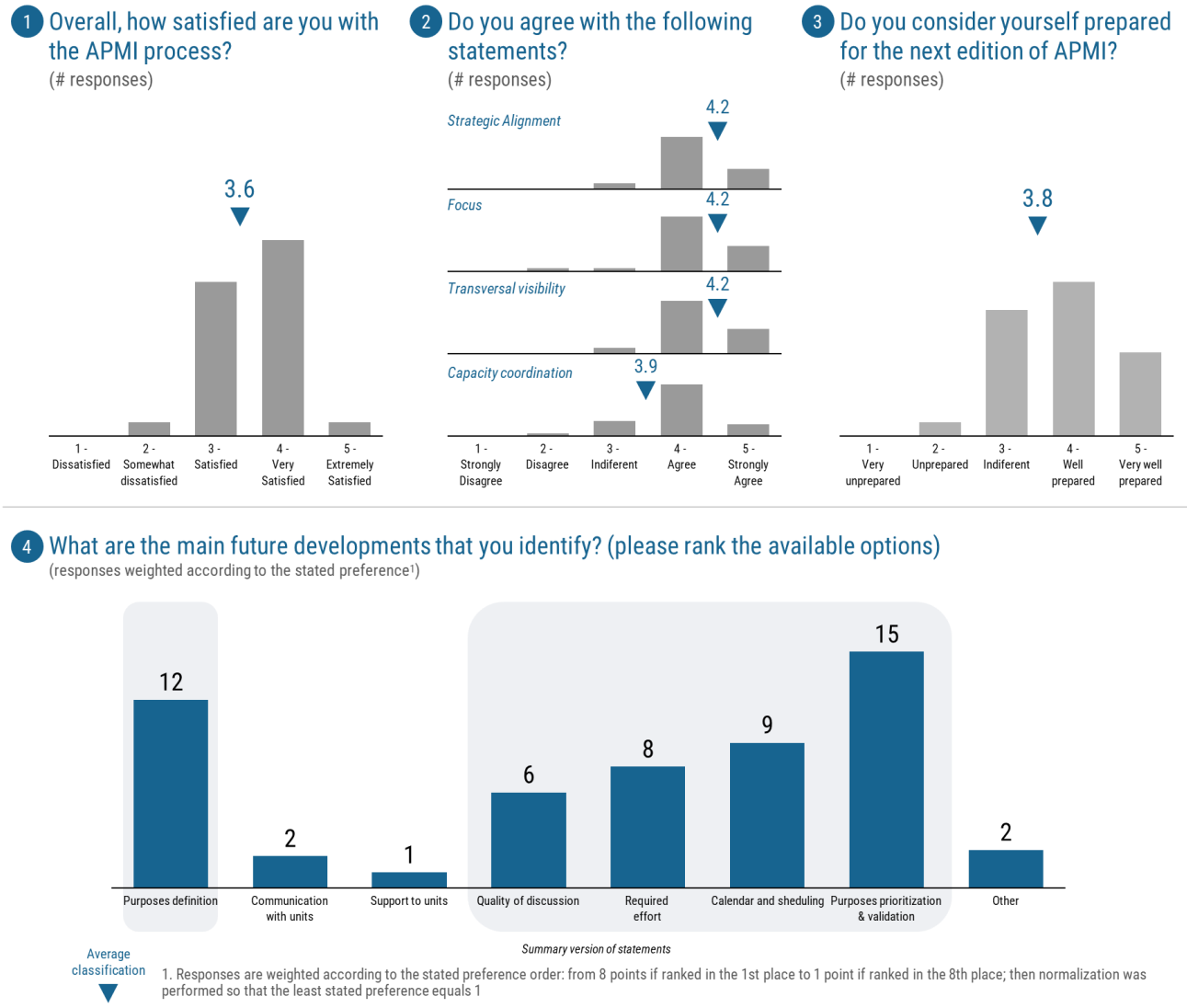

Figure 8 - The APMI evaluation survey results (questions 1-4)

The fourth question aimed to identify the process's most significant future developments from the participating executives' view. In this sense, a set of seven potential model improvement opportunities were identified across the following themes:

- Purposes definition;
- Communication with units;
- Level of support given to the units by the APMI implementation support team;
- Quality of the discussion moments;
- Level of effort required by the process;

- Calendar and scheduling of the process's stages; and
- Purposes prioritization and validation.

