Vol. 12 | No. 3 | 2024

International Journal of Information Systems and Project Management

ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X

Available online at ijispm.sciencesphere.org

IJISPM

UMinho Editora

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Mission

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

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

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

Description

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

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

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

Topics covered

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

The topics include, but are not limited to:

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

Special issues focused on important specific topics will be evaluated for publication.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Correspondence and questions

All correspondence and questions should be directed to João Varajão (Editor-in-Chief). E-mail: editor.ijispm@sciencesphere.org

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Table of contents

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

IJISPM

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Editorial

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

It is our great pleasure to bring you the third number of the twelfth volume of IJISPM. In this issue, readers will find important contributions on GDPR, project teams, project portfolios, and project management offices.

The first article, "Five years with the GDPR: an empirical study emphasising information privacy and the consumer", is authored by Wanda Presthus and Hanne Sørum. According to the authors, consumers' privacy rights were enshrined in law long before information systems and the Internet were brought to life. In 2018, stricter regulations relating to information privacy came into force, named the General Data Protection Regulation (GDPR). Using elements of Roger's diffusion of innovations theory, the authors investigated the research question: How has five years of the GDPR influenced consumer's knowledge, attitude, and practice of their enhanced rights? They draw on empirical data collected in Norway through four online survey questionnaires over five years. Quantitative and qualitative analyses were performed to obtain a state-of-the-art mapping of insights on consumers and their information privacy. Their findings show that the respondents' answers remained similar over the years and that the GDPR has not had a significant influence on the consumer. The respondents demonstrated a high degree of knowledge regarding both the regulation and technology, such as cookies. Their attitude was skeptical, as they valued their enhanced rights but questioned the feasibility. Regarding practice, findings reveal diversity. Some respondents took careful actions to protect their privacy, while most did not.

The title of the second article is "Team delivery capability and agility: complementary effects on information systems development project outcomes" and Weidong Xia, Shekhar Rathor and Dinesh Batra are the authors. According to them, contemporary Information systems development (ISD) involves not only implementing a predefined set of requirements but also managing changes that emerge during the development process due to unanticipated business and technical needs. ISD project requirements increasingly become both planned and emergent. ISD teams need delivery capabilities to execute what has been planned and agile capabilities to sense and respond to changes that emerge during the development project. In other words, ISD teams must effectively manage their abilities to not only routinely deliver software applications that meet defined requirements but also sense and respond to changes emerging during the project. The extant literature has not studied the distinction and relationship between ISD team delivery capability and agility. This study empirically examines the differential effects of ISD team delivery capability and agility on ISD project outcomes. Survey data collected from professionals working on software development projects were used to test the research model and hypotheses. The results suggest that ISD delivery capability positively affects agility, agility positively impacts change-response outcome, and agility mediates the relationship between delivery capability and change-response outcome.

The third article, authored by Camilo Micán, Gabriela Fernandes, and Madalena Araújo, is entitled "Towards a comprehensive framework for risk assessment of organizational development project portfolios". The benefits of risk management in the context of project portfolios have been widely recognized in the literature. However, approaches that assess the risk of organizational development project portfolios from the perspective of how the portfolio delivers value to the parent organization remain largely unexplored. To address this gap, this research takes a constructivist approach and an organizational perspective on project portfolios. The authors conducted twenty-eight semi-structured interviews and used thematic analysis to identify and relate four themes of a comprehensive project portfolio risk assessment framework.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

"The impact of Project Management Offices on organizational performance: a comprehensive review of the literature" is the fourth article and is authored by Rahmad Syalevi, Teguh Raharjo, and Wahyu Setiawan Wibowo. In today's dynamic environment, information technology (IT) stands as the cornerstone for organizational success and competitive advantage, with project management playing a crucial role in efficiently deploying IT resources. Project Management Offices (PMOs) facilitate task organization and supervision, whether it is for IT product development, service improvement, system design, or implementing organizational changes. Despite extensive research on the positive impact of PMOs on organizational performance, a significant research gap exists due to the absence of a direct comparison between the influence of PMOs on IT and non-IT industries, indicating the necessity for further investigation in this domain. This study delves into the contribution of PMOs to organizational performance using the Competing Values Framework and evaluates five models and 17 performance metrics within the IT industry and across sectors. When comparing PMO performance, non-IT sectors precede interpersonal relationships, competency-based training, and workplace environment, whereas IT sectors emphasize the knowledge of PMO resource teams, efficient training, technology utilization, and collaboration for project success. Additionally, IT industries underline the role of technology in averting project management failures and prioritizing the punctual delivery of client requirements. These differences highlight the variations in PMO priorities between these industries, underscoring the significance of PMOs in enhancing organizational performance.

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

University of Minho

Portugal

João Varajão is a professor of information systems (IS) and project management (PM) at the University of Minho. He is also a researcher at the ALGORITMI/LASI research center. Born and raised in Portugal, he attended the University of Minho, earning his Graduate (1995), Masters (1997), and Doctorate (2003) degrees in Technologies and Information Systems. In 2012, he received his Habilitation from the University of Trás-os-Montes e Alto Douro. His main research interests are IS PM, IS Development, and IS Management (addressing PM success and the success of projects). Before joining academia, he worked as an Information Technology (IT)/IS consultant, project manager, IS analyst, and software developer, for private companies and public institutions. He has supervised over 140 MSc and PhD theses. He has published more than 300 works, including refereed publications in journals, authored books, edited books, book chapters, and communications at international conferences. He serves as editor-in-chief, associate editor, and editorial board member for international journals. He has served on numerous committees for international conferences. ORCID: 0000-0002-4303-3908

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Five years with the GDPR: an empirical study emphasising information privacy and the consumer

Wanda Presthus
Kristiania University College
Kirkegata 24-26, 0153 Oslo
Norway
wanda.presthus@kristiania.no

Hanne Sørum
Kristiania University College
Kirkegata 24-26, 0153 Oslo
Norway
hanne.sorum@kristiania.no

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Wanda Presthus, Hanne Sørum, "Five years with the GDPR: an empirical study emphasising information privacy and the consumer", *International Journal of Information Systems and Project Management*, vol. 12, no. 3, pp. 5-25, 2024.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Five years with the GDPR: an empirical study emphasising information privacy and the consumer

Wanda Presthus
Kristiania University College
Kirkegata 24-26, 0153 Oslo
Norway
wanda.presthus@kristiania.no

Hanne Sørum
Kristiania University College
Kirkegata 24-26, 0153 Oslo
Norway
hanne.sorum@kristiania.no

Abstract:
Consumers' privacy rights have been enshrined in law, long before information systems and the Internet was brought to life. In 2018, stricter regulations relating to information privacy came into force, named the General Data Protection Regulation (GDPR). Using elements of Roger's diffusion of innovations theory, we investigated the research question: How has five years of the GDPR influenced consumer's knowledge, attitude, and practice of their enhanced rights? We draw on empirical data collected in Norway through four online survey questionnaires over five years (N=1293). Quantitative (descriptive statistics) and qualitative analyses (manual cluster text mining) were performed to obtain a state-of-the-art mapping of insights on consumers and their information privacy. Our findings show that the respondents' answers remained similar over the years, and that the GDPR has not had a significant influence on the consumer. The respondents demonstrated a high degree of knowledge regarding both the regulation and technology, such as cookies. Their attitude was sceptical, as they valued their enhanced rights but questioned the feasibility. Regarding their practice, our findings reveal diversity. Some respondents took careful actions to protect their privacy, while most did not. The present paper should be interesting to both the industry (practitioners) and academia (researchers).

Keywords:
information privacy; General Data Protection Regulation (GDPR); consumers; diffusion of innovations theory; online survey.

DOI: 10.12821/ijispm120301

Manuscript received: 11 September 2023
Manuscript accepted: 26 February 2024

1. Introduction

With a combination of only three variables of data—postal code, birth date, and gender—what percentage of individuals did computer scientist Latanya Sweeney manage to identify? Answer: 87% [1]. Add to this the consumer's use of the internet, mobile phones, and the many other digital traces we leave in this high-tech society, and companies can feast on our personal data. On the positive side, for example, as consumers, we now get faster application processing at the bank, and better predictions of health issues [2]. However, there are also challenges. With the development of technology, more decisions are now made without the involvement of human actors. For example, a bank's machine algorithm can decide whether an applicant will get a mortgage. Such cases are not illegal, but consumers have the right to be informed if the decision was made automatically and without human involvement. A more questionable example, perhaps, is when the algorithm of a hotel chain matches your device's IP address with your country of resident and categorises it as wealthy or not. Residents of wealthy countries are shown higher prices for hotel rooms, a phenomenon called *price discrimination*.

Companies also know where we shop, what we are likely to buy in the future, and what our digital movements are like. Most people are probably not familiar with all the various digital traces they leave behind every day; but some individuals care more than others. However, there are laws and regulations to protect consumers so that their privacy is safeguarded in a fair and good way. In Norway, there have been strict rules related to privacy and the handling of personal data for many decades. Consumers' interests have been well looked after, and people usually do not think too much about this unless problems arise, such as the misuse of their personal data. In 2018, an even stricter regulation named the General Data Protection Regulation (GDPR) was enacted. The GDPR is a privacy law that affects all citizens who live in European Union (EU) or European Economic Area (EEA) countries and any company that does business with these citizens. A privacy law will normally address two parties: the consumer, who gets increased rights, and the company, who gets increased duties [1].

This study focuses on the consumer's increased rights [1] and the research question is: *How has five years of the GDPR influenced consumer's knowledge, attitude, and practice of their enhanced rights?* Drawing on our empirical data collected between 2018 and 2023, we offer a mapping of consumers' perspectives during these years. The aim is to explore how this regulation works in practice and how consumers are aware of and use their rights. We discuss our findings with the help of elements from the diffusion of innovations theory [3]. Thus, we contribute with mainly new insights to the industry, but also to academia due to our use of a well-known theory.

Our paper is divided into seven parts: In Section 2, we review relevant literature; in Section 3, we present our theoretical framework; and in Section 4, we describe the use of method and the data analysis performed in the present study. The findings are presented in Section 5, followed by a discussion in Section 6. The conclusion is provided in Section 7, along with suggestions for future research.

2. Related work of privacy and the GDPR in an information systems' context

The literature on privacy is extensive and interdisciplinary [4]. It includes definitions for philosophers, conceptual frameworks for academics, insights into the laws and regulations for legal professionals, business strategies for companies, and benefits and challenges for individuals, companies, and society. More recently, topics such as *algorithmic transparency* [5] and *responsible artificial intelligence* [6] have emerged.

The famous juridical definition of privacy as "*the right to be left alone*" was suggested in 1890 by lawyers Warren and Brandeis. As explained by Solove [7], the motivation behind this was the invention of a portable camera. Extant literature claims that we lack a common definition of privacy [8], however, in this study, we will focus on information privacy, which is a subset of privacy and often used in an information systems context [9].

Information systems are a young discipline [10], at least compared to privacy and jurisprudence. As suggested by Dahlbom, the evolution of information systems can be divided into four phases [11]:

> **Phase 1.** The first computing machines were automatic versions of the mechanical calculating machines used in offices and retail stores. The machines performed the same tasks as humans, only faster, cheaper, and more reliable.
>
> **Phase 2:** In the early 1960s, computers began to be used as information systems due to their capacity to handle large sets of data. Information systems were used by companies and government agencies to register and keep track of people, products, payments, and taxes.
>
> **Phase 3:** The personal computer became portable, and networks and client server technology were introduced in the late 1980s. This made it possible to distribute, sort, and cooperate with all the documents and spreadsheets produced in the PCs. Computer technology became a medium of communication for entertainment, education, news, and marketing.
>
> **Phase 4:** Today, we have witnessed the emergence of the Internet, infrastructures, interactive multimedia, cyberspace, networks, machine learning, artificial intelligence, and the Internet of Things.

From Dahlbom's [11] description of information systems, we note concepts such as *automatic*, *handling large sets of data*, and *keeping track of people*. Further, benefits such as *fast*, *cheap*, and *reliable* occur. A case from Norway illustrates the how fraud was revealed: The Driver and Vehicle Licensing Agency's database of people who had recently obtained their driver's licence was mapped with the social security office's database of people who also received welfare for being blind. Several matches were made [12].

Research has addressed the benefits and questionable consequences of using technology and analysing large amounts of data from multiple sources. Examples of benefits for the individual, organisation, and society include improved and tailored medical treatment, facilitated urban planning, catching more criminals, and thus creating a safer nation. These benefits also come with drawbacks such as *price discrimination*, tempting the consumer with targeted advertising, letting criminals know that you are away from home, and hacking companies' systems [2].

By browsing the Internet, a lot goes on behind the user's computer, and much is automated. For example, cookies are being traced, companies have an auction, and the highest bidder will place their ad on the user's screen [13]. Cookies have caught the attention of researchers considering the divide between EU/EAA citizens and non-EU/EAA citizens after the implementation of the GDPR. The GDPR rules of the former group are stricter, and EU/EAA users may experience a denial of access to, for example, US webpages [14].

The GDPR applies to any EU or EAA citizen. The GDPR is a central regulatory framework almost regardless of the industry or business sector [15]. The regulation replaced over 40 privacy laws in Europe, and one of the motivations behind the GDPR was the emergence of technology and analytical tools. The GDPR consists of 99 articles, 11 of which were found to influence how companies use information systems in particular [16]. For this study, the following articles apply:

> *Article 5: Principles relating to the processing of personal data*
> Consumers' personal data should be processed with fairness, lawfulness, and transparency and only collected for specified, legitimate, and explicit purposes.
>
> *Article 7: Conditions for consent*
> Consumers can withdraw their consent at any time and in an easy manner.
>
> *Article 15: Rights of access by the data subject*
> Consumers can obtain confirmation regarding whether personal data concerning them are being processed.

Article 17: Right to erasure ("right to be forgotten")
Consumers have the right to have their personal data erased from the organisation.

Article 20: Right to data portability
Consumers have the right to receive their personal data, and reuse them for their own purposes. It allows them to move, copy, or transfer personal data easily from one IT environment to another in a secure way.

Article 22: Automated individual decision-making, including profiling
Consumers have the right not to be subject to a decision based solely on automated processing (without any human involvement).

Article 25: Data protection by design and by default
The organisation must ensure that only the consumers' personal data that are necessary for each specific purpose of the processing are processed.

The use of cookies is not directly mentioned in the 99 articles of the GDPR. The regulation (found here: https://gdpr-info.eu/) mentions cookies in recital number 30:

> *"Natural persons may be associated with online identifiers provided by their devices, applications, tools and protocols, such as internet protocol addresses, cookie identifiers or other identifiers such as radio frequency identification tags. This may leave traces which, in particular when combined with unique identifiers and other information received by the servers, may be used to create profiles of the natural persons and identify them".*

However, some researchers claim that other articles in the GDPR indirectly address how the owners of webpages use cookies, such as Article 6*: Lawfulness of processing* [17]. We also surmise that Articles 5 and 7, as listed above, are related to the use of cookies. The regulation poses challenges for organisations, and research shows that companies want to comply but struggle to understand their new duties [16, 18]. Failing to comply with the GDPR can result in sanctions from the country's data protection authority [19]. Another study by Dexe et al. [20] found that the translation of the GDPR wording differed in five countries. Companies struggle with the interpretation of the regulation, and the authors call for clarification from legislators.

If companies struggle to interpret the regulation, consumers most certainly will be puzzled. Before the GDPR, the privacy calculus model prevailed (see, e.g. Dinev et al. [21]), which involved people calculating which of their private data to give up in exchange for benefits when shopping online. Privacy in an online context has been a topic for many years, and several studies have explored consumers' concerns about the violation of their privacy, especially in e-commerce. Typically, consumers are concerned about misuse of personal information, monitoring, spam, hackers, viruses, and the risks associated with payment [8]. More recently, Momen et al. [22] investigated the effects of the GDPR on consumers' Android apps. Among others, the findings show that changes point to positive impacts of the implementation of GDPR regarding user's app behaviour and in user feedback. In general, the authors concluded that privacy in apps has moderately improved post-implementation of the new regulation. Previous studies [23] show that the GDPR has made progress in protecting user data. However, more progress is needed regarding giving users the right to edit and delete personal data. Recently, researchers have wondered whether consumers have any choice regarding their privacy, because they must give up personal data to exist in today's society [13, 24, 25].

3. Theoretical framing: the KAP model from Rogers' diffusion of innovations

In his well-known book on the diffusion of innovations, Roger's described a model called KAP: *knowledge, attitude, practice* [3, p. 176]. The author used cigarette smoking to exemplify KAP as follows: First, an individual needs to know that smoking is dangerous. Then, the smoker needs to want to give up smoking. Finally, the person must act and stop smoking, and remain a non-smoker.

In other words, there is a process: knowing → wanting → acting. The problem, as discussed by Rogers, is the *KAP gap*, which indicates the discrepancy between knowledge, attitude, and action. Knowing that fast food has many calories, and wanting to lose weight, an individual may still continue to eat hamburgers and deep-fried food. Sometimes, an individual may need a *cue-to-action* to change behaviour or adopt an innovation. A cue-to-action is *"... an event occurring at a time that crystallizes a favourable attitude into overt behavioural change"* [3, p. 176]. A cue-to-action may occur naturally; for example, in our context, a bank customer may experience being denied a mortgage, thus motivating the customer to exercise their *right to access* (Article 15). Another example can be triggered by rock stars, as discussed later in the article.

In the information privacy literature, the discrepancy between what people claim they do, and what they actually do is called the *privacy paradox* [26]. Consumers claim to care about their privacy, but their actions do not correspond. For example, they will willingly give up personal information to gain benefits, such as discounted prices, when shopping. Recently, the privacy paradox has been criticised, and some researchers, such as Knijnenburg et al. [24] and Solove [25], claim that consumers do not really have a choice.

In our study, *knowledge* refers to the information possessed by consumers, such as their awareness of information privacy and the GDPR. *Attitude* deals with the willingness to change one's behaviour. In our study, one example is choosing to care about one's privacy, or, as some do, simply give up the fight and hope for the best. *Practice* is about acting and making use of the enhanced rights offered by regulations such as the GDPR, including data portability, the right to be forgotten, insight, and rejecting cookies on websites. Our questionnaire and discussion were constructed based on the KAP concept [3] and is summarised in Table 1.

Table 1. Attributes regarding information privacy and the GDPR investigated in the present study.

Information privacy and the GDPR		
Knowledge	**Attitude**	**Practice**
Consumers must possess information about technology and be aware of their enhanced rights	Consumers must care about their privacy and be willing to change their behaviour, such as rejecting cookies on websites and start reading terms & conditions	Consumers must make use of the enhanced rights. The GDPR provides several articles: Article 15: right to insights Article 17: right to be forgotten Article 20: right to data portability Articles 5/6/7: consent

4. Methods

We drew on empirical data collected through four different online surveys. In this paper, we present our quantitative findings, in addition to a thorough qualitative analysis of the quotes from the respondents, to provide a richer and more descriptive picture of our findings. We start by presenting the most recent survey from 2023, followed by those from 2018 [27], 2019 [28], and 2020 [29].

4.1 Data collection

The survey from 2023 was designed by utilising the online tool *Nettskjema* (www.nettskjema.no). This tool was developed by the University of Oslo (Norway) and meets the requirements for privacy and research ethics. After the survey was designed using *Nettskjema*, a link (web address) was generated, and the respondents used the link to access the survey. Before data collection took place, we carried out a pilot test with four respondents. The purpose was to test that the questions were understandable; that there was a logical connection between question-and-answer alternatives; checking typographical errors; and that the link worked. We received a few comments that were implemented in the survey, mainly about improving the answer alternatives on some of the questions. This was useful and valuable feedback.

The data collection took place from February to the end of June 2023. Since privacy and the GDPR concern all people, we wanted answers from a broad target group. The link to the survey was therefore distributed through various channels. The link was posted on Facebook, sent to our contact network (private and work), and we recruited respondents who are students at a university in Norway. These students were from various fields of study and therefore had different backgrounds and interests. On the first page of the survey (start page), participants were informed of the topic of the survey, that participation was voluntary, and that all responses were anonymous. In addition, we included contact information for the research team. The survey was completed in June 2023 with 306 respondents.

By using the online tool for surveys *Nettskjema*, we only had access to respondents who filled in all the questions in the survey (and not those who dropped out before completing the questionnaire). Moreover, due to this method of posting a survey link on social media among networks and students who were physically present at school, we cannot report on the response rate. We closed the survey when we had a scientifically acceptable number of respondents, and we detected clear patterns in the responses.

The surveys from 2018, 2019, and 2020 were conducted using SurveyMonkey®. The main structures of the survey were similar. They all had an introduction consisting of a description of the topic, contact information of the research team, and information about research ethics, such as anonymity. All questionnaires contained questions that generated both qualitative and quantitative data. However, the surveys have been somewhat altered and improved based on the comments that we received in the open-ended questions. In the 2018 survey, 10 respondents stated that the survey was too long and cumbersome, with long sentences in our questions. They also claimed that the survey had either too many alternatives or that none of the alternatives suited them. We interpreted these comments as genuine interest in the topic. Based on this valuable feedback, we made some changes to our survey every year. For example, when we conducted the first explorative survey in 2018, the GDPR was yet to be implemented; thus, we had to provide descriptions of the articles in the survey questions. Over the years, the topic has become more known, and we have reduced the explanatory text in the questions.

Based on feedback from the previous participants, and pilot tests in 2023, we changed the last sentence "*What do you think about this*?" to "*Which answer option suits you best*?" to provide more flexibility to the participants. Moreover, it was necessary to change the verb tense from "I *may want to execute* this new right" prior to the implementation of the GDPR in 2018 to "I *have executed* this new right" in 2019 and onward. We acknowledge that altering the questions poses some challenges in comparing the results, but we will address this issue in the next sections.

4.2 Respondents

As mentioned above, we did not have a specific target group. Table 2 shows the detailed gender of all respondents between 2018 and 2023. We had a total of 1293 respondents, of which 652 were men, 633 were women, 2 indicated 'other', and 6 did not answer the gender question.

Table 2. Number of respondents in the four surveys conducted between 2018–2023.

	2018	**2019**	**2020**	**2023**
Men	137 (63.43%)	178 (54.43%)	166 (37.39%)	171 (55.9%)
Women	79 (36.57%)	146 (44.65%)	274 (61.71%)	134 (43.8%)
Other	-	-	1 (0.23%)	1 (0.30%)
Do not want to answer	-	3 (0.92%)	3 (0.68%)	-
SUM number of respondents	**216**	**327**	**444**	**306**

The distribution of the respondents for the survey conducted in 2023 is shown in Table 3.

Regarding the respondents who took part in the previous surveys, the following findings are highlighted: In 2018, more males participated in the survey (63%) than females (37%). Most of the respondents were 21–25 years old, followed by the 26–30-year-old group. In 2019, 54% of the respondents were men, and 45% were female. The rest did not want to give up their gender. Most respondents were 21–25 years old, followed by the 26–30-year-old group. In 2020, the typical respondent was female in the age group of 18–25 years. In all the surveys conducted, there was a dominance of younger people enrolled in a higher educational programme (typically a bachelor's degree).

Table 3. Overview of the respondent's characteristics in 2023.

Age	18–25 years: 148 (48.4%)
	26–30 years: 41 (13.4%)
	31–40 years: 37 (12.1%)
	41–50 years: 32 (10.5%)
	51–60 years: 34 (11.1%)
	Over 60 years: 14 (4.6%)
	Don't want to give up: 0
Level of education	Primary school: 0
	Upper secondary school: 22 (7.2%)
	Vocational school or equivalent: 20 (6.5%)
	Education at bachelor's level: 194 (63.4%)
	Master's level or higher: 68 (22.2%)
	Other: 2 (0.7%)
Main occupation	Income–generating work: 124 (40.5%)
	Student: 176 (57.5%)
	Other (for example, stay-at-home, retired): 6 (2%)

4.3 Data analysis

Our survey provided us with quantitative and qualitative data. Regarding the quantitative data, we first carried out descriptive analyses, looking for patterns and trends in the results. We used Microsoft Excel® to create tables and visual graphs. In this paper, we present descriptive data on how the answers were distributed on the measurement scale. This provided us with an understanding of how consumers viewed the GDPR over time.

In addition to quantitative data, our survey from 2023 included one open-ended question (see the Appendix), to which 36 respondents provided answers. The length of the answers was mostly one or two sentences, but some wrote a whole paragraph. Drawing on techniques for analysing qualitative data [30] we created a matrix in Microsoft Excel® and looked for clusters, or common topics, in the answers. The "search-and-mark-all" function in Microsoft Excel® allowed us to perform *stemming*, a text-mining term. Stemming is the process of reducing words to their roots. For example, stemmer, stemming, and stemmed are all from the root 'stem' [31]. We coded the most frequent words or topics and added up the occurrences. Due to the limited quantity of text, it was manageable to conduct the text analysis manually. The benefit of manual text analysis is that we can detect emotions, irony, and spelling errors.

As previously mentioned, our survey has been altered over the years. In 2018, we had six open-ended questions, and we received 69 answers in total. In 2019, we increased the open-ended questions to 11, and we received 160 answers. In 2020, we still had 11 open questions, and we received 101 answers in total. Typically, the respondents wrote one or two sentences, but a few wrote a small section. In summary, we obtained 366 different text answers from respondents from four surveys, as shown in Table 4.

Table 4. Number of qualitative comments in each of the four surveys conducted.

Survey year	2018	2019	2020	2023	**SUM**
Qualitative answers	69	160	101	36	**366**

4.4 Strengths and weaknesses of our method

The strengths of our method are that we have respondents of different ages and backgrounds, and we could repeat our survey multiple times and compare the results over time. A link to the survey was distributed in various networks, and the research team worked actively to get respondents who did not primarily reflect a given group in the society. Nevertheless, we acknowledge that most of our respondents were students in their twenties.

As mentioned, despite our pilot tests before collecting data, the survey had to be altered and improved over the years. For example, a few respondents in 2018 indicated that some questions were too leading, or, that there were not enough alternatives to choose from. In response to this, we included more open-ended questions in 2019 and 2020. Although we received more qualitative replies, we noted that there were many repetitive answers. In addition, some participants in

2019 claimed that the survey was too long and cumbersome. For these reasons, we only had one open-ended question at the end of the survey in 2023 (see the Appendix).

5. Findings

The following section is divided into two parts: Section 5.1 provides the quantitative findings, and Section 5.2 presents the qualitative findings from the open-ended questions in our study.

5.1 Quantitative findings

At the beginning of the survey, the respondents were asked questions about their knowledge of the GDPR. Table 5 shows how the answers are distributed, and Figure 1 shows a visual impression of the data in Table 5.

Table 5. Knowledge of the GDPR over the years (actual numbers in percentages).

	Knowledge of the GDPR			
	2018 (n = 216)	2019 (n = 327)	2020 (n = 444)	2023 (n = 306)
Yes, and I know what it means	46.76%	61.77%	26.13%	46.7%
Yes, I know a little, but not enough about what it means	26.39%	30.58%	26.80%	26.1%
Yes, but I do not know what it means	5.56%	3.06%	12.39%	8.8%
I have never heard of that	21.30%	4.59%	34.68%	18.3%

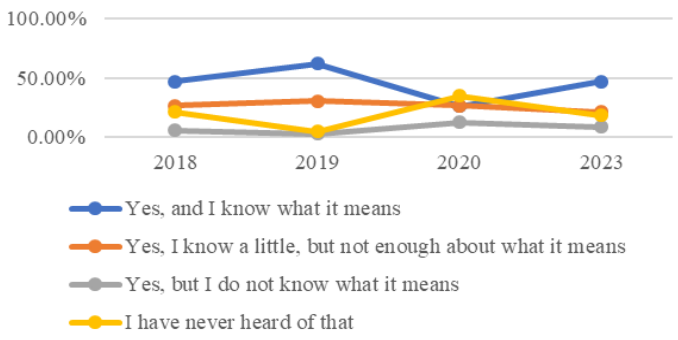


Fig. 1. Visualisation of the distribution of knowledge of the GDPR from 2018–2023.

Regarding the knowledge of the GDPR, there have been changes over the years, and most people had heard of the regulation and knew what it meant by 2019. This knowledge seemed to decline in 2020, but it increased in 2023. The number of respondents who had "never heard of the GDPR" was very few in 2018 and 2019, whereas in 2020, this represented approximately 35% of the respondents. In the survey from 2023, this number dropped to less than 20% among the respondents. Furthermore, the respondents were asked about their attitudes towards the GDPR and whether they were generally concerned as a consumer. The results are shown in Table 6 and a visual impression of the numbers is shown in Figure 2.

Table 6. Attitude of the GDPR over the years.

	Attitude of the GDPR			
	2018 (n = 220)	**2019 (n = 327)**	**2020 (n = 444)**	**2023 (n = 306)**
Not at all	1%	1%	2%	0.3%
Low	10%	12%	12%	11.1%
Medium	55%	56%	54%	50.7%
High	34%	31%	30%	37.9%
I do not know	1%	1%	3%	0

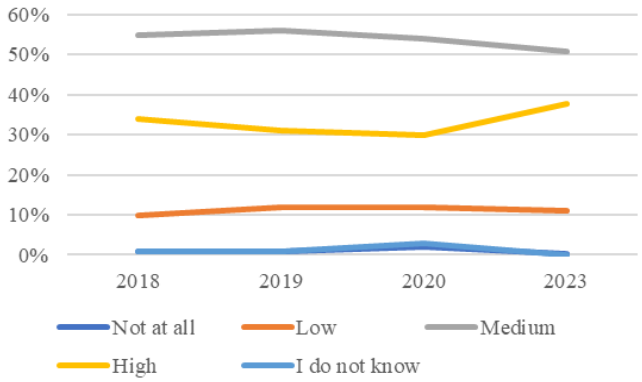


Fig. 2. Visualisation of the distribution on attitude pertaining to the GDPR from 2018–2023.

The findings show that the answers to this question have been relatively stable over the years, with one exception. We observe that the graph depicting high concern increased somewhat in 2023 (just below 40%).

In the following graphs we have omitted the results from 2018 due to the differences in the verb tenses in the questions, as explained earlier. We focus on comparing the actual practices of the respondents. However, we describe the results of the 2018 survey under each graph.

Our description of Data portability (Article 20) for the present study reads: Consumers have the right to receive their personal data and reuse it for their own purposes. They can move, copy, or transfer personal data easily from one IT environment to another in a secure way.

Regarding data portability, the analysis showed that the patters have been relatively stable from 2019-2023. However, inn 2023, even more respondents answered that they “might execute this right”. The size of “I do not know” group had decreased.

In 2018 (prior to the implementation of the GDPR and not included in Figure 3), 17% of the 203 respondents believed they would make more use of the right to transfer personal data. More than half of the respondents (53%) stated that they might want to use the right, 20% indicated that they most likely would not, 3% did not care, and 7% did not know.

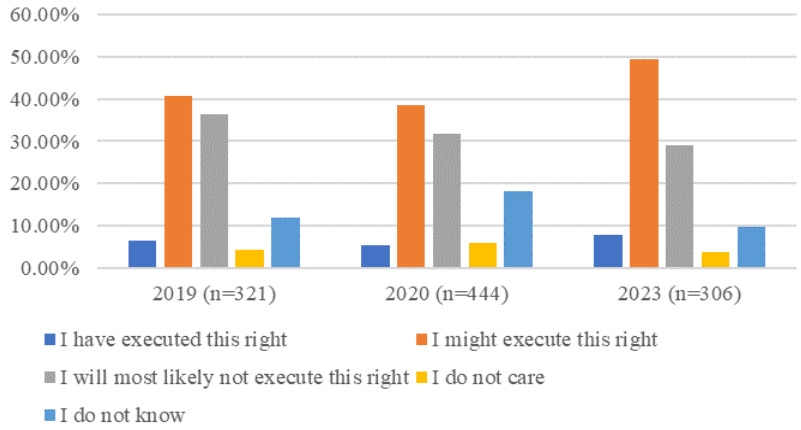


Fig. 3. Visualisation of answers pertaining to data portability from 2019–2023.

Our description of the Right to be forgotten/Erasure (Article 17) for the present study reads: Consumers have the right to have some of their personal data erased from the organisation.

Regarding the right to be forgotten, the answers were almost equal regarding distribution on the measurement scale. Over the years, most respondents answered that they might execute this right. Few responded that they did not care. Moreover, the findings show that surprisingly few respondents had executed this right over the years (above 10%).

Numbers from 2018 (not included in Figure 4) showed that 39% indicated that they would make use of this right, while 49% stated that they might take advantage of this right. Moreover, 9% answered that it was a right they most likely would not make use of, 1% of the respondents did not care, and 2% did not know.

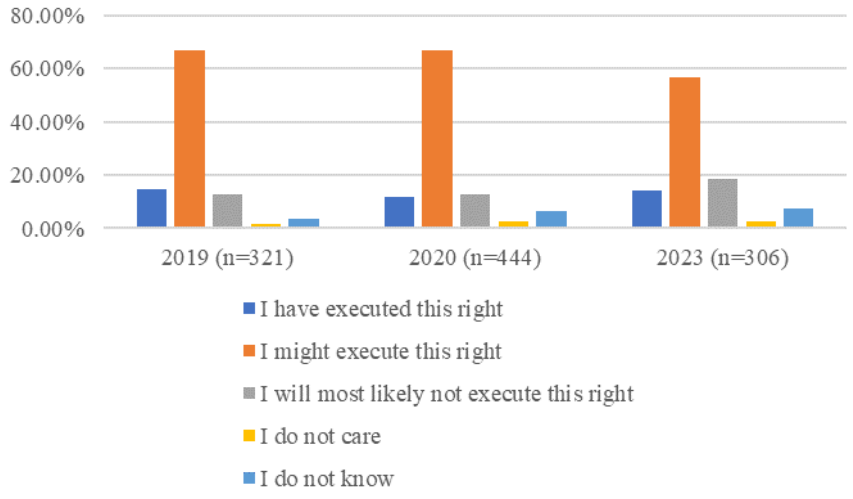


Fig. 4. Visualisation of answers pertaining to right to be forgotten from 2019–2023.

Our description of Right to access (Article 15) for the present study reads: Consumers can obtain confirmation of whether or not personal data concerning them are being processed. They have the right to insight and to rectify potential wrong information.

Regarding the right to access, there was a small variation in relation to what the respondents answered over the years. In 2020, 6% answered that they had exercised this right, and in 2019 and 2023, the affirmative response was also below 10%. Most of the respondents said that they would possibly make use of this right to access personal data. Very few of the respondents said they did not care.

According to the 2018 survey (not included in Figure 5), 17% of the respondents answered that they had wanted this opportunity for a long time, 9% indicated that it did not matter, 20% believed they would surely make use of it, and 53% stated that they could possibly use it. Furthermore, 13% stated that this was most likely a right they would not exercise, and 39% believed that this would create challenges for many companies.

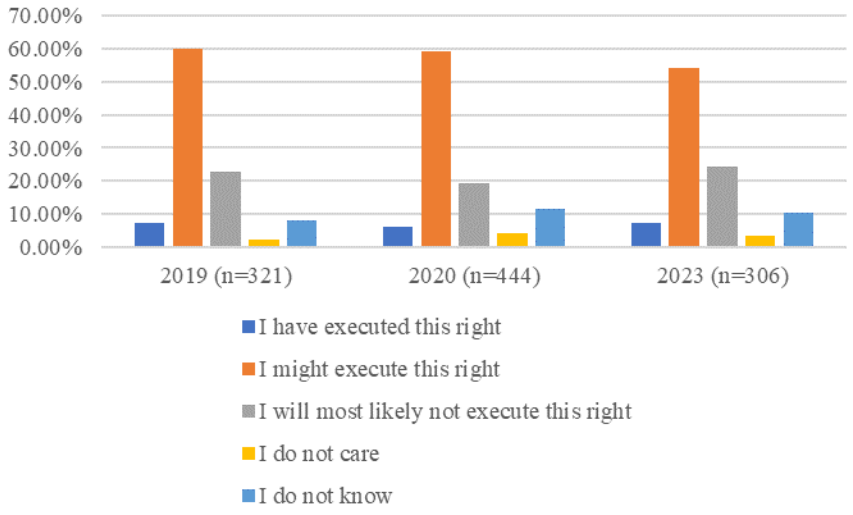


Fig. 5. Visualisation of answers pertaining to right to access from 2019–2023.

Our description of Cookies (Articles 5/6/7) for the present study reads: Consumers' personal data shall be processed with fairness, lawfulness, and transparency and only collected for specified, legitimate, and explicit purposes.

We need to mention that the numbers (percentage) in Figure 6 are more than 100% for some answers, as it was possible to check off more than one answer option in this question. However, the findings showed that the respondents generally experienced that companies had become better at informing about cookies after the GDPR was introduced. The responses from 2023 (compared to 2019 and 2020) show a clear increase in users' perceived opportunities to opt out of cookies or whether they want to accept all of them. At the same time, the findings also show that there is uncertainty associated with companies' use of cookies. A few people answered that they did not care and/or know what cookies were.