The participants were asked to rank the improvement opportunities according to their relevance. If desired, the participants were also encouraged to add any other topic to the given list. In this way, it was possible to assess the overall relative importance given to each improvement opportunity.

From the results shown in Figure 8, the most relevant factor to be improved was the one regarding the purposes' prioritization and validation. After that, several respondents also attributed high relevance to improving the purposes' definition, optimizing the calendar, and scheduling of the discussion moments, minimizing the process's required effort, and improving the discussion moments' quality.

Finally, the fifth question aimed to collect richer and more interpretive feedback by allowing the respondents to give new contributions. This question was not mandatory and was answered by 11 executive participants (41%). In this question, the respondents provided additional feedback and gave more interpretive opinions about the APMI, such as:

- Rethink the organizational perimeter of the process, namely the allocation of units in the different clusters;
- Strengthen the process of building impact KPIs, namely in purposes focused on operational improvements;
- Ensure greater transversality in the purposes since some focus on different dimensions of the same objective.

5. Results Discussion

The APMI model was proposed and developed to meet three main aspects: 1) being agile, 2) complying with portfolio management standards, and 3) being suitable for an insurance company.

Regarding the APMI's agility, the model embedded several agile features in its design, such as the clusters alignment, the Purposes and OKRs (Objectives and Key Results) definition and prioritization, the customer centricity, or the alignment between business and IT [25]–[27], [29]. These features contributed to the alignment of the model with key Agile values such as "valuing individuals and interactions over processes and tools," "valuing customer collaboration over contract negotiation" or "responding to change over following a plan." Nevertheless, the clusters could be more self-organized, autonomous, and further involved in the several decision moments of the process. The execution and monitoring phase of planning (see Figure 2) will play a key role in minimizing this question and enabling an even greater response to change. As the defined and selected purposes are periodically reviewed and generate more granular and shorter initiatives (or epics), clusters should be empowered to autonomously change course (if needed) and deliberate on their top priorities for the next cycle (typically three or four months). The corporate level should monitor the decisions and intervene only in critical strategic initiatives or to resolve potential conflicts in resource allocation.

Regarding the APMI's alignment with the current portfolio management standards, the main objective of any portfolio management model should be to enable a company to finish more initiatives (or purposes in the APMI's case) by doing fewer and more impactful initiatives [6], [8], [9], [11]. The survey results confirmed that the proposed APMI model did promote an increased focus in the organization with an evaluation score of 4.2 out of 5. As mentioned before, the execution and monitoring phase of the proposed APMI model will also play a critical role in this matter, as it will periodically review which initiatives are progressing as planned and which are behind schedule. More important, it will also monitor whether the purposes are delivering the value and impact that was initially proposed or not.

The survey also verified that the APMI model increased the strategic alignment of the organization's activities, achieving an evaluation score of 4.2 out of 5. In this matter, the APMI model proved to be highly effective by linking each purpose with the group's strategic priorities and each unit's OKR. As a result, in the APMI, each purpose should have a clear value and impact on the company's strategic direction, which is highly positive.

Moreover, the survey also showed that the APMI was very successful in aligning the entire organization on the path of moving forward, ensuring a higher comprehension and engagement with the decided annual business plan. In fact,

through its several alignment sessions, either within each cluster or with the entire organization, the APMI enabled transversal visibility that will undoubtedly facilitate the execution of the annual purposes plan (transversal visibility had a score of 4.2/5 in the survey). This alignment was fostered by the W shape of this model (see previous Figure 4) that enabled both a top-down (ExCo to Units) and bottom-up (Units to ExCo) alignment and collaboration [34].

Regarding the APMI's suitability for insurance companies, results show that the proposed APMI model can be suitable for any large corporation in the insurance industry or other industries as well, since the only aspect that made this model more suitable for an insurer was its cluster structure that was made according to the insurance's lines of business and can be easily adjusted to other industries' lines of business. For instance, if the APMI was implemented in a car company, clusters could bring together business units from various lines of business in the automotive industry, such as vehicles, electric vehicles, luxury vehicles, family vehicles, and so on.