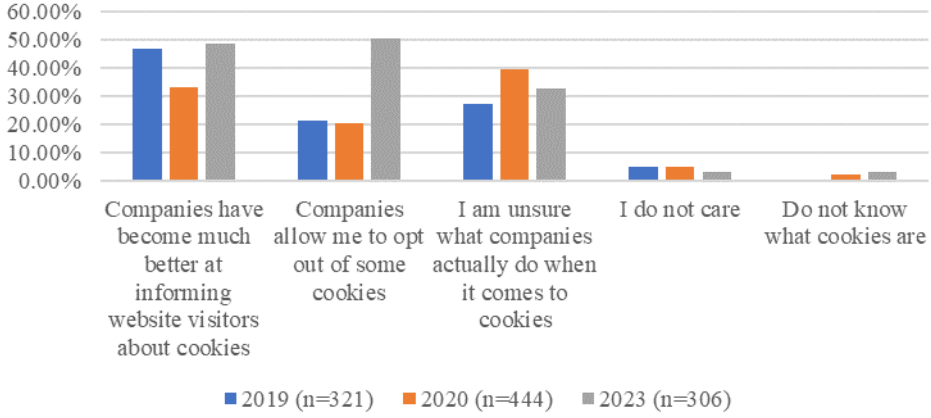


Fig. 6. Visualisation of answers pertaining to cookies from 2019–2023.

Regarding the 2018 data (not included in Figure 6), 63% of the respondents were positive about the expected enhanced rights enforced by the GDPR regarding cookies, 38% had no faith that all businesses would follow the new regulation, 29% were unsure of how this would work in practice, 7% did not care, and 2% of the respondents did not know what cookies were. Table 7 summarises the trends and patterns that emerged from the quantitative findings.

Table 7. An overview of the findings of the present study.

	2018	2019	2020	2023
Knowledge and attitude				
Knowledge of the GDPR	Yes, and I know what is means	Yes, and I know what is means	I have never heard of that	Yes, and I know what is means
Attitude/level of concern for privacy	Medium	Medium	Medium	Medium
Practice				
Right to data portability	May use	Might use	Might use	Might use
Right to data erasure	May use	Might use	Might use	Might use
Right to personal data access	May use	Might use	Might use	Might use
Consent/cookies	Positive to the expected enhanced rights	Companies better at informing about cookies	I am unsure what companies do about cookies	Companies allow me to opt out of some cookies

5.2 Qualitative findings

The text analysis revealed insights and more details within knowledge, attitude, and practice. This section starts by presenting the findings from 2023, followed by the main findings from 2018, 2019, and 2020.

The text analysis in 2023 resulted in four clusters:

Cluster 1: Dislike of cookie warnings on websites (mentioned by 19 participants)
Cluster 2: Expressing concerns pertaining to privacy (mentioned by 18 participants)
Cluster 3: Positive to new rights (mentioned by 5 participants)
Cluster 4: Sceptical to new rights; they do not work as intended (mentioned by 18 participants)

Regarding the largest cluster, cookies, the comments were exclusively negative. All the participants had versions of this quote: *"It is incredibly annoying to have to deal with a pop-up about GDPR every time you access a website. Many companies make it extremely difficult to limit cookies and super easy to accept everything".*

The text analysis also revealed that some participants had mixed emotions. For example, one participant shared: *"I have sent several "data erasure requests" over the past few years, many of which were positively addressed by the companies. I believe that the GDPR has increased businesses' awareness of data ownership and responsibility. However, I cannot be entirely certain that the data has not been misused".*

Thus, the comments indicated the respondents' annoyance towards cookies on websites and clear evidence of concerns about their information privacy in general. However, only 36 out of 306 participants chose to answer this open-ended question. However, the comments were similar to the results from previous surveys.

In 2018, our analysis revealed that the respondents had some, or good, knowledge, and interest about privacy and GDPR, and they demonstrated reflection. Their attitude was that the GDPR did not necessarily improve their rights. Regarding practice, the majority stated that they *might* execute their new rights (access, data portability, right to delete). This was before the implementation of the GDPR. Typical quotes:

"I am unsure to what extent this is actually prioritised by the businesses and how one can alone demand this".

"In general, I think that in a large and complicated society, it is more appropriate to have strict, clear GENERAL LAWS AND RULES related to privacy and data collection, rather than to set up for us to have detailed control over

how information about us is used. And in the continuation: that companies MUST comply with clear laws and regulations, but not spend large resources on answers to individual consumers. But, I could be wrong".

"To date, I have not come across a long "terms and conditions" that is readable by most people, so if the text is longer than what fits on one page, it is unlikely to be understandable. At the same time, most such texts are quite similar, so if you are familiar with one, you usually know the main points in most of them".

In the following study of 2019, the respondents demonstrated high knowledge about the regulation and technology, as shown by one of the quotes: *"one cannot have webpages without cookies"*. Regarding attitude, the respondents stated that they were positive about the new rights and articles in theory; however, they did not all think that their rights had improved in everyday life. Regarding practice, they were aware of, for example, cookies and the long "terms and conditions" when downloading an app, but they clicked "I agree" nonetheless. Two reflections read:

"Some companies make it cumbersome and difficult to find out the consequences of where the data ends up, and suggest that you accept the companies' terms that they want you to accept as much data as possible for them", and:

"This is completely idiotic. You cannot have websites without cookies. That they should inform me about cookies and that I must approve every time I access a website is just nonsense. Tracking, on the other hand, should rather be disclosed (which in that case is misuse of cookies)".

Most of the respondents were positive about the idea of the GDPR but unsure about its feasibility. There were a few outliers that were against the whole regulation: *"I would like to add that I am personally completely against the entire GDPR. 'The Right to be Forgotten' conflicts with principles of how the Internet should exist; this should be single-function pages and companies can choose to use, otherwise inform consumers that they do not enforce the right. […] GDPR is an encroachment on the private sphere by a state that should not exist, and people should react to it as such".*

In 2020, our analysis indicated the same conclusions as in previous years: the respondents were clearly concerned about their privacy and were in favour of the new articles. Regarding their practices, we detected some incoherence, as some respondents took more action than others.

To summarise the text analysis, our conclusion from the four surveys is that the respondents claimed extended knowledge about their privacy and the GDPR; they were positive towards their new or enhanced rights, but they had a sceptical attitude towards the feasibility, and their practices were incoherent.

6. Discussion

In response to our research question — *How has five years of the GDPR influenced consumer's knowledge, attitude, and practice of their enhanced rights?* — we structure our discussion according to the KAP (knowledge, attitude, and practice) framework [3] in Section 6.1. We then zoom out to discuss the topic by considering more elements of the diffusion of innovations theory in Section 6.2.

6.1 Knowledge, attitude, and practice

In our study, *knowledge* embraced the GDPR in general, and whether the respondents had heard about cookies. From the quantitative data visualised in Figure 1, we observe that knowledge about the GDPR has fluctuated over the years. It is difficult to see any patterns or make any forecasts regarding whether knowledge has improved over the years. Regarding cookies, however, a few respondents stated that they did not know what cookies were in 2018. No participants ticked off for "Do not know what cookies are" in 2019, but in 2020 and 2023, a few participants stated that they had no knowledge about cookies. From the answers provided in the open-ended questions, it seemed that most of our respondents possessed good knowledge throughout the years, and they seemed to be concerned about the same topics, such as protecting their personal data. One comment read: *"My e-mail was just sold to someone that spams my e-mail with topics like consumer loans".*

The overall *attitude* towards the GDPR has only slightly changed. As visualised in Figure 2, we observe that the "medium" is decreasing, while the "high" is increasing in 2023. Most of our respondents claim that their rights following the GDPR have improved. For every question about enhanced rights, we included the option to choose "I do not care at all". Very few, about 1–2%, ticked off this alternative. Our first study on privacy and the GDPR was published in 2018, just before the GDPR was enforced. The findings showed that prior to the implementation of the GDPR, consumers were more interested in the anticipated enhanced rights than proved to be the case in our survey after 2018. This can be due to several reasons. Just before and at the time when the GDPR was first introduced, there was a lot of focus on the regulation in the media and in various workplaces. The attention on the regulation decreased after the implementation, resulting in less awareness among consumers.

According to our qualitative data, the attitude towards cookies was clearly negative. Some participants went as far as to claim that companies made the information and possibility of opting out difficult and cumbersome on purpose. This negative attitude remained similar in the four surveys. The same observation was made regarding the attitude towards the GDPR. As indicated earlier, a few participants claimed that they were against regulation, but the majority found it useful and interesting. However, they questioned the feasibility, and very few stated that they had executed their enhanced rights.

In our study, *practice* pertains to the use of the right to data portability, insight, and deletion. Our data from the four surveys revealed a status quo, with a small dip compared to our first study in 2018. As previously described, cookies were a recurring topic for many of our respondents in the open-ended question. This may be because consumers encounter this issue almost every time they visit a website. As pointed out by many respondents, if they do not accept the website's use of (at least the necessary) cookies, access is denied and/or limited to a greater extent. Nevertheless, the findings show that cookies are engaging and that consumers noticed a change in the information provided relating to the use of cookies after the GDPR was implemented.

Do we find any evidence of cue-to-action [3] in our research? Meaning, do our participants describe any "wake-up calls" that have led them to take more action? From the comments provided in the open-ended questions, we noted that there were descriptions of incidents, such as having e-mails sold to third parties. However, we did not find that the incidents were severe enough. One reply reads: *"If I had been really concerned about privacy, I would have stopped using Facebook and Google a long time ago".*

6.2 Using other elements from the diffusion of innovations

Rogers claimed that most studies within the diffusion of innovations theory have been from a variance perspective, and he issued a call for more research using a process perspective [3]. Variance research is a type of analysis of a set of variables that examines cause and effect, while process research seeks to determine the sequence of events over time [32]. Rogers did not provide any reasons for the predominance of variance research, but we believe that the reason is rather obvious: research over time requires, well… time. Thus, we argue that the main strength of this study is the empirical data collected four times between 2018 and 2023. By drawing on both quantitative and qualitative data, we demonstrated knowledge, attitude, and practice over time using graphs, and we unravelled some insights among consumers, as summarised in Table 5.

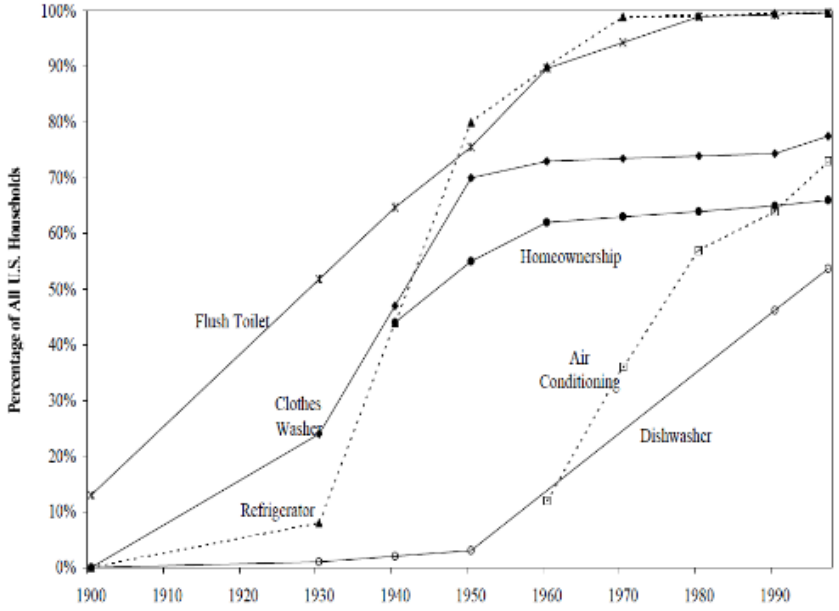
As with any theory, the diffusion of innovations faces several weaknesses, despite its popularity. One criticism provided by Rogers himself is the lack of attention to *anti-diffusion* — that is, the spreading of *bad innovations*, such as cigarettes. Is the increasing ability of information systems to capture, store, and exploit consumer data to be regarded as a *bad innovation*? Add to this machine learning, artificial intelligence, and algorithms. Companies that do not follow this evolution may find themselves out of business if they do not match the actions of their competitors. Researchers have placed a high emphasis on *algorithmic transparency* and *explainable AI*, and it will be interesting to follow the running race between innovative technologies and the call for transparency.

Another criticism that Rogers addressed is that diffusion researchers tend to rely too much upon models, such as KAP, as too rationalistic. Other elements are at play, for example, culture and other decision traps that individuals tend to fall into, such as anchoring, sunk cost, confirming evidence, and more [33]. People are not as rational as we like to think

that we are regarding decision-making [34]. Confirming previous studies [13, 24, 25], we think that our respondents made somewhat informed decisions regarding their personal data, but they had the potential to take more action and place higher value on their personal data.

Third, Rogers drew our attention to the researcher's lack of consequences when an innovation has reached critical mass and becomes self-sustaining. As a serious example, we have the *tragedy of the commons* [35], in which the rational choice of one individual *"...ironically drives the entire system (the is, the "commons") to disaster"* [3 p. 348]. A less serious example is the diffusion of fashion: *"A woman wearing a new fashion becomes furious when she meets another woman at a party wearing the same dress"* (p. 360). This leads us over to the concepts of S-curve and critical mass.

An element of Rogers' diffusion of innovations is the S-curve, introduced in 1913 by Tarde (in Rogers [3]). The strength of S-curves is that they promote forecasting. The weakness is that S-curves can be found in almost *"anything with a beginning and an ending"* [36]. Examples include the number of women with the ability to read, the number of one-year-old infants being vaccinated, and the share of the US population owning a refrigerator [37]. The refrigerator example is depicted [38] with the dotted line in Figure 7 below. To have an S-curve, we need critical mass. Following a critical mass, we get self-sustainability.



Sources: *American Housing Survey for the United States in 1997;* and U.S. Bureau of the Census, "Housing Then and Now," www.census.gov/hhes/www/housing/census/histcensushsg.html.

Fig. 7: *Improvement in U.S. Housing* [38, p. 19].

Our case is not about home appliances, but rather making people care about their information privacy and enhanced rights. This can be harder to quantify than sales numbers. Nevertheless, none of our graphs depict any S-curves and our findings indicate that we are nowhere near critical mass. We keep in mind that researchers warn against placing too much emphasis on S-curves, and we probably need more than five years of study to draw further conclusions. How can we reach critical mass, S-curves and self-sustainability? Rogers suggested four strategies for reaching critical mass:

First strategy: Highly respected individuals should embrace innovations.

Second strategy: If possible, change the perception of the innovation, for example, by indicating that the critical mass has already been reached.

Third strategy: Introduce the innovation to groups that are most perceptive to innovations.

Fourth strategy: Provide incentives for using the innovation.

Regarding the use of a new information system, for example, these strategies are logical. Hence, the following is plausible: Introduce the new HR/CRM/ERP system to a few cool people in the department (first strategy), focus on the great benefits that "everybody" talks about (second strategy), target the *right* people instead of *many* people (third strategy), and provide free training or sell the information system cheap at first (forth strategy).

However, we struggle with these strategies in our context. For example, many people resisted taking the polio vaccine in the 1950s, until Elvis Presley appeared on television while getting the shot. Suddenly, 80% ran to get the vaccine (see, for example [39, 40]). Will it help if we get a contemporary rock star to promote the GDPR? Probably not. Actually, our analysis showed that our respondents were focused on themselves, and they did not mention any network or influence from others. Nobody mentions being affected by peers, for example. It does not seem to matter what family, friends, or colleagues do. Thus, it is tempting to conclude that we need another explanation. As mentioned earlier, Rogers reminded researchers of the cultural aspects of innovations. According to, for example, Hofstede [41], Norway's culture is individual-centred but also with high trust in the authorities. One participant wrote that *"Terms and conditions of that kind are largely invalid in Norway, so they mostly do not apply to me".* We are unsure of how to interpret this statement. Is it naïve? We argue that most of our respondents did not appear naïve but rather demonstrated that they were aware of companies' (mis)use of their personal data.

Table 8 summarises our discussion. This table also constitutes our contribution, which is mainly new insights to the industry but also to academia due to our strong use of the diffusion of innovations theory.

Table 8. Summing up our discussion and main findings.

The diffusion of innovations [3] is a process of four main elements: we need (1) an innovation that is (2) communicated through certain channels (3) over time among (4) members of a social system.		
Element	**Description by Rogers [3]**	**Our study and findings**
1) An innovation	An idea, practice, or object that is perceived as new by an individual. The innovation can be planned or spontaneous. *Innovation* and *technology* are often used as synonyms.	The innovation is both the technology and the analytical tools as part of information systems, as well as the implementation of the GDPR.
2) Communicated through channels	The means by which messages get from one individual to another. Radio, TV, newspaper, Internet, or face-to-face exchanges between two or more individuals or peers.	Privacy has been debated for many years, probably mostly in newspapers and books. In addition, we have TV, telephone, and, lately, the Internet. The words of the GDPR are accessible to anyone with a laptop and the Internet.
3) Over time	Usually, when visualised by a graph, the innovation evolves with an "S-curve", if critical mass occurs. After critical mass, the innovation becomes self-sustainable by adding more value to the new users and adopters of the innovation.	Our study is between 2018–2023, with four sets of data collection. Our graphs do not form S-curves, and we lack critical mass. Will one individual's care about privacy and use of the GDPR make it more valuable to everyone? 5 years of study may not be sufficient. It took 150 years before the fax machine became successful.
4) Members of a social system	A social system is a set of interrelated units that are engaged in solving problems or reaching a common goal. The members can be individuals, groups, villages, organisations, or subsystems. Smoking, for example, was an individual choice until it became illegal by law to smoke in public places (restaurants and others).	Making use of enhanced rights (the articles of the GPDR) is an individual act. Using credit cards and opting out of cookies from websites may no longer be an actual choice. The members in our study are mainly the individuals, namely the citizens within EU/EAA. However, the data protection authority enforces violations of the GDPR.

7. Conclusion, limitations, and suggested future research

This study has been guided by the research question: *How has five years of the GDPR influenced consumer's knowledge, attitude, and practice of their enhanced rights?* Based on our empirical data, it should be safe to conclude that the GDPR has not changed too much for consumers. The graphs presented in this study indicate unclear patterns regarding knowledge. The graphs either show fluctuations, as in the knowledge of the GDRP, or stability, as in the low execution of the articles. We may not be able to draw any conclusions about the influence of the regulation. Our participants possessed a high level of knowledge about the GDPR and technology, both before and after the implementation of the regulation. Their attitude is positive towards the GDPR in theory, but they question the feasibility. Recurring examples are cookies on websites and long-term regulations when downloading an app. Regarding the practice, our respondents acted differently. Some took much action, others did not, but both groups reflected on their actions or lack of action. Our findings regarding the use of selected articles, such as the right to access, data portability, and deletion, are crystal clear. Most respondents *might want to execute* their rights, followed by *will most likely not execute* these rights.

Our contribution consists of insights. We applied elements from the diffusion of innovations, which helped us structure the study. However, the theory proved less useful in discussing how to make consumers take more action. This is but one limitation of our study. Another limitation is that we cannot fully explain the insights that we offer, and we hope that future research projects will conduct in-depth interviews with consumers, for example. We note that there is a lack of network effects or influence from peers. Thus, it is tempting to conclude that for the GDPR or future regulations to be used by consumers, authorities and legislators must be the main drivers. This could also be subject to future research.

Our surveys were completed by Norwegian citizens. It will be interesting to follow the development in, for example, the US, where similar regulations are being implemented. Future studies can include cultural aspects. For example, will we witness more network effects in countries with a more collective culture than in Norway? Future studies can try to pinpoint the typical *change-agent* [3]. In this case, a change-agent is a person with a high score in knowledge and attitude towards the GDPR and technology, and one who has made use of their rights (forgive our far-fetched association of a "GDPR-Elvis Presley"). Other related research question arises: How can we raise a population that is "algorithm literate"? Studies drawing on different theoretical frameworks or other elements of the diffusion of innovations are also suggested.

This study was built on empirical data collected over five years by the same research team and emphasised the GDPR from a consumer's perspective. We believe that this paper is of interest to both academia and the industry, as well as to individuals and companies. Five years is not long compared to the history of technology and jurisprudence, and more research is needed on the interaction of information systems, information privacy, and regulations in the years to come. We welcome any research that confirms, contradicts, and/or extends, our present study.

Acknowledgments

We thank the editor and the anonymous reviewers at the IJISPM for valuable feedback that raised the quality of our study. Also, we thank all our survey participants. We emphasise that this present journal article builds on three previous publications by Presthus and Sørum, namely CENTERIS 2018 [27], IJISPM 2019 [28], and IADIS 2021 [29]. Our gratitude goes once again to the editors and reviewers of the former publications.

References

[1] D. J. Solove. (2023, January 11). *Data Is What Data Does: Regulating Use, Harm, and Risk Instead of Sensitive Data*. [Online]. Available: https://ssrn.com/abstract=4322198

[2] K. E. Martin, "Ethical issues in the big data industry," *MIS Quarterly Executive*, vol. *14*, no. *2*, pp. *67-85*, June, 2015.

[3] E. M. Rogers, *Diffusion of Innovations*, *5*th ed. The Free Press, 2003.

[4] K. D. Martin and P. E. Murphy, "The role of data privacy in marketing," *Journal of the Academy of Marketing Science*, vol. *45*, pp. *135-155*, March, 2017.

[5] H. J. Watson and C. Nations, "Addressing the Growing Need for Algorithmic Transparency," *Communications of the Association for Information Systems*, vol. *45*, pp. *488-510*, January, 2019.

[6] P. Vassilakopoulou, E. Parmiggiani, A. Shollo and M. Grisot, "Responsible AI: Concepts, critical perspectives and an Information Systems research agenda," *Scandinavian Journal of Information Systems*, vol. *34*, no. *2*, pp. *89-112*, December, 2022.

[7] D. J. Solove. (2020, January 26). *Privacy + Security Blog. News, Developments, and Insights.* [Online]. Available: https://teachprivacy.com/cartoon-the-history-of-privacy/

[8] T. Kaapu and T. Tiainen, "Consumers' Views on Privacy in E-Commerce," *Scandinavian Journal of Information Systems*, vol. *21*, no. *1*, pp. *3-22*, 2009.

[9] F. Bélanger and R. E. Crossler, "Privacy in the Digital Age: A Review of Information Privacy Research in Information Systems," *MIS Quarterly*, vol. *35*, no. *4*, pp. *1017-1041*, December, 2011.

[10] J. Webster and R. T. Watson, "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly*, vol. *26*, no. *2*, pp. *xiii-xxiii*, June, 2002.

[11] B. Dahlbom, "The New Informatics," *Scandinavian Journal of Information Systems*, vol. *8*, no. *2*, pp. *29-48*, 1996.

[12] I. J. Aasen, T. Brattvåg and I. Eidhammer, *Innføring i databehandling*, [Norwegian] *2*th ed. Tano Aschehoug, 1998.

[13] W. Presthus and L. R. Andersen, "Information Privacy from a Retail Management Perspective," in *Proceedings of the 25th European Conference on Information Systems (ECIS)*, Guimarães, Portugal, June 5-10, 2017, pp. *1968-1983.*

[14] I. Sanchez-Rola, M. Dell'Amico, P. Kotzias, D. Balzarotti, L. Bilge, P. A. Vervier and I. Santos, "Can I Opt Out Yet? GDPR and the Global Illusion of Cookie Control," in *Proceedings of the 2019 ACM Asia Conference on Computer and Communications Security*, Auckland, New Zealand, July 9-12, 2019, pp. *340-351.*

[15] E. Jarbekk and S. Sommerfeldt, *Personvern og GDPR i praksis*. [Norwegian] Cappelen Damm, 2019.

[16] W. Presthus, H. Sørum, and L. R. Andersen, "GDPR compliance in Norwegian Companies," in *Norsk konferanse for organisasjoners bruk av IT (NOKOBIT)*, Svalbard, September 18-20, 2018, pp. *1-14.*

[17] A. Dabrowski, G. Merzdovnik, J. Ullrich, G. Sendera and E. Weippl, "Measuring cookies and web privacy in a post-gdpr world," In *Passive and Active Measurement: 20th International Conference, PAM 2019, Proceedings 20* Springer International Publishing, Puerto Varas, Chile, March 27–29, 2019, pp. *258-270.*

[18] J. Dexe and U. Franke, "Nordic lights? National AI policies for doing well by doing good," *Journal of Cyber Policy*, vol. *5*, no. *3*, p. *332-349*, December, 2020.

[19] W. Presthus and K. F. Sønslien, "An analysis of violations and sanctions following the GDPR," *International Journal of Information Systems and Project Management*, vol. *9*, no. *1*, pp. *38-53*, February, 2021.

[20] J. Dexe, U. Franke, K. Söderlund, N. van Berkel, R. H. Jensen, N. Lepinkäinen and J. Vaiste, "Explaining automated decision-making: a multinational study of the GDPR right to meaningful information," *The Geneva Papers on Risk and Insurance-Issues and Practice*, vol. *47*, no. *3*, pp. *669-697*, May, 2022.

[21] T. Dinev, M. Bellotto, P. Hart, V. Russo, I. Serra and C. Colautti, "Privacy calculus model in e-commerce – a study of Italy and the Unites States," *European Journal of Information Systems*, vol. *4*, no. *15*, pp. *389-402*, 2006.

[22] N. Momen, M. Hatamian, and L. Fritsch, "Did app privacy improve after the GDPR?", *IEEE Security & Privacy*, vol. *17*, no. *6*, pp. *10-20*, 2019.

[23] R. N. Zaeem, and K. S. Barber, "The effect of the GDPR on privacy policies: Recent progress and future promise," *ACM Transactions on Management Information Systems (TMIS)*, vol. *12*, no. *1*, pp. *1-20*, December, 2020.

[24] D. J. Solove, "The Myth of the Privacy Paradox," *George Washington Law Review, Legal Studies Research Paper*, vol. *89*, no. *1*, pp. *1-52*, January, 2021.

[25] B. Knijnenburg, E. Raybourn, D. Cherry, D. Wilkinson, S. Sivakumar and H. Sloan. (2017, February 27). *Death to the Privacy Calculus*? [online]. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2923806

[26] T. Alashoor, "Explaining the Privacy Paradox through Identifying Boundary Conditions of the Relationship between Privacy Concerns and Disclosure Behavior," Doctor of Philosophy Dissertation, Georgia State University, 2019.

[27] W. Presthus and H. Sørum, "Are Consumers Concerned About Privacy? An Online Survey Emphasizing General Data Protection Regulation," *Procedia Computer Science*, vol. *138*, pp. *603–611*, 2018.

[28] W. Presthus and H. Sørum, "Consumer perspectives on information privacy following the implementation of the GDPR," *International Journal of Information Systems and Project Management*, vol. *7*, no. *3*, pp. *19-34*, May, 2019.

[29] W. Presthus and H. Sørum, "A three-year study of the GDPR and the consumer," in *14th IADIS International Conference Information Systems*. Virtual Conference, March, 2021, pp. *153-160*.

[30] M. B. Miles and A. M. Huberman, *Qualitative Data Analysis*. Thousand Oaks: Sage Publications, 1994.

[31] R. Sharda, D. Delen, and E. Turban, *Analytics, Data Science & Artificial Intelligence: Systems for Decision Support*. *11*th ed. Hoboken, NJ, Pearson, 2020.

[32] A. Burton-Jones, E. R. McLean and E. Monod, "Theoretical perspectives in IS research: from variance and process to conceptual latitude and conceptual fit," *European journal of information systems*, vol. *24*, p. *664-679*, September, 2015.

[33] J. S. Hammond, R. L. Keeney and H. Raiffa, "The Hidden Traps in Decision Making," *Harvard Business Review*, vol. *84*, no. *1*, pp. *118-126*, January 2006.

[34] H. A. Simon, *The new science of management decision*, (Revised). Prentice-Hall, Inc. 1977.

[35] G. Hardin, "The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality," *Science*, vol. *162*, pp. *1243-1248*, 1968.

[36] T. Modis, "Strengths and weaknesses of S-curves," *Technological Forecasting and Social Change*, vol. *74*, pp. *866-872*, July, 2007.

[37] H. Rosling, O. Rosling, and A. R. Rosling, *Factfulness. Ti knep som hjelper deg å forstå verden*, [Norwegian]. *1*st ed. Cappelen Damm, 2018.

[38] S. Moore and J. L. Simon, "The greatest century that ever was: 25 miraculous trends of the past 100 years," *Cato Institute*, no. *368*, pp. 1-32, December, 1999.

[39] M. Hungeberg. (2023, January 6) *Vaccinehistorier: Elvis, kampagner og erstatninger [Danish]*. The Polio Society [Online]. Available: https://www.polio.dk/publikationer-polio/vaccinehistorier-elvis-kampagner-og-erstatninger/

[40] H. Hershfield and I. Brody. (2021, January 18). *How Elvis Got Americans to Accept the Polio Vaccine* Scientific American [Online]. Available: https://www.scientificamerican.com/article/how-elvis-got-americans-to-accept-the-polio-vaccine/

[41] G. Hofstede, "Cultural predictors of national negotiation styles," in *Processes of international negotiations*, Frances Mautner-Markhof, Westview Press, Boulder, San Franscisco & London, 2019, Routledge, 2019, ch. *3*, pp. *193-201*.

Appendix: Our questionnaire (from 2023) consisting of 12 questions

1. Gender
2. Age
3. Level of education
4. Main occupation

5. To what extent are you generally concerned about privacy, when it comes to yourself as a consumer?
[None whatsoever - Low degree - Medium degree - High degree - Do not know]

6. On July 20, 2018, the GDPR (General Data Protection Regulation) was introduced in Norway. Have you heard about it (before you started answering this survey)?
[Yes, and I know what it means - Yes, I know a little, but not enough about what it means - Yes, but I do not know what it means - No, I have never heard of the GDPR]

7. The GDPR means that individuals have gained new rights regarding the collection and storage of personal data. Which answer option suits you best?
[I think my rights have improved - I do not think my rights have improved - I do not care at all - Do not know]

8. Data portability is a central part of the GDPR. This means that you can transfer all data about you that a business has stored. E.g. you can request that your telephone company sends your mobile usage data to a competitor if you wish to change mobile operator. Which answer option suits you best?
[This is something I have used - I will possibly use - I most likely will not use - I do not care at all - Do not know]

9. The GDPR has given you a greater right to demand that certain personal data (that businesses have collected about you) be deleted. Which answer option suits you best?
[This is something I have used - I will possibly use - I most likely will not use - I do not care at all - Do not know]

10. The GDPR gives you the right to an answer within 30 days when you approach businesses with questions related to your data (the right to access). The overview must be sent in a readable format and that way you can correct any errors. Which answer option suits you best?
[This is something I have used - I will possibly use - I most likely will not use - I do not care at all - Do not know]

11. The GDPR states that you can accept some cookies, but not all, when you visit a website. In addition, information must be given to a greater extent about the purpose of the data that is stored about you. Tick all the answer options that you think applies to you.
[Companies have become much better at informing about cookies - The companies give me the opportunity to opt out of some cookies - I am unsure what the companies actually do when it comes to cookies - I do not care at all - Do not know what cookies are]

12. If you have any experiences related to privacy and GDPR beyond what is covered in the questions above, please describe: [open question with text box]

Wanda Presthus
Wanda Presthus is an Associate Professor at Kristiania University College in Oslo, Norway. She holds a Ph.D. from the University of Gothenburg (Sweden). Her research focuses on information systems, business analytics, research methods, privacy and the GDPR. She has published in international journals and conferences.

Hanne Sørum
Hanne Sørum is an Associate Professor at Kristiania University College in Oslo, Norway. She holds a Ph.D. from Copenhagen Business School (Denmark). Her research focuses on information systems, human-computer interactions, eGovernment and privacy and the GDPR. She has published in international journals and conferences.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Team delivery capability and agility: complementary effects on information systems development project outcomes

Weidong Xia
Florida International University
11200 S.W. 8th St, Miami, Florida, 33199
USA
xiaw@fiu.edu

Shekhar Rathor
Sam Houston State University
1905 University Ave, Huntsville, Texas, 77340
USA
srathor@shsu.edu

Dinesh Batra
Florida International University
11200 S.W. 8th St, Miami, Florida, 33199
USA
batra@fiu.edu

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Weidong Xia, Shekhar Rathor, Dinesh Batra, "Team delivery capability and agility: complementary effects on information systems development project outcomes", *International Journal of Information Systems and Project Management*, vol. 12, no. 3, pp. 28-47, 2024.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Team delivery capability and agility: complementary effects on information systems development project outcomes

Weidong Xia
Florida International University
11200 S.W. 8th St, Miami, Florida, 33199, USA
xiaw@fiu.edu

Shekhar Rathor
Sam Houston State University
1905 University Ave, Huntsville, Texas, 77340, USA
srathor@shsu.edu

Dinesh Batra
Florida International University
11200 S.W. 8th St, Miami, Florida, 33199, USA
batra@fiu.edu

Abstract:
Contemporary Information systems development (ISD) involves not only implementing a predefined set of requirements but also managing changes that emerge during the development process due to unanticipated business and technical needs. ISD project requirements increasingly become both planned and emergent. ISD teams need delivery capabilities to routinely execute what has been planned, and agile capabilities to sense and respond to changes that emerge during the development project. In other words, ISD teams must effectively manage their abilities to not only routinely deliver software applications that meet defined requirements but also sense and respond to changes emerging during the project. The extant literature has not studied the distinction and relationship between ISD team delivery capability and agility. This study empirically examines the differential effects of ISD team delivery capability and agility on ISD project outcomes. Survey data collected from professionals working on 160 software development projects were used to test the research model and hypotheses. The results suggest that ISD delivery capability positively affects agility, agility positively impacts change-response outcome, and agility mediates the relationship between delivery capability and change-response outcome.

Keywords:
information systems development; team delivery capability; team agility; project outcomes; PLS.

DOI: 10.12821/ijispm120302

Manuscript received: 1 September 2023
Manuscript accepted: 17 April 2024

1. Introduction

Information systems development (ISD) is a complex process involving many resources, collaboration among diverse stakeholders, and multiple project outcomes [1, 2]. The nature of ISD has evolved in recent years to include not only implementing a predefined set of requirements but also managing changes that emerge during the development process [1, 3]. Many changes can emerge during the ISD project, primarily due to unanticipated business and technical changes. Traditional plan-driven software development approaches provide delivery capabilities focusing on routine predictability, stability, and assurance [4]. These approaches follow a disciplined and planned process to manage the ISD team's ability to deliver software applications that meet the business requirements. Such approaches are appropriate where requirements are predefined and stable, but not adequate where requirements are frequently changing [5]. In contrast, agile approaches provide flexibility for sensing and responding to emerging changes during an ISD project [6, 7]. Agile methods are recommended when frequent changes are expected, and requirements are emergent in ISD projects [8, 9]. Many organizations have recently adopted agile methods [10, 11]. Agile methods focus more on rapid business value and response to change [4]. These methods recommend agile practices for developing the capabilities that ISD teams need to effectively anticipate and execute ongoing changes in project requirements.

ISD teams need delivery capabilities to routinely execute what has been planned, and agile capabilities to sense and respond to changes that emerge during the development project. However, in practice, ISD teams often struggle to maintain a balance between their disciplined delivery capability and agility during the project [4, 12]. Understanding the distinction, relationship, and impacts of ISD team delivery capability and agility is critical for organizations to plan and manage appropriate capabilities based on the project context. As both business and technology environments become uncertain and fast changing, practitioners need to understand and appropriately plan and manage the relationships between ISD team delivery capabilities and agility, and their impacts on project outcomes. However, the distinctions and relationship between ISD team delivery capability and agility, as well as their impacts on ISD project outcomes, have not been studied in the literature.

This study addresses the practical need and research gap by empirically examining the differential effects of ISD team delivery capability and agility on project outcomes. The objective of this study is to answer this research question: "What is the relationship between team delivery capabilities and agility, and their impacts on project outcomes?". The main contributions of this study include building a theoretical rationale for the use of agile methods, distinguishing between ISD team delivery capability and agility, conceptualizing ISD team agility as a multi-dimensional variable, and providing rich insights about the differential effects of ISD team delivery capability and agility on project outcomes.

The following sections draw on the organizational and agile literature to define ISD team delivery capability and agility. We propose a set of hypotheses regarding the relationships between ISD delivery capability, agility, and their differential effects on two types of ISD project outcomes: change-response outcomes and project satisfaction. We then present the measures, data collection methods, and data analysis results. We conclude the paper by discussing the theoretical contributions and practical implications of our study findings, as well as the limitations of our study and future research directions.

2. Theoretical background

In this study, capability refers to the ability of an organization or a team to perform a task or activity in at least a minimally satisfactory manner [13, 14]. The literature has commonly conceptualized two types of capabilities: routine and dynamic capability [15-19]. Routine capability is also referred to as a basic operational, ordinary, or delivery capability. Routine capability is the ability to deliver or perform defined, repetitive, and planned activities based on the knowledge of basic operational and daily tasks [19, 20]. Dynamic capability is the ability to integrate and reconfigure internal and external resources and competencies to address rapidly changing environments [18, 19, 21, 22]. Dynamic capability can be viewed as a higher-order organizational ability and improvisation of routine capability [19]. Agility is a dynamic capability defined as an organization's ability to sense environmental changes and respond efficiently and effectively [23, 24]. It is an organization's ability to deal with constantly changing market conditions and to thrive by

exploiting unpredictable and emerging business opportunities [25, 26]. Organizations conduct their business in a dynamic business environment due to intense competition, market unpredictability, and the need to continuously innovate [27]. Organizations must balance their routine and dynamic capabilities for survival and competitive advantage. While organizations need the dynamic capability to adapt to unanticipated changes due to rapidly changing environments, they also need the routine capability to manage their standards and processes to achieve operational efficiency [28, 29]. Based on the organizational literature, in the following section, we conceptualize ISD team delivery (routine) capability and agility (dynamic capability) in the ISD context.

The ISD process is complex and knowledge-intensive, involving business and technology issues and changes [30-32]. ISD teams must deal with not only implementing predefined business requirements and technical specifications but also sensing and responding to unanticipated business and technology changes [33, 34]. In this research, we define ISD team delivery capability as the team's routine and essential ability to perform basic operational activities, such as delivering a solution as planned to a given set of requirements by efficiently applying their resources (e.g., time and money) and skills (e.g., technical, business, interpersonal, and problem-solving) in the ISD project. Whether or not the target amount of work is completed by the end of each iteration is an indicator of the delivery capability of the ISD team [35]. ISD team delivery capability is the result of the team's following standard processes and knowledge base to perform project activities to deliver information systems that meet the requirements. Such standard and routine-based approaches bring discipline to the project and emphasize assurance and predictability in project outputs [4].

ISD team agility is a multidimensional construct [5, 36-38]. It is often not a prior characteristic but an emergent capability of the team due to the use of agile methods in ISD projects [39, 40]. ISD team agility concerns "the continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment" [36] (p. 340). In this study, we conceptualize ISD team agility as the ability to sense changes, respond to changes, and learn from the changes that occur during the project, in addition to the given requirements or known conditions. ISD team agility is presented as a dynamic capability based on the organizational literature. It is a critical success factor when an ISD project has a high level of uncertainty or experiences frequent unanticipated changes during the project [41-43].

As both business and technology environments become increasingly dynamic and fast-evolving, an ISD project must deal with frequent business and technical requirement changes that were not anticipated and planned before project inception [36, 44]. For example, ISD projects may experience hardware and software resource changes [5, 36], human resource changes [5, 45], and budget and schedule changes [36, 40]. The requirement changes in the project are the most common among all other changes. Requirements can change because of changes in stakeholder preferences, competition threats, and changes in technology [46, 47]. ISD teams need to develop agility to deal with project changes and enhance project performance, especially when the changes are large. Agility allows teams to integrate, build, and reconfigure resources and competencies for effective sensing, responding, and learning from changes [48, 49]. ISD team agility is critical for project success [48].

The dynamic capabilities of an organization allow it to sense and respond to opportunities and threats by reconfiguring its assets for competitive advantage [50, 51]. Organizations need dynamic capabilities to handle unpredictable changes and turbulent market dynamics, which require a novel reconfiguration of delivery capabilities [15, 16]. Organizations struggle to balance between dynamic and routine capabilities [14]. While organizations need to be strategically flexible to adapt to unanticipated changes, they also need to optimize their routine processes to achieve operational efficiency for planned tasks. Similarly, in ISD projects, a successful project in a changing environment requires a disciplined balance between delivery capability and agility [52, 53]. The balance between these capabilities becomes more critical when the project environment evolves rapidly. While the ISD team needs discipline for stability, it needs agility for sensing, responding to, and learning from changes, yet these two capabilities are often conflicting in nature [12]. ISD teams must reconcile the conflicting demands for project success. The delivery capability provides discipline and structure to the project, and agility provides flexibility and adaptability. Developing and sustaining these capabilities requires effective and efficient use of team members' collective skills and coordination. A team's collective skills and coordination are important for developing the capabilities of the software development team for project success [54].

ISD teams need both the delivery capability to execute the predefined activities as per the plans and the agility to deal with changes that can occur during the development process. The ISD team members use different methods to develop their capabilities. The use of agile methods is particularly important in helping ISD teams balance delivery capabilities and agility. Agile methods (e.g., Scrum, Kanban) are a set of software development methods that exhibit the ability to respond to changes in turbulent business environments [12, 55]. These methods are based on the view that organizations are complex adaptive systems in which requirements are emergent rather than predefined [4]. These methods emphasize people and their skills in developing the capabilities required to deal with emergent changes. The social and technical practices of agile methods help achieve agility in ISD projects [56]. Agile practices recommended by various agile methods help capitalize on ISD team members' capabilities to achieve project success [57].

Short delivery cycles, frequent customer feedback, minimum documentation, prioritizing requirements, and accepting changes based on priority are some of the key characteristics of agile methods [8, 9]. In contemporary ISD contexts, the practices recommended by various agile methods enable ISD teams to develop and balance delivery capabilities and agility. For example, the Scrum method recommends working on prioritized requirements in short iterations of two to eight weeks [58]. Within each iteration, IT and Business teams have the stability to utilize their delivery capability to execute planned tasks. However, at the end of each iteration, these teams can consider new requirements and prioritize again to decide on the set of delivery tasks that they need to do in the next iteration. These agile practices enable ISD teams to develop and sustain delivery capabilities and agility.

3. Research model and hypothesis development

The research model of this study, as shown in Figure 1, illustrates the relationships between team delivery capability, team agility, project satisfaction, and project change response outcome.

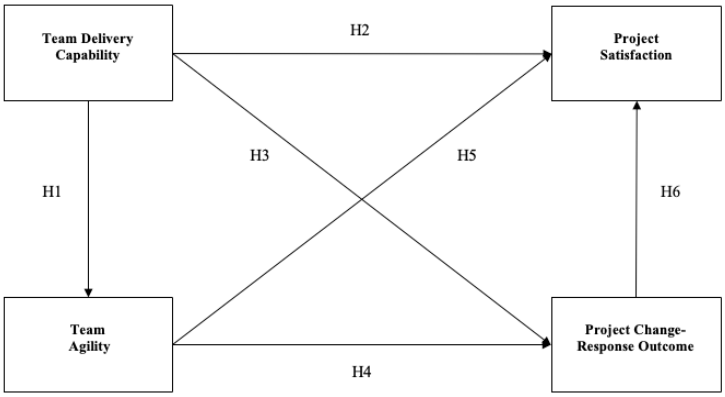


Figure 1: Research Model

ISD team delivery capability represents the basic ability of a team to effectively use its skills to routinely accomplish a planned task. As defined above, ISD team agility refers to the team's ability to sense, respond to, and learn from changes that were not part of the initial project scope and plan. Although ISD team agility is important for sensing changes, ISD team delivery capability is required to respond effectively. Agility or dynamic capability relies on delivery or routine capability [18, 21, 59]. Agility is achieved by improving delivery capabilities [19]. An ISD team cannot effectively and efficiently deal with the changes that emerge during an ISD project if the team does not possess the necessary delivery capability [60]. An ISD team is more likely to have a higher level of agility if it has a higher delivery capability. Therefore, we hypothesize as follows:

H1: ISD team delivery capability positively correlates with the ISD team's agility.

ISD team capabilities impact project outcomes [33]. The definition and measurement of IS project success can vary depending on the stakeholders' perspective [61]. The Project Management Institute (PMI) has defined project success in four dimensions: scope, schedule, cost, and quality. Previous ISD studies used various project outcome measures to assess project success, such as software quality [32, 62, 63], business value [1, 63], software functionality [1, 33], on-time completion [33, 64], on-budget completion [33, 64], process effectiveness [65], and customer satisfaction [1, 63].

In this study, to capture both traditional project outcomes and emergent change-related outcomes, we define two categories of project outcomes: project satisfaction and change-response outcome. Project satisfaction refers to client satisfaction regarding project time and budget, functionalities of the developed system, quality of the system, and business value of the system [63, 66]. Project satisfaction indicates the extent to which the ISD team can achieve its intended goals and deliver the system according to the expectations of the clients [67]. Agile methods specifically emphasize customer satisfaction through continuous software delivery [54]. One of the agile principles states that "our highest priority is to satisfy the customer through early and continuous delivery of valuable software." Therefore, measuring how customers feel about the delivered system is critical for understanding project outcomes.

ISD teams with higher delivery capability are more likely to accomplish the given project tasks as per the project plan, directly affecting project satisfaction outcomes [17]. For example, when an ISD team delivers the prioritized requirements as per the plan at the end of an iteration, the customer can see the business value of the delivered product. This enhances the customer satisfaction level with the system being developed. The delivery capability of an ISD team indicates that the team can optimize its process and resources to deliver working software products over time as per the plan [68]. Such a team is more likely to reconfigure its processes and resources to handle the changes that can occur during the ISD project. A team with a higher delivery capability can deal with various changes in a project more effectively and efficiently, which directly impacts the change-response outcome. Therefore, we hypothesize as follows:

H2: ISD team delivery capability positively correlates with project satisfaction.

H3: ISD team delivery capability positively correlates with project change-response outcome.

An ISD project environment that is often unstable owing to changes serves as a critical risk factor for ISD project success [34, 69]. ISD teams should be able to sense changes, develop expertise, coordinate with each other, and take collective actions to respond to and learn from changes [34]. These teams must possess the necessary skills and resources to deal with such changes. ISD team agility is an indicator that a team can effectively deal with changes in requirements during a project. Requirement changes affect project outcomes [70]. Managing requirement changes is one of the main activities in ISD projects, because it significantly impacts project outcomes [71]. The key focus of agile methods is to deliver rapid business value to customers by responding quickly to changes in requirements [4]. Ongoing changes will be incorporated into the development process when the ISD team can sense, respond to, and learn from changes effectively and efficiently, which results in better change-response outcomes [72]. A team with high agility is more likely to deal with changes more effectively and efficiently than a team with low agility. Project satisfaction is also higher when the change-response outcome is better. Therefore, we hypothesize as follows:

H4: ISD team agility positively correlates with project change-response outcome.

H5: ISD team agility positively correlates with project satisfaction.

ISD teams need agility for sensing, responding to, and learning from the requirement changes caused by evolving market conditions, emerging system requirements, and changes in technology [73]. Agile values and principles recommend embracing and responding to changes in ISD. Agile methods are recommended for projects where frequent requirement changes are expected, as the project scope is not well-defined at the beginning of the project [8, 9]. How effectively the changes are handled in the project is an important indicator of the project outcomes [32]. Therefore, we include change-response outcomes as an important aspect of ISD project outcomes. The change-response outcome refers to how satisfied the clients are with the way various changes (business and technical requirement changes, human resources, schedule changes, etc.) are handled by the ISD team during the project [5]. Clients will be more satisfied with project outcomes when the change-response outcome is better. Therefore, we hypothesize as follows:

H6: ISD project change-response outcome positively correlates with project satisfaction.

4. Research method

A quantitative research approach was used to conduct this study [74]. Survey data were collected and analyzed using the partial least squares structural equation modelling (PLS-SEM) method to test the hypotheses. The measures for the study variables were adapted from relevant literature sources. The variables can be measured using reflective or formative indicators, depending on the researcher's theoretical expectations [75]. These indicators represent the defining characteristics of the latent variables in this study [76]. All variables were measured using formative indicators. The ISD team delivery capability was measured using four items adapted from the literature [35, 59, 77]. These items assessed the extent to which the ISD team could deliver system solutions that met (1) business requirements, (2) technical requirements, (3) functional requirements, and (4) non-functional requirements. The ISD project satisfaction was measured using five items adapted from the literature [1, 63, 66]. These items assessed the extent to which the customer was satisfied with the new system delivered in terms of (1) functionalities, (2) quality, (3) delivery time, (4) project cost, and (5) benefits/value from the system. The ISD project change-response outcome was measured using four items adapted from the literature [1, 5, 63, 66]. These items assessed the extent to which the customer was satisfied with how the changes were managed by the ISD team in terms of changes in (1) business requirements, (2) technical requirements, (3) human resources, and (4) schedules.

ISD team agility was conceptualized as a second-order construct consisting of three dimensions: sense, respond, and learn. The ISD team sense capability was assessed using four items adapted from the literature [36, 44, 78, 79]. These items assessed the extent to which the ISD team could sense changes in (1) business requirements, (2) technical requirements, (3) human resources, and (4) project schedules. The ISD team response capability was assessed using four items adapted from the literature [33, 36, 78, 80]. These items assessed the extent to which the ISD team could respond to changes in (1) business requirements, (2) technical requirements, (3) human resources, and (4) project schedules. The ISD team learning capability was assessed using four items adapted from the literature [36, 78, 79]. These items assessed the extent to which the ISD team was able to learn and enhance its ability to sense and respond to changes in (1) business requirements, (2) technical requirements, (3) human resources, and (4) project schedules. A Q-sorting procedure was conducted with five ISD experts to ensure the content validity of the measures [75, 81]. After completing the Q-sorting procedure, a pilot test was conducted with 18 ISD practitioners to refine the survey items. We used a seven-point Likert-type scale to measure the variables in this study. In addition to the items used to assess the studied variables, information about the survey respondents, such as their project type, industry type, and agile experience, was also collected. Table A1 in the Appendix shows the final survey items and references.

4.1 Data collection

Data for this study were collected using an online survey. Online surveys are efficient at quickly distributing and helping to get relevant data [82]. ISD team members (software developers, business analysts, and project managers) working on agile software development projects were the survey respondents. The respondents were contacted by approaching IT companies using snowball sampling and posting the survey on professional communities on Facebook and LinkedIn. Table 1 shows the study sample characteristics, including the respondents' countries, roles in the agile project, the agile methods used in the project, and industry types. The total number of final usable survey responses was one hundred and ninety-four. To define the minimum sample size required for our data analysis, we used the guideline recommended by [83]; the minimum sample size should be at least ten times the number of indicators used to assess the formative construct with the highest number of indicators.

In this study, the project satisfaction variable had the maximum number of indicators (five). The survey responses were checked for incompleteness and inconsistencies to enhance data quality before data analysis [84]. Thirty-four responses with more than 15% missing values were removed from the initial sample [85]. One hundred and sixty responses were used for the final data analysis, which is more than the minimum sample size required. The PLS-SEM statistical technique was used for data analysis using SmartPLS3 software. It is a non-parametric technique to estimate coefficients and maximize the variance (R^2 value) explained by endogenous variables [85]. The PLS-SEM technique was used because this study's research model consisted of formative variables. PLS-SEM is best suited for data analysis

when formative variables are in the research model and are more appropriate when the study sample is not very large [81, 86-89].

Table 1: Survey sample characteristics (n=160)

Respondent Role		**Industry Type**	
Software Developer	51 (31.9%)	Financial Services	51 (31.9%)
Project Manager	17 (10.6%)	Telecom	13 (8.1%)
Senior Management	15 (9.4%)	Education, Research	4 (2.5%)
Business Analyst	5 (3.1%)	Healthcare, Medical	15 (9.4%)
Scrum Master	26 (16.3%)	Transportation	14 (8.8%)
Product Owner	9 (5.6%)	Manufacturing	11 (6.9%)
Tester	30 (%)	Media and Entertainment	8 (5.0%)
Others	7 (4.4%)	Other	44 (27.5%)
Agile Method		**Country/Region**	
Scrum	84 (52.5%)	India	73 (45.6%)
Extreme Programming	3 (1.9%)	US/Canada	55 (34.4%)
Modified Agile Method	32 (20.0%)	Europe	24 (15.0%)
Hybrid	24 (15.0%)	Others (China, Latin America)	8 (5.0%)
Others	17 11.6)		

Harmon's single-factor test was conducted to check for common method bias [90, 91]. All constructs were analyzed by performing an unrotated principal component analysis using SPSS software. The analysis identified more than one factor with an eigenvalue greater than one. These results indicate that not one factor is responsible for explaining the majority of the variance, which suggests that a common method bias is not an issue for this study [90, 91]. Table A2 in the Appendix shows the factors with eigenvalues greater than one and the variances explained.

4.2 Measurement validation

The measures were validated before the structural model assessment based on the guidelines suggested in the literature [75, 85, 92, 93]. The variance inflation factor (VIF), the significance of outer weights, and outer loadings are estimated and checked to validate the formative constructs used in the study. Each indicator of a formative construct represents a different aspect of that construct; therefore, a high correlation is not required between formative indications [92]. A high correlation between indicators leads to multicollinearity issues [75]. Variance inflation factor (VIF) values were used to identify multicollinearity problems in formative indicators [92, 94]. If the VIF value is less than five, multicollinearity is not a problem for that formative indicator [85]. Some researchers suggest a more conservative VIF value of 3.3 or less to ensure that multicollinearity is not a problem [92, 95]. VIF values, outer weights, their significance, and outer loadings for the second-order formative indicators are presented in Table 2.

Table 2: VIF, outer weights, and outer loadings (second order)

Indicators	**VIF**	**Outer Loadings**	**Outer Weights**	**P-Values (Outer Weights)**
CNGOTM1	1.749	0.794	0.276	0.044
CNGOTM2	1.586	0.725	0.221	0.266
CNGOTM3	1.558	0.742	0.264	0.019
CNGOTM4	1.567	0.865	0.491	0.001
DLVCAP1	1.961	0.820	0.340	0.010
DLVCAP2	1.596	0.754	0.250	0.046
DLVCAP3	2.184	0.850	0.301	0.040
DLVCAP4	1.458	0.768	0.361	0.005
DLVSTF1	1.850	0.571	0.134	0.511
DLVSTF2	1.708	0.314	-0.387	0.113
DLVSTF3	1.652	0.806	0.562	0.001
DLVSTF4	1.666	0.759	0.422	0.006
DLVSTF5	1.352	0.709	0.384	0.084
LEARN	1.544	0.756	0.317	0.016
RESPOND	1.474	0.906	0.618	0.000
SENSE	1.640	0.760	0.264	0.042

The formative indicators used in this study did not have multicollinearity issues because all indicators had VIF values less than 3.3. Table A3 in the Appendix shows the detailed results for first-order formative indicators. The outer weights of the formative indicators represent their relative importance, whereas the outer loadings represent their absolute importance in defining a construct. Indicators with significant weights were also included in the analysis. Formative indicators with insignificant outer weights (p-value <0.05) and outer loadings greater than 0.5 can also be included in the data analysis [85]. One of the indicators (DLVSTF2) did not have significant outer weights or loadings of >0.5. This was not removed from the analysis because it is important for the content validity of the delivery satisfaction variable [85]. All the formative indicators shown in Table 2 were used in the data analysis because they had significant outer weights or outer loadings greater than 0.5 or were critical for the content validity of the construct [85].

4.3 Hypothesis testing

A structural model assessment was conducted after the measurement model of the variables was validated. The analysis of the structural model consisted of calculating the path coefficients and their significance, variance explained (R^2 value), and effect size (F^2 value) [85]. The PLS algorithm using the factor-weighing scheme was used to test the relationships between variables in this study. As discussed in the previous section, ISD agility was conceptualized as a second-order formative hierarchical construct with sense, respond, and learn as its first-order formative variables. Since ISD team agility is a second-order formative variable, a two-stage approach for estimating the latent hierarchal variables was used. This approach is recommended for estimating research models that consist of higher-order formative variables [87, 96]. In this approach, the latent scores of lower-order variables are used as indicators for higher-order variables. The latent scores of ISD team sense, response, and learning capabilities were used as formative indicators of ISD team agility.

Path coefficients were estimated to indicate the strengths of the relationships among the various variables using the PLS algorithm. Figure 2 shows the path coefficients among the variables and their significance (p-values in brackets). The bootstrapping procedure was used with five thousand samples to calculate the significance levels of the path coefficients [85, 97, 98].

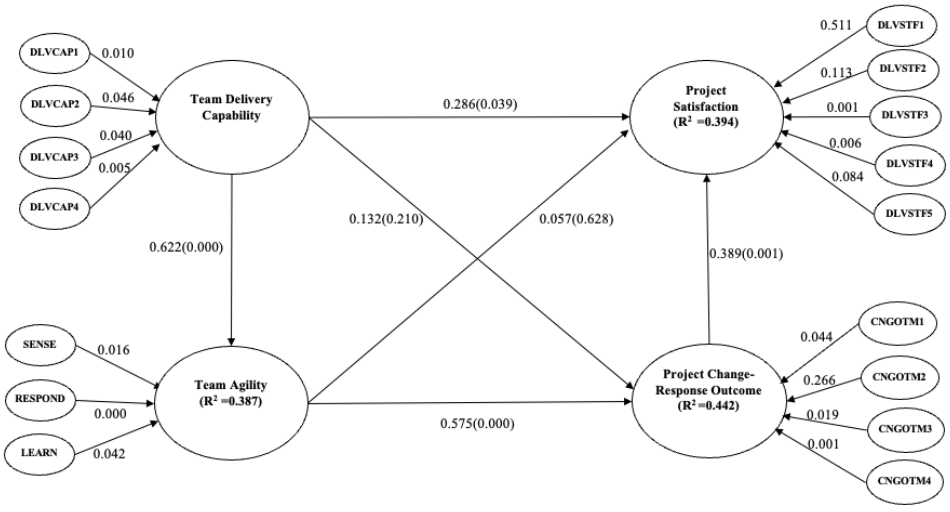


Figure 2: Results of structural model testing

Table 3 shows the path coefficients of the original sample, means of the bootstrap samples, standard deviations, and their p-values. These results suggest that ISD team delivery capability had significant and positive effects on ISD team agility (β=0.622, p <0.01) and project satisfaction (β=0.286, p <0.05), supporting hypotheses 1 and 2, respectively. However, ISD team delivery capability had an insignificant effect on project change-response outcomes; as such, hypothesis 3 was not supported. ISD team agility had a significant and positive effect on project change-response

outcomes (β=0.575, p <0.01), supporting hypothesis 4. However, ISD team agility had an insignificant effect on project satisfaction; as such, hypothesis 5 was not supported. Project change-response outcomes had a significant and positive effect on project satisfaction (β=0.389, p <0.01), supporting hypothesis 6. The coefficient of determination (R^2) was calculated to determine the predictive power of the model. It represents the amount of variance in the endogenous variables explained by the exogenous variables. It is a "squared correlation between a specific endogenous construct's actual and predicted values" [85] p198).

Table 3: Path coefficients and their significance

Relationship Paths	Original Sample (O)	Sample Mean (M)	Std Dev (STDEV)	T Statistics (|O/STDEV|)	p Values
Agility -> Change-response Outcome	0.575	0.556	0.092	6.230	0.000
Agility -> Delivery Satisfaction	0.057	0.106	0.117	0.485	0.628
Change-response Outcome -> Delivery Satisfaction	0.389	0.399	0.113	3.442	0.001
Delivery Capability -> Agility	0.622	0.634	0.052	12.055	0.000
Delivery Capability -> Change-response Outcome	0.132	0.176	0.105	1.254	0.210
Delivery Capability -> Delivery Satisfaction	0.286	0.254	0.139	2.062	0.039

Table 4 presents the adjusted R^2 and R^2 values. R^2 adjusted values are better indicators of the parsimony of the model [85, 99]. These values were calculated by adjusting R^2 based on the sample size and number of exogenous variables [85].

Table 4: Coefficient of determination (R^2)

Endogenous Constructs	R^2	R^2 Adjusted
Agility	0.387	0.383
Change-response outcome	0.442	0.435
Project satisfaction	0.394	0.382

The effect size (F^2) value was calculated for the research model, which indicates the impact of removing an exogenous construct on the R^2 value of an endogenous variable [85]. For example, the variance in project change-response outcomes was mainly explained by ISD team agility but not by ISD team delivery capability. Table 5 shows the F^2 values. The exogenous variable does not affect the endogenous variable when the F^2 values are less than 0.02 [100].

Table 5: Effect size (F^2)

Exogenous > Endogenous Constructs	F^2
Agility -> Change-response outcome	0.363
Agility -> Project satisfaction	0.002
Change-response Outcome -> Project satisfaction	0.139
Delivery Capability -> Agility	0.632
Delivery Capability -> Change-response Outcome	0.019
Delivery Capability -> Project satisfaction	0.081

4.4 Testing mediating effects

We further tested the indirect effects of ISD team delivery capability on project satisfaction and project change-response outcomes, as well as the indirect effect of ISD team agility on project satisfaction. There are mediation effects of variables if the indirect effects are significant [85, 101]. For example, as shown in the first row of Table 6, the total indirect effect of ISD team agility on project satisfaction, which was mediated by the change-response outcome, was significant (β=0.223, p=0.007).

Table 6: Total indirect effects

Relationship Path	Original Sample	P Values
Agility -> Delivery Satisfaction	0.223	0.008
Delivery Capability -> Change-response Outcome	0.358	0.000
Delivery Capability -> Delivery Satisfaction	0.225	0.005

Specific indirect effects were examined to assess the mediating effects of each path separately. For example, as shown in Table 7, the relationship between ISD team delivery capability and project satisfaction had three paths; only one of the three paths was significant (β=0.139, p=0.009). The total indirect effects indicate the combined mediating effects of all the mediating paths. By contrast, specific indirect effects indicate the individual contribution of each mediator in defining the strength of the mediating relationship between the dependent and independent variables.

Table 7: Specific indirect effects

Relationship Path	Original Sample	P Values
Delivery Capability -> Agility -> Change-response Outcome	0.358	0.000
Delivery Capability -> Agility -> Delivery Satisfaction	0.035	0.637
Agility -> Change-response Outcome -> Delivery Satisfaction	0.223	0.008
Delivery Capability -> Agility -> Change-response Outcome -> Delivery Satisfaction	0.139	0.010
Delivery Capability -> Change-response Outcome -> Delivery Satisfaction	0.051	0.231

5. Discussion

The use of agile methods has increased in recent years. Most of the studies related to agile methods and ISD are qualitative in nature [102-104]. Very little theoretically grounded empirical research affirms the relationships between, and benefits of, different agile project team capabilities [105]. In this study, we answer the research question: What is the relationship between team delivery capabilities and agility, and their impacts on project outcomes? The empirical results of this study presented an interesting set of relationships between ISD team capabilities and project outcomes. The results suggest that ISD team delivery capability is a significant determinant of ISD agility and project satisfaction but not a direct determinant of project change-response outcomes. This indicates that ISD teams with a high level of delivery capability are more likely to develop high levels of team agility and project satisfaction. The result is consistent with the organizational agility literature in that routine delivery capability impacts operational performance [68]. The relationship between ISD delivery capability and ISD project change-response outcomes is mediated by ISD team agility. ISD team agility is a significant determinant of project change-response outcomes, but not a significant determinant of project satisfaction. In addition, project change-response outcomes mediate the relationship between ISD team agility and project satisfaction. These results have important implications for the ISD/agile literature and ISD/agile practitioners.

5.1 Implications

This study contributes to both the theoretical development and practical management of ISD and agile practices. First, it contributes to the ISD/agile literature by taking a step forward in building a theoretical understanding of the use of agile methods, distinguishing between ISD team delivery capability and agility, conceptualizing ISD team agility as a multi-dimensional variable, and providing rich insights about the differential effects of ISD team delivery capability and agility on project outcomes. This study contributes to the literature by responding to calls for research to build a theoretical rationale for the use of agile practices [36], and to focus on theoretical development in agile literature [12]. Drawing on the organizational routine and dynamic capabilities literature and the ISD/agile literature, we conceptualize two distinct and complementary, and yet often conflicting, ISD team capabilities: delivery capability and agility. While the ISD/agile literature has recognized that ISD/agile teams must deal with not only implementing predefined business requirements and technical specifications but also sensing and responding to unanticipated business and technology changes [33, 34], no empirical studies have made a clear distinction between ISD team delivery capability and agility. Our study will serve as a first stepstone for developing a theoretical foundation that helps explain the different ISD team capabilities required for executing routine tasks versus for sensing, responding to, and learning from emergent changes.

Second, the extent literature often uses agility as an adjective for agile methods and practices without a theoretical basis [36, 106]. Our research conceptualize ISD agility as a second-order variable with three dimensions (sense, respond, and learn). Previous studies have called for the empirical validation of the multifaceted concept of agility in the software development context [36, 56]. Agility is a nebulous concept, and its dimensions are still not clearly understood [107].

Studies in the literature have measured agility using a particular aspect of agility, for example, the response dimension [33]. This study helps to develop a deeper understanding of agility by studying all three dimensions of ISD team agility. The results show that an ISD team possessing a high level of agility in terms of sensing, responding to, and learning from changes would produce better change-response outcomes, which in turn would lead to better project satisfaction. This study contributes to the ISD/agile literature by conducting a rigorous quantitative study on two related ISD team capabilities that have not been adequately examined in the ISD/agile literature [103]. ISD practitioners can use the results of this study to understand the multidimensional nature of ISD agility and how ISD team delivery capability is necessary for ISD team agility.

Third, in addition to distinguishing the two types of ISD team capabilities, our study shed light on their relationship. While these two ISD capabilities have been discussed individually in the literature [4, 35, 48, 108, 109], they have not been conceptualized and examined together. Our study suggests that ISD team delivery capability enables ISD team agility, which is required to address the changes that occur during an ongoing project. The risk of software project failure is reduced when prioritized changes are incrementally delivered within punctuated time-boxes [110]. This understanding of the relationships is important for developing a theoretical understanding of agile methods. It also helps to understand the assumptions underlying agile practices. Such understanding is critical for the effective application of agile practices in a particular project context [111]. Agile practices need to be tailored based on project and organizational contexts [112, 113]. The results of this study will help ISD practitioners understand the nature and relationship between these capabilities. It can serve as a guide to adapt organizations' project practices to appropriately plan and manage the development and balance of these capabilities. Organizations must create a project environment in which they can balance discipline and flexibility for better project performance [12].

Finally, our study provides insights into how the two types of ISD team capabilities jointly affect ISD project outcomes. Team performance is an important research theme in agile software development [114]. This study helps to understand the different roles that the two types of team capabilities play in impacting ISD project outcomes. Our results contribute to the literature by bridging a theoretical gap regarding the lack of understanding of the relationships between ISD team delivery capability and agility, and project outcomes [106]. The change-response outcome variable can be used to assess the performance impact of ISD team agility. Previous studies in the agile literature have used traditional project outcomes, such as project satisfaction, time, cost, scope, and quality, to study the impact of ISD team agility [33, 48, 115]. The empirical results of our study concerning the differential effects of ISD team delivery capability and agility on project change-response outcomes and project satisfaction provide a much richer understanding of the dynamic relationships between ISD team capabilities and project outcomes than what is provided by the existing literature. Understanding such a relationship is critical for ISD practitioners as it will help them build a balance between these two capabilities.

5.2 Limitations and future research

The results of this study should be interpreted with caution because of its limitations. First, the data for this study were collected only from agile ISD projects. The results of this study are related to the agility and delivery capabilities of teams using agile methods in their projects. These results may not be readily generalizable to ISD projects that use a traditional waterfall model-based software development approach. Future studies may collect data from projects using agile and traditional approaches and compare the results based on the different development approaches used.

Second, this study used data collected primarily from an ISD team's perspective. Perceptions of project outcomes, such as delivery satisfaction, can differ between IT and business teams. Future research may collect data from both the IT and the business team's perspectives to better estimate project outcomes, such as customer satisfaction.

Lastly, this study focused on the relationships between ISD team delivery capability and agility, and their differential effects on ISD project change-response outcomes and project satisfaction. We did not include variables that may affect the ISD team’s delivery capability and agility. Many factors can affect ISD team capabilities. Agility can be influenced by external and internal factors such as team size, project type, team autonomy, and market conditions, which require further investigation [106]. Future studies may include factors such as team competence, team culture, team

collaboration, team communication, and iterative development to investigate how these variables affect ISD team delivery capability and agility.

6. Conclusion

As both business and technology become increasingly dynamic and uncertain, ISD teams are facing difficulties in appropriately managing the constant conflict between executing planned tasks and dealing with unexpected changes. In this study, we provide a theoretical perspective to understand and explain this challenge by distinguishing two ISD team capabilities, delivery capability and agility, and empirically examining their relationship and joint effects of project outcomes. The PLS-SEM analysis results of the survey data suggest that ISD team delivery capability significantly impacts ISD agility and project satisfaction but not project change-response outcomes. These results show that ISD teams with a high level of delivery capability are more likely to develop high levels of team agility and project satisfaction. This study contributes to the literature by initiating a new research stream that will enable researchers to build a theoretical rationale for the use of agile methods and provide further insights about the differential effects of ISD team delivery capability and agility on project outcomes. This study will help ISD practitioners to understand the multi-dimensional nature of agility and the dynamic relationships between ISD team capabilities and project outcomes.

References

[1] K. Siau, Y. Long, and M. Ling, "Toward a unified model of information systems development success," *Journal of Database Management,* vol. 21, no. 1, pp. 80-101, 2010.

[2] S. Morcov, L. Pintelon, and R. J. Kusters, "Definitions, characteristics and measures of IT project complexity-a systematic literature review," *International Journal of Information Systems and Project Management,* vol. 8, no. 2, pp. 5-21, 2020.

[3] R. A. Teubner, "IT program management challenges: insights from programs that ran into difficulties," *International Journal of Information Systems and Project Management,* vol. 6, no. 2, pp. 71-92, 2018.

[4] B. Boehm and R. Turner, *Balancing Agility and Discipline: A Guide for the Perplexed*. Boston, USA: Addison-Wesley Professional, 2003.

[5] S. Rathor, D. Batra, W. Xia, and M. Zhang, "What constitutes Software Development Agility?," presented at the Americas Conference on Information Systems (AMCIS), San Diego, USA, 2016.

[6] J. Erickson, K. Lyytinen, and K. Siau, "Agile modeling, agile software development, and extreme programming: The state of research," *Journal of Database Management,* vol. 16, no. 4, pp. 88-100, 2005.

[7] B. Henderson-Sellers and M. Serour, "Creating a dual-agility method: The value of method engineering," *Journal of Database Management,* vol. 16, no. 4, pp. 1-24, 2005.

[8] S. Nerur, R. Mahapatra, and G. Mangalaraj, "Challenges of migrating to agile methodologies," *Communications of the Acm,* vol. 48, no. 5, pp. 72-78, 2005.

[9] B. Boehm, "Get ready for agile methods, with care," *IEEE Computer,* vol. 35, no. 1, pp. 64-69, 2002.

[10] VersionOne and Collabnet, "13th Annual State of Agile Report," 2019.

[11] M. Durbin and F. Niederman, "Bringing templates to life: overcoming obstacles to the organizational implementation of Agile methods," *International Journal of Information Systems and Project Management,* vol. 9, no. 3, pp. 5-18, 2021.

[12] B. Ramesh, K. Mohan, and L. Cao, "Ambidexterity in Agile Distributed Development: An Empirical Investigation," *Information Systems Research,* vol. 23, no. 2, pp. 323-339, 2012.

[13] C. Helfat, S. Finkelstein, W. Mitchell, M. Peteraf, H. Singh, D. Teece, and S. G. Winter, *Dynamic capabilities: Understanding strategic change in organizations*. MA, USA: Wiley-Blackwell Publishing, 2009.

[14] C. E. Helfat and S. G. Winter, "Untangling dynamic and operational capabilities: Strategy for the (N) ever-changing world," *Strategic Management Journal,* vol. 32, no. 11, pp. 1243-1250, 2011.

[15] T. Neise and J. R. Diez, "Adapt, move or surrender? Manufacturing firms' routines and dynamic capabilities on flood risk reduction in coastal cities of Indonesia," *International Journal of Disaster Risk Reduction,* vol. 33, pp. 332-342, Feb 2019, doi: 10.1016/j.ijdrr.2018.10.018.

[16] M. Zollo and S. G. Winter, "Deliberate learning and the evolution of dynamic capabilities," *Organization Science,* vol. 13, no. 3, pp. 339-351, May-Jun 2002, doi: 10.1287/orsc.13.3.339.2780.

[17] G. Cepeda and D. Vera, "Dynamic capabilities and operational capabilities: A knowledge management perspective," *Journal of Business Research,* vol. 60, no. 5, pp. 426-437, 2007.

[18] B. Bai, B. Yoo, X. Deng, I. Kim, and D. Gao, "Linking routines to the evolution of IT capability on agent-based modeling and simulation: a dynamic perspective," *Computational and Mathematical Organization Theory,* vol. 22, no. 2, pp. 184-211, 2016.

[19] S. G. Winter, "Understanding dynamic capabilities," *Strategic Management Journal,* vol. 24, no. 10, pp. 991-995, 2003.

[20] H. Wilhelm, M. Schlömer, and I. Maurer, "How dynamic capabilities affect the effectiveness and efficiency of operating routines under high and low levels of environmental dynamism," *British Journal of Management,* vol. 26, no. 2, pp. 327-345, 2015.

[21] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," *Strategic Management Journal,* pp. 509-533, 1997.

[22] D. J. Teece, "Dynamic capabilities: Routines versus entrepreneurial action," *Journal of Management Studies,* vol. 49, no. 8, pp. 1395-1401, 2012.

[23] E. Overby, A. Bharadwaj, and V. Sambamurthy, "Enterprise agility and the enabling role of information technology," *European Journal of Information Systems,* vol. 15, no. 2, pp. 120-131, 2006.

[24] C. M. Felipe, J. L. Roldán, and A. L. Leal-Rodríguez, "An explanatory and predictive model for organizational agility," *Journal of Business Research,* vol. 69, no. 10, pp. 4624-4631, 2016.

[25] Y. Lu and K. Ramamurthy, "Understanding the link between information technology capability and organizational agility: An empirical examination," *MIS Quarterly,* vol. 35, no. 4, p. 931, 2011.

[26] P. Mikalef and A. Pateli, "Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: Findings from PLS-SEM and fsQCA," *Journal of Business Research,* vol. 70, pp. 1-16, 2017.

[27] H. Li, Y. Wu, D. Cao, and Y. Wang, "Organizational mindfulness towards digital transformation as a prerequisite of information processing capability to achieve market agility," *Journal of Business Research,* vol. 122, pp. 700-712, 2021, doi: 10.1016/j.jbusres.2019.10.036.

[28] K. M. Eisenhardt, N. R. Furr, and C. B. Bingham, "CROSSROADS—Microfoundations of performance: Balancing efficiency and flexibility in dynamic environments," *Organization Science,* vol. 21, no. 6, pp. 1263-1273, 2010.

[29] S. Kortmann, C. Gelhard, C. Zimmermann, and F. T. Piller, "Linking strategic flexibility and operational efficiency: The mediating role of ambidextrous operational capabilities," *Journal of Operations Management,* vol. 32, no. 7-8, pp. 475-490, 2014.

[30] V. L. Mitchell, "Knowledge integration and information technology project performance," *MIS Quarterly*, pp. 919-939, 2006.

[31] K. Siau, X. Tan, and H. Sheng, "Important characteristics of software development team members: an empirical investigation using Repertory Grid," *Information Systems Journal*, vol. 20, no. 6, pp. 563-580, 2010.

[32] C. Iriarte and S. Bayona, "IT projects success factors: a literature review," *International Journal of Information Systems and Project Management*, vol. 8, no. 2, pp. 49-78, 2020.

[33] G. Lee and W. Xia, "Toward agile: an integrated analysis of quantitative and qualitative field data on software development agility," *MIS Quarterly*, vol. 34, no. 1, pp. 87-114, 2010.

[34] J. S.-C. Hsu, T.-C. Lin, S.-Y. Wang, and C.-M. Chen, "Exploring the role of dynamic capabilities of information system development project teams," in *7th Pre-ICIS International Research Workshop on Information Technology Project Management (IRWITPM 2012)*, 2012, p. 75.

[35] M. Choetkiertikul, H. K. Dam, T. Tran, A. Ghose, and J. Grundy, "Predicting delivery capability in iterative software development," *IEEE Transactions on Software Engineering*, vol. 44, no. 6, pp. 551-573, 2018.

[36] K. Conboy, "Agility from First Principles: Reconstructing the Concept of Agility in Information Systems Development," *Information Systems Research*, vol. 20, no. 3, pp. 329-354, 2009.

[37] D. Batra, D. VanderMeer, and K. Dutta, "Extending agile principles to larger, dynamic software projects: a theoretical assessment," *Journal of Database Management*, vol. 22, no. 4, pp. 73-92, 2011.

[38] D. Batra, W. Xia, and S. Rathor, "Agility Facilitators for Contemporary Software Development," *Journal of Database Management*, vol. 27, no. 1, pp. 1-28, 2016.

[39] J. Iivari and N. Iivari, "The relationship between organizational culture and the deployment of agile methods," *Information and Software Technology*, vol. 53, no. 5, pp. 509-520, 2011.

[40] R. Vidgen and X. Wang, "Coevolving systems and the organization of agile software development," *Information Systems Research*, vol. 20, no. 3, pp. 355-376, 2009.

[41] S. Nidumolu, "The effect of coordination and uncertainty on software project performance: residual performance risk as an intervening variable," *Information Systems Research*, vol. 6, no. 3, pp. 191-219, 1995.

[42] L. Jun, W. Qiuzhen, and M. Qingguo, "The effects of project uncertainty and risk management on IS development project performance: A vendor perspective," *International Journal of Project Management*, vol. 29, no. 7, pp. 923-933, 2011.

[43] S.-Y. Wang, J. S.-C. Hsu, Y. Li, and K.-T. Cheng, "Team Quotients, Resilience, and Performance of Software Development Projects," *International Research Workshop on IT Project Management*, 2016.

[44] Y. Li, K. C. Chang, H. G. Chen, and J. J. Jiang, "Software development team flexibility antecedents," *Journal of Systems and Software*, vol. 83, no. 10, pp. 1726-1734, 2010.

[45] B. Boehm and R. Turner, "Management challenges to implementing agile processes in traditional development organizations," *Software, IEEE*, vol. 22, no. 5, pp. 30-39, 2005.

[46] B. Boehm, "Requirements that handle IKIWISI, COTS, and rapid change," *Computer*, vol. 33, no. 7, pp. 99-102, 2000.

[47] B. Ramesh, L. Cao, and R. Baskerville, "Agile requirements engineering practices and challenges: an empirical study," *Information Systems Journal*, vol. 20, no. 5, pp. 449-480, 2010, doi: 10.1111/j.1365-2575.2007.00259.x.

[48] Y. Li, M. Shepherd, J. Y.-C. Liu, and G. Klein, "Enhancing development team flexibility in IS projects," *Information Technology and Management*, vol. 18, no. 1, pp. 83-96, 2017.

[49] G. Lee and W. Xia, "The ability of information systems development project teams to respond to business and technology changes: a study of flexibility measures," *European Journal of Information Systems,* vol. 14, no. 1, pp. 75-92, 2005.

[50] D. J. Teece, "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance," *Strategic Management Journal,* vol. 28, no. 13, pp. 1319-1350, 2007.

[51] P. Mikalef, J. Krogstie, I. O. Pappas, and P. Pavlou, "Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities," *Information & Management,* vol. 57, no. 2, p. 103169, 2020.

[52] B. Boehm and R. Turner, "Balancing agility and discipline: Evaluating and integrating agile and plan-driven methods," in *26th International Conference on Software Engineering (ICSE'04)*, Washington, DC, USA, 2004: IEEE Computer Society, pp. 718-719.

[53] C. Lindskog, "Tensions and ambidexterity: a case study of an agile project at a government agency," *International Journal of Information Systems and Project Management,* vol. 10, no. 2, pp. 5-23, 2022.

[54] S. C. Misra, V. Kumar, and U. Kumar, "Identifying some important success factors in adopting agile software development practices," *Journal of Systems and Software,* vol. 82, no. 11, pp. 1869-1890, 2009.

[55] J. Highsmith and A. Cockburn, "Agile Software Development: The Business of Innovation," *IEEE Computer Society,* vol. 34, no. 9, pp. 120-127, 2001, doi: 10.1109/2.947100.

[56] G. Vial and S. Rivard, "Understanding Agility in ISD Projects," presented at the International Conference on Information Systems (ICIS), Fort Worth, Texas, USA, 2015.

[57] A. Cockburn and J. Highsmith, "Agile software development, the people factor," *Computer,* vol. 34, no. 11, pp. 131-133, 2001.

[58] K. Schwaber, *Agile project management with Scrum*. Redmond, WA, USA: Microsoft Press, 2004.

[59] V. Wohlgemuth and M. Wenzel, "Dynamic capabilities and routinization," *Journal of Business Research,* vol. 69, no. 5, pp. 1944-1948, 2016.

[60] S. Rathor, D. Batra, and W. Xia, "Tradeoffs between Delivery Capability and Agility in Software Development," presented at the 15th AIS SIGSAND Symposium, Lubbock, TX, USA, May 12-14, 2016, 2016.

[61] G. Thomas and W. Fernández, "Success in IT projects: A matter of definition?," *International Journal of Project Management,* vol. 26, no. 7, pp. 733-742, 2008.

[62] J. Varajão, A. Trigo, J. L. Pereira, and I. Moura, "Information systems project management success," *International Journal of Information Systems and Project Management,* vol. 9, no. 4, pp. 62-74, 2021.

[63] J. Sheffield and J. Lemetayer, "Factors associated with the software development agility of successful projects," *International Journal of Project Management,* vol. 31, no. 3, pp. 459-472, 2013, doi: DOI 10.1016/j.ijproman.2012.09.011.

[64] L. Cao, K. Mohan, P. Xu, and B. Ramesh, "A framework for adapting agile development methodologies," (in English), *European Journal of Information Systems,* vol. 18, no. 4, pp. 332-343, Aug 2009, doi: Doi 10.1057/Ejis.2009.26.

[65] A. E. Akgün, H. Keskin, A. Y. Cebecioglu, and D. Dogan, "Antecedents and consequences of collective empathy in software development project teams," *Information & Management,* vol. 52, no. 2, pp. 247-259, 3// 2015, doi: http://dx.doi.org/10.1016/j.im.2014.11.004.

[66] P. Serrador and J. K. Pinto, "Does Agile work?—A quantitative analysis of agile project success," *International Journal of Project Management,* vol. 33, no. 5, pp. 1040-1051, 2015.

[67] M. D. Myers, "Dialectical hermeneutics: a theoretical framework for the implementation of information systems," *Information Systems Journal*, vol. 5, no. 1, pp. 51-70, 1995.

[68] D. X. Peng, R. G. Schroeder, and R. Shah, "Linking routines to operations capabilities: A new perspective," *Journal of Operations Management*, vol. 26, no. 6, pp. 730-748, 2008.

[69] L. Wallace, M. Keil, and A. Rai, "Understanding software project risk: a cluster analysis," *Information & Management*, vol. 42, no. 1, pp. 115-125, 2004.

[70] S. Ferreira, J. Collofello, D. Shunk, and G. Mackulak, "Understanding the effects of requirements volatility in software engineering by using analytical modeling and software process simulation," *The Journal of Systems & Software*, vol. 82, no. 10, pp. 1568-1577, 2009, doi: 10.1016/j.jss.2009.03.014.

[71] S. Ramzan and N. Ikram, "Making decision in requirement change management," in *International Conference on Information and Communication Technologies*, Karachi, Pakistan, 2005: IEEE, pp. 309-312.

[72] W. J. Kettinger and V. Grover, "Toward a theory of business process change management," *Journal of Management Information Systems*, vol. 12, no. 1, pp. 9-30, 1995.

[73] L. Cao, B. Ramesh, and T. Abdel-Hamid, "Modeling dynamics in agile software development," *ACM Transactions on Management Information Systems (TMIS)*, vol. 1, no. 1, p. 5, 2010.

[74] A. Bhattacherjee, *Social science research: principles, methods, and practices*. USF Tampa Library Open Access Collections 2012.

[75] S. B. MacKenzie, P. M. Podsakoff, and N. P. Podsakoff, "Construct measurement and validation procedures in MIS and behavioral research: Integrating new and existing techniques," *MIS Quarterly*, vol. 35, no. 2, pp. 293-334, 2011.

[76] C. B. Jarvis, S. B. MacKenzie, and P. M. Podsakoff, "A critical review of construct indicators and measurement model misspecification in marketing and consumer research," *Journal of consumer research*, vol. 30, no. 2, pp. 199-218, 2003.

[77] M. C. Becker, "A framework for applying organizational routines in empirical research: linking antecedents, characteristics and performance outcomes of recurrent interaction patterns," *Industrial and Corporate Change*, vol. 14, no. 5, pp. 817-846, 2005.

[78] K. Lyytinen and G. M. Rose, "Information system development agility as organizational learning," (in English), *European Journal of Information Systems*, vol. 15, no. 2, pp. 183-199, 2006.

[79] S. Sarker and S. Sarker, "Exploring Agility in Distributed Information Systems Development Teams: An Interpretive Study in an Offshoring Context," *Information Systems Research*, vol. 20, no. 3, pp. 440-461, 2009, doi: 10.1287/isre.1090.0241.

[80] J. Highsmith, *Agile Project Management*. Boston, MA: Addison-Wesley, 2004, p. 277.

[81] D. Straub, M.-C. Boudreau, and D. Gefen, "Validation guidelines for IS positivist research," *Communications of the Association for Information Systems*, vol. 13, no. 24, pp. 380-427, 2004.

[82] D. R. Cooper and P. S. Schindler, *Business Research Methods*, Eleventh ed. New York, USA: McGraw-Hill education, 2011.

[83] J. F. Hair Jr, G. T. M. Hult, C. Ringle, and M. Sarstedt, *A primer on partial least squares structural equation modeling (PLS-SEM)*, 3rd ed. London, UK: Sage Publications, 2022, p. 328.

[84] A. D. Chapman, *Principles of data quality*. GBIF, 2005.

[85] J. F. Hair Jr, G. T. M. Hult, C. Ringle, and M. Sarstedt, Second, Ed. *A primer on partial least squares structural equation modeling (PLS-SEM)*. Los Angeles: SAGE Publications, Inc, 2016, p. 384.

[86] J. Henseler, T. K. Dijkstra, M. Sarstedt, C. M. Ringle, A. Diamantopoulos, D. W. Straub, D. J. Ketchen, J. F. Hair, G. T. M. Hult, and R. J. Calantone, "Common beliefs and reality about PLS comments on Rönkkö and Evermann (2013)," *Organizational Research Methods*, p. 1094428114526928, 2014.

[87] C. M. Ringle, M. Sarstedt, and D. Straub, "A critical look at the use of PLS-SEM in MIS Quarterly," *MIS Quarterly*, vol. 36, no. 1, 2012.

[88] Y. Chen, Y. Wang, S. Nevo, J. Benitez, and G. Kou, "Improving Strategic Flexibility with Information Technologies: Insights for Firm Performance in an Emerging Economy," *Journal of Information Technology*, vol. 32, no. 1, pp. 10-25, 2017, doi: 10.1057/jit.2015.26.

[89] W. Reinartz, M. Haenlein, and J. Henseler, "An empirical comparison of the efficacy of covariance-based and variance-based SEM," *International Journal of Research in Marketing*, vol. 26, no. 4, pp. 332-344, 2009.

[90] P. M. Podsakoff and D. W. Organ, "Self-reports in organizational research: Problems and prospects," *Journal of Management*, vol. 12, no. 4, pp. 531-544, 1986.

[91] P. M. Podsakoff, S. B. MacKenzie, J.-Y. Lee, and N. P. Podsakoff, "Common method biases in behavioral research: a critical review of the literature and recommended remedies," *Journal of Applied Psychology*, vol. 88, no. 5, p. 879, 2003.

[92] S. Petter, D. Straub, and A. Rai, "Specifying formative constructs in information systems research," *MIS Quarterly*, pp. 623-656, 2007.

[93] R. T. Cenfetelli and G. Bassellier, "Interpretation of formative measurement in information systems research," *MIS Quarterly*, pp. 689-707, 2009.

[94] D. Gefen, D. W. Straub, and M.-C. Boudreau, "Structural equation modeling and regression: Guidelines for research practice," *Communications of the Association for Information Systems*, vol. 4 no. 1, 2000.

[95] A. Diamantopoulos and J. A. Siguaw, "Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration," *British Journal of Management*, vol. 17, no. 4, pp. 263-282, 2006.

[96] J.-M. Becker, K. Klein, and M. Wetzels, "Hierarchical latent variable models in PLS-SEM: guidelines for using reflective-formative type models," *Long Range Planning*, vol. 45, no. 5, pp. 359-394, 2012.

[97] B. Efron and R. J. Tibshirani, *An introduction to the bootstrap*. New York: Chapman and Hall/CRC, 1994.

[98] A. C. Davison and D. V. Hinkley, *Bootstrap methods and their application*. Cambridge university press, 1997.

[99] J. Henseler, C. M. Ringle, and R. R. Sinkovics, "The use of partial least squares path modeling in international marketing," *Advances in international marketing*, vol. 20, no. 1, pp. 277-319, 2009.

[100] J. Cohen, *Statistical power analysis for the behavior sciences*, 2nd ed. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers, 1988, p. 590.

[101] A. F. Hayes, *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Newyork, USA: The Guilford Press, 2013, p. 507.

[102] R. Hoda, N. Salleh, J. Grundy, and H. M. Tee, "Systematic literature reviews in agile software development: A tertiary study," *Information and Software Technology*, vol. 85, pp. 60-70, 2017.

[103] R. Vallon, B. J. da Silva Estácio, R. Prikladnicki, and T. Grechenig, "Systematic literature review on agile practices in global software development," *Information and Software Technology*, vol. 96, pp. 161-180, 2018.

[104] A. Behrens, M. Ofori, C. Noteboom, and D. Bishop, "A systematic literature review: how agile is agile project management?," *Issues in Information Systems*, vol. 22, no. 3, 2021.

[105] N. A. Bonner, N. Kulangara, S. Nerur, and J. T. Teng, "An empirical investigation of the perceived benefits of agile methodologies using an innovation-theoretical model," *Journal of Database Management,* vol. 27, no. 3, pp. 38-63, 2016.

[106] E. C. Conforto, D. C. Amaral, S. L. da Silva, A. Di Felippo, and D. S. L. Kamikawachi, "The agility construct on project management theory," *International Journal of Project Management,* vol. 34, no. 4, pp. 660-674, 2016.

[107] V. Balijepally, G. DeHondt, V. Sugumaran, and S. Nerur, "Agility in Software Development and Project Value: An Empirical Investigation," *Journal of Database Management* vol. 28, no. 4, pp. 40-59, 2017.

[108] J.-H. Wong, "System development team flexibility: its antecedents and project performance," *PACIS 2008 Proceedings,* p. 92, 2008.

[109] L. Mathiassen and A. M. Vainio, "Dynamic capabilities in small software firms: A sense-and-respond approach," *IEEE Transactions on Engineering Management,* vol. 54, no. 3, pp. 522-538, 2007.

[110] J. M. Bass, "Artefacts and agile method tailoring in large-scale offshore software development programmes," *Information and Software Technology,* vol. 75, pp. 1-16, 2016.

[111] D. Turk, R. France, and B. Rumpe, "Assumptions underlying agile software development processes," *Journal of Database Management,* vol. 16, no. 4, pp. 62-87, 2014.

[112] M. N. Aydin, F. Harmsen, K. van Slooten, and R. A. Stegwee, "On the adaptation of an agile information systems development method," *Journal of Database Management,* vol. 16, no. 4, pp. 24-40, 2005.

[113] B. Fitzgerald, G. Hartnett, and K. Conboy, "Customising agile methods to software practices at Intel Shannon," *European Journal of Information Systems,* vol. 15, no. 2, pp. 200-213, 2006.

[114] T. Dingsøyr and C. Lassenius, "Emerging themes in agile software development: Introduction to the special section on continuous value delivery," *Information and Software Technology,* vol. 77, pp. 56-60, 2016.

[115] L. M. Maruping, V. Venkatesh, and R. Agarwal, "A control theory perspective on agile methodology use and changing user requirements," *Information Systems Research,* vol. 20, no. 3, pp. 377-399, 2009.

[116] S. Rathor, W. Xia, and D. Batra, "Achieving software development agility: different roles of team, methodological and process factors," *Information Technology & People*, vol. 37, no. 2, pp. 835-873, 2023, doi: 10.1108/ITP-10-2021-0832.

Appendix A

Table A1: Survey measurements

Variables	Measures	Key References
Project Satisfaction	The customer is satisfied with the functionalities of the new system (DLVSTF1) The customer is satisfied with the quality of the new system (DLVSTF2) The customer is satisfied with the delivery time of the system (DLVSTF3) The customer is satisfied with the cost of the new system (DLVSTF4) The customer is satisfied with the benefits/value from the new system (DLVSTF5)	[63], [1], [66]
Change-Response Outcome	The customer is satisfied with the way changes in business requirements were managed in the project (CNGOTM1) The customer is satisfied with the way changes in technical requirements were managed in the project (CNGOTM2) The customer is satisfied with the way changes in human resource requirements were managed in the project (CNGOTM3) The customer is satisfied with the way changes in schedule was managed in the project (CNGOTM4)	[63], [1], [66], [5]
Delivery Capability	Project team was able to deliver solutions that met business requirements (DVLCAP1) Project team was able to deliver solutions that met technical requirements (DVLCAP2) Project team was able to deliver solutions that met functional requirements (DVLCAP3) Project team was able to deliver solutions that met non-functional requirements (DVLCAP4)	[35], [59], [77]
Agility-Sense	During the project, project team was able to sense changes in business requirements. (Sense1) During the project, project team was able to sense changes in technical requirements. (Sense2)	[78], [36],

Variables	Measures	Key References
Agility-Respond	During the project, project team was able to sense changes in human resource requirements. (Sense3) During the project, project team was able to sense changes in schedule. (Sense4) During the project, project team was able to respond to changes in business requirements. (Respond1) During the project, project team was able to respond to changes in technical requirements. (Respond2) During the project, project team was able to respond to changes in human resource requirements. (Respond3) During the project, project team was able to respond to changes in schedule. (Respond4)	[79], [44], [116], [80], [78], [36], [33], [116]
Agility-Learn	As the project progressed, project team member(s) were able to learn and enhance their ability to sense and respond to changes in business requirements. (Learn1) As the project progressed, project team member(s) were able to learn and enhance their ability to sense and respond to changes in technical requirements. (Learn2) As the project progressed, project team member(s) were able to learn and enhance their ability to sense and respond to changes in human resource requirements. (Learn3) As the project progressed, project team member(s) were able to learn and enhance their ability to sense and respond to changes in schedule (Learn4)	[78], [36], [79], [116]

Table A2: Harman's single factor test: total variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.461	33.845	33.845	8.461	33.845	33.845
2	2.381	9.523	43.368	2.381	9.523	43.368
3	1.774	7.095	50.464	1.774	7.095	50.464
4	1.509	6.036	56.500	1.509	6.036	56.500
5	1.247	4.989	61.489	1.247	4.989	61.489
6	1.210	4.838	66.327	1.210	4.838	66.327
7	1.089	4.355	70.681	1.089	4.355	70.681
8	.919	3.676	74.358			
9	.732	2.926	77.284			
10	.677	2.707	79.991			
11	.603	2.412	82.402			
12	.523	2.094	84.496			
13	.467	1.866	86.362			
14	.452	1.808	88.171			
15	.417	1.669	89.840			
16	.387	1.546	91.386			
17	.333	1.333	92.718			
18	.305	1.219	93.938			
19	.280	1.119	95.057			
20	.256	1.024	96.080			
21	.237	.948	97.028			
22	.229	.917	97.946			
23	.203	.811	98.757			
24	.173	.694	99.451			
25	.137	.549	100.000			

Extraction Method: Principal Component Analysis.

Table A3: VIF, outer weights, and outer loadings (first order)

Indicators	VIF	Outer Loadings	Outer Weights	P Values(Outer Weights)
CNGOTM1	1.749	0.789	0.262	0.084
CNGOTM2	1.586	0.742	0.250	0.195
CNGOTM3	1.558	0.752	0.278	0.124
CNGOTM4	1.567	0.853	0.467	0.013
DLVCAP1	1.961	0.806	0.298	0.027
DLVCAP2	1.596	0.739	0.223	0.141
DLVCAP3	2.184	0.872	0.366	0.015
DLVCAP4	1.458	0.771	0.359	0.031

Indicators	VIF	Outer Loadings	Outer Weights	P Values(Outer Weights)
DLVSTF1	1.850	0.576	0.182	0.480
DLVSTF2	1.708	0.279	-0.438	0.090
DLVSTF3	1.652	0.773	0.515	0.010
DLVSTF4	1.666	0.746	0.409	0.028
DLVSTF5	1.352	0.730	0.430	0.046
LEARN1	1.368	0.705	0.339	0.183
LEARN2	1.607	0.740	0.229	0.304
LEARN3	1.532	0.670	0.151	0.477
LEARN4	1.694	0.881	0.556	0.004
RESPOND1	2.113	0.828	0.308	0.108
RESPOND2	2.141	0.824	0.282	0.106
RESPOND3	1.810	0.789	0.265	0.128
RESPOND4	1.924	0.844	0.360	0.019
SENSE1	1.470	0.854	0.655	0.000
SENSE2	1.726	0.608	-0.037	0.848
SENSE3	1.499	0.613	0.138	0.511
SENSE4	1.346	0.753	0.502	0.004

Biographical notes

Weidong Xia

Weidong Xia is a professor in the Department of Information Systems and Business Analytics at Florida International University. Before joining FIU, he was on the faculty of the Carlson School of Management at the University of Minnesota. His research interests relate to project complexity and flexibility, healthcare process and analytics, and IT-enabled business innovations. His work has been published in MIS Quarterly, Journal of Operations Management, Journal of MIS, Journal of Business Research, European Journal of Information Systems, Decision Sciences, Journal of Information Systems, Journal of Medical Internet Research, Communications of the ACM, International Journal of Information Management, and other journals.

Shekhar Rathor

Shekhar Rathor is an assistant professor in the Department of Management, Marketing, & Information Systems at Sam Houston State University. His research interests include agile software development, IT Outsourcing, IT Project Management, Web 3.0, and Business Analytics. His work has been published in the Journal of Information Technology & People, Journal of Database Management, and premier information systems conference proceedings.

Dinesh Batra

Dinesh Batra is a professor in the Department of Information Systems and Business Analytics at Florida International University. His work has been published in Management Science, Journal of MIS, Communications of the ACM, Journal of Database Management, European Journal of Information Systems, Decision Support Systems, Communications of the AIS, International Journal of Human-Computer Studies, Database, Information and Management, Requirements Engineering Journal, Information Systems Management, and other journals. He is a co-author of the book Object-Oriented Systems Analysis and Design, published by Pearson Prentice-Hall. He has served as the President of the AIS SIG on Systems Analysis and Design (SIGSAND).

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Towards a comprehensive framework for risk assessment of organizational development project portfolios

Camilo Micán
School of Industrial Engineering, Universidad del Valle
Campus Meléndez, Calle 13 # 100-00, Cali 760034
Colombia
camilo.mican@correounivalle.edu.co

Gabriela Fernandes
CEMMPRE, Department of Mechanical Engineering, University of Coimbra
Rua Luís Reis Santos, Polo II da Universidade de Coimbra, Coimbra 3030-788
Portugal
gabriela.fernandes@dem.uc.pt

Madalena Araújo
ALGORITMI, Department of Production and Systems, University of Minho
Campus de Azurém, Av. da Universidade, Guimarães 4800-058
Portugal
mmaraujo@dps.uminho.pt

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Camilo Micán, Gabriela Fernandes, Madalena Araújo, “Towards a comprehensive framework for risk assessment of organizational development project portfolios”, *International Journal of Information Systems and Project Management*, vol. 12, no. 3, pp. 50-69, 2024.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Towards a comprehensive framework for risk assessment of organizational development project portfolios

Camilo Micán
School of Industrial Engineering, Universidad del Valle
Campus Meléndez, Calle 13 # 100-00, Cali 760034, Colombia
camilo.mican@correounivalle.edu.co

Gabriela Fernandes
CEMMPRE, Department of Mechanical Engineering, University of Coimbra
Rua Luís Reis Santos, Polo II da Universidade de Coimbra, Coimbra 3030-788, Portugal
gabriela.fernandes@dem.uc.pt

Madalena Araújo
ALGORITMI, Department of Production and Systems, University of Minho
Campus de Azurém, Av. da Universidade, Guimarães 4800-058, Portugal
mmaraujo@dps.uminho.pt

Abstract:
The benefits of risk management in the context of project portfolios have been widely recognized in the literature. However, approaches that assess the risk of organizational development project portfolios from the perspective of how the portfolio delivers value to the parent organization remain largely unexplored. To address this gap, our research takes a constructivist approach and an organizational perspective on project portfolios. We conducted twenty-eight semi-structured interviews and used thematic analysis to identify and relate four themes of a comprehensive project portfolio risk assessment (PPRA) framework: "project portfolio as the organizational unit for PPRA"; "organizational capabilities as portfolio outcomes in which PPR can be assessed"; "project portfolio levels as sources of risk factors in PPRA"; and "balance between project portfolio attributes complexity". Within the framework of organizational development project portfolios, this study contributes to our understanding of PPRA by providing two propositions: (1) The capabilities to be generated by the project portfolio can be used as the portfolio primary results on which PPRA can assess the risk of the project portfolio, establishing the impact of PPR on the project portfolio value delivering to the parent organization, and (2) The risk factors that impact the project portfolio expected results can be represented into PPRA as 'output-related' risk factors and 'outcome-related' risk factors.

Keywords:
project portfolio management; project portfolio risk; risk assessment; qualitative analysis; thematic analysis.

DOI: 10.12821/ijispm120303

Manuscript received: 25 April 2023
Manuscript accepted: 8 March 2024

1. Introduction

Project portfolio risk management seeks to maximize the value delivered to the organization through the impact achieved on strategic goals while managing limited resources, capabilities, and an assumed level of risk [1]–[4]. In this context, the strategic alignment of project portfolios is seen as a guiding principle for project selection [5], [6], and the positive influence of project portfolio risk management on the project portfolio success has been recognized in the literature [7]–[9]. Project Portfolio Risk Assessment (PPRA), like project portfolio risk planning, project portfolio risk identification, and project portfolio risk response, is an element of project portfolio risk management [10]. PPRA is designed to provide information about the significance of risks and risk trends, among other factors, to support risk response decisions [9], [10]. It enables managers to better monitor and prevent risks [11]. To achieve this, PPRA should generate greater approximations to reality and incorporate a portfolio-wide view through which inherent project portfolio characteristics would be recognized [8], [12], [13].

A project portfolio can be defined as an organization hosting temporary organizations (projects and programs) that interact with the parent organization and its strategy [14]. Thus, recognizing how the project portfolio delivers value to the parent organization is crucial when managing project portfolios [5], [15]. Then, the fact that project portfolios share resources with the parent organization, as well as the strategic impact of the portfolios does not come directly from the outputs of each project within the portfolio but is generated through a comprehensive process of value delivery to the parent organization are highlighted as inherent project portfolio characteristics [16]–[18]. However, these project portfolio characteristics have not been widely explored and incorporated into PPRA approaches [12], [16].

On the one hand, the most traditional PPRA approach focuses on evaluating the financial risk taken by the parent organization when investing in one or another project portfolio [11], [19], [20]. However, this approach does not consider how the project portfolio delivers value to the parent organization. On the other hand, from a second risk planning approach, PPRA has been oriented to evaluate the risk associated with achieving project objectives considering interdependencies between projects, and traditionally by assessing the impact on duration or cost of each project within the portfolio [20], [21]. However, this second risk planning approach did not explicitly consider the relationship between the portfolio and the parent organization's strategy.

Thus, in recent years studies have evolved to assess the impact of project portfolio risk on strategic goals [22], [23], including not only the risk derived from the projects and their interdependencies, but also the risk derived from the project portfolio level itself [2]. As a result, the traditional conceptualization and theory of PPRA has been complemented by an emerging approach based on the impact of risk at the strategic level. However, considerations on the implications for PPRA derived from considering the interaction between the project portfolio and the parent organization and its strategy, as well as how the project portfolio delivers value to the parent organization, remain absent.

Considering the above, the PPRA literature could benefit from adopting a comprehensive framework that recognizes the organizational perspective of project portfolios. The organizational perspective of project portfolios helps to understand the different portfolio levels and their interrelationships; as well as recognizing that the project portfolio interacts with the parent organization and its strategy while serving multiple stakeholders, organizational resource constraints and resource competition [14], [17], [24]. Therefore, the current study addresses the following research question: What could be the implications for PPRA when an organizational perspective of the project portfolios is adopted?

For this purpose, this study was developed based on the qualitative analysis of twenty-eight semi-structured interviews conducted with project portfolio practitioners. This research focused on organizational development project portfolios. This type of project portfolio is associated with structures that respond to changes in the competitive environment, marketing priorities, consumer demands, production technology requirements, Etc. In this regard, organizational development project portfolios comprise a set of mixed projects [25]. The empirical findings derived from this study provide insights into PPRA and suggest four interdependent themes that describe and conceptualize it from an organizational perspective. In addition, this research leads to recognizing the interaction between the project portfolio

and the parent organization and its strategy into PPRA through two propositions derived from the discussion, opening new avenues for theoretical and empirical studies in the field.

The remainder of the paper is organized as follows. Firstly, a PPRA background is presented, followed by a description of the research methodology used for the study. Then, the findings of the interview analysis are presented, leading to the description of a comprehensive framework for PPRA. The findings are followed by the discussion in which empirical propositions for PPRA are developed, and finally, conclusions are summarized.

2. Literature review

2.1 Project portfolio risk assessment

The literature on risk assessment in the project portfolio context can be classified into two main classical approaches: 1) Risk assessment carried out as part of project portfolio selection. This approach is derived from the Modern Portfolio Theory proposed by Markowitz in 1952; this theory mainly focuses on optimizing project portfolio investments [3], [13], [19]. 2) risk analysis in the project portfolio execution phase, where the literature has focused on integrating project interdependencies with project risk assessment models [21], [26], seeking a better representation of project portfolio risk as a network of interdependent projects and risk factors [24], [11]. According to Ahmadi-Javid et al. [20], the first group is related to general management, and the second group is related to the project management field.

Project portfolio risk management and PPRA developments applied to project portfolios mainly focus on analyzing risks from the project portfolio selection perspective. Thus, the problem of creating an optimal risk-reward portfolio has been actively considered in the literature [19], [27]. In this regard, the proposed model by Loperfido [27] is an example of recent work done from this perspective. Thus, from the investors' perspective, PPR has been mainly associated with the expected economic results. Consequently, risk measures derived from risk analysis of financial portfolios have been mainly used to assess the PPR [11]. However, assessing risk only in monetary terms does not consider the diversity of strategic objectives that make up the strategic orientation [22], [28]. Therefore, this perspective does not capture the diversity of organizational outcomes expected by the parent organization when a project portfolio is selected and executed [3]. It also neglects to acknowledge how the project portfolios deliver value to the parent organization [16].

Although assessing the financial risk derived from the portfolio investment is highly relevant from the investor's perspective, it does not assess the risk at the portfolio level in a manner that provides information to support the management of portfolio risk when it is being executed. In this vein, the literature suggests that the technical or operational risk associated with the result of the project portfolio execution should also be considered [21], [29].

Only in the last two decades have considerations of PPRA in project portfolio execution been introduced [30], [31]. In this regard, proposals for PPRA are initially focused on each project's technical and operational impacts [20], [21]. In this approach, the portfolio risk was assessed based on the risk of each project within the portfolio, specifically, the risk based on project measures such as the project's duration or total cost. More recently, proposals have been oriented to incorporate and evaluate the influence of project interdependencies and risk interdependencies on Project Portfolio Risk (PPR) [11], [21], [32]; and also considering the interdependencies between projects but focusing on selecting a suitable project portfolio to achieve a set of strategic goals [22], as is illustrated, for instance, in the study carried out by Han et al. [13]. Thus, broader perspectives have been adopted by introducing into PPRA some inherent characteristics of project portfolios, such as the influence of project interdependencies and risk factor interdependencies derived from the projects within the project portfolio.

Looking to incorporate the fact that the portfolio risk goes beyond the sum of the individual risk of each project in the portfolio [33], [34], Hofman and Grela [35] assess a set of project portfolio-level risk factors based on the likelihood and the impact on project portfolio goals. Based on that, the risk factors categorization is proposed based on risk likelihood and impact perspectives. Ghasemi et al. [12] identify risk factors caused by project interactions, and they also define risk factors at the project portfolio level as causes that could generate negative consequences on portfolio success factors and portfolio management objectives.

By focusing on the influence of resource interdependency between projects, Bai et al. [32] found that poor communication and cooperation among projects and lack of technology sharing are among the leading factors of the PPR. Later, Bai et al. [11] focused on considering project portfolios as a network through which the risk is propagated through the projects due to their interdependencies. To that end, the authors assess the risk as a unidimensional measure of impact level. Similarly, Zhang et al. [34] incorporated interdependencies between projects, which is complemented with considerations related to shared risk sources between projects and risk factors at the project portfolio level. In all these studies, PPR is presented as an aggregate measure, and the proposals do not allow the identification of the impact on the project portfolio's expected results.

Another perspective is adopted by Wang et al. [16], who study the uncertainty associated with the realized value of projects and their interdependency. In contrast to traditional project-based control, they establish that a strategic perspective is required for portfolio coordination to improve the overall strategic benefits. Similarly, considering risk factors derived from project- and project portfolio-level and their impact on a set of portfolio outcomes, Micán et al. [2] proposed a PPRA model where the risk impact on the strategic objectives is assessed. In this regard, the portfolio risk is established as a non-aggregate risk measure.

Thus, the risk associated with portfolio expected results and the incorporation of risk factors explicitly derived at the project portfolio level is being explored by some PPRA approaches. However, some types of risk factors identified in the literature have not been incorporated into PPRA, such as those associated with project portfolio management (PPM