However, it should be noted that the model will likely be more suitable for traditional companies with a functional structure (instead of a projectized or matrix structure). These organizations typically separate their departments in silos and therefore benefit from the model's several alignment and visibility moments. Moreover, these organizations generally tend to have their support resources centralized and need a model that manages the demand from the business units [8].

6. Conclusion and future developments

In conclusion, from the performed literature review on current Agile and Portfolio Management (PfM) knowledge, several insights and best practices can already be identified and summarized. However, since no Agile Portfolio Management (APfM) model for insurance companies was identified, this research study developed and proposed an APfM model that could be implemented in insurance companies, the APMI – Agile Portfolio Management for Insurers. This model considered current Agile practices and knowledge, as well as the available PfM best practices standards, and was tested in a Portuguese leading insurance company.

The APMI model used a W-shaped approach to strategic planning (see Figure 4) that was not yet fully explored in the academic literature (only in grey literature). This study further explored and detailed the W short-term planning (typically one year) and added new relevant features to it such as the cluster organizational structure or the introduction of Purposes and OKRs as key planning artefacts.

Moreover, this study also contributed to the existing knowledge regarding ambidexterity, one of the critical factors for being agile, as it developed a model that can align the corporative need for predictability and long-term strategic planning with the market's need to be flexible and constantly review (and, if necessary, change) how new and innovative business fields are approached. In other words, the APMI model guarantees the production of a plan that is aligned with the long-term corporate strategy, but can also be cyclically reviewed, allowing for a constant (re)focus and (re)selection of the initiatives that will enable achieving that strategy in the better and most effective way.

On the current research study limitations and future developments, the APMI model was tested in a single case study from an insurance group that constituted a typical and suitable case to achieve the goals of this research project. However, the proposed model is highly transversal and can be applied in many other industries with few modifications. Therefore, a major future development would be to implement the APMI model in other companies, from the insurance sector or not, to further validate its impact and adequacy.

Finally, another significant future development would be to further explore in deeper detail the design of the APMI model execution and monitoring phase, given its relevance to the model's agility and successful execution of the planned initiatives/ purposes. This phase of the APMI model should address four key objectives: 1) Review business performance in the past cycle (typically three or four months); 2) Update Purposes' pipeline and share key achievements and next steps, considering the success metrics and the committed roadmap; 3) Define Epics and success metrics for the upcoming cycle; and 4) If needed, prioritize Epics competing for the same capacity while managing dependencies between them.

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Appendix A. APMI feedback questionnaire

1. Overall, how satisfied are you with the APMI model that was implemented for the first time this year? (1 - Dissatisfied to 5 - Extremely Satisfied)
2. Do you agree with the following statements? (1 – Strongly Disagree to 5 – Strongly Agree)
    a. The APMI allowed a greater strategic alignment of the organization's activities
    b. The APMI has led to a greater focus on the organization for 2022
    c. The APMI allowed the various units to have transversal visibility on the priorities for 2022
    d. The APMI increased the capacity coordination between units, promoting a successful execution of the defined Purposes
3. Do you consider yourself prepared for next year's edition of the APMI (e.g., to define Purposes and establish annual objectives)? (1 – Very unprepared to 5 – Very well prepared)
4. What are the main future developments that you identify for the APMI process? (put first the improvement opportunities that you consider most relevant; it is not necessary to select all options)
    a. Improve the quality of the definition of purposes (example: tangibility of ambition)
    b. Simplify communication with units
    c. Improve the support given to units
    d. Promote greater quality and relevance of the discussion moments
    e. Reduce the effort dedicated to the process (example: the number of preparation meetings)
    f. Optimize the calendar of discussion moments, minimizing overlap with other processes (example: budget)
    g. Strengthen the validation and prioritization of purposes taking into account the strategic priorities and available resources in the organization
    h. Other (if yes, which one?)
5. What other considerations would you like to provide as feedback to the APMI process?

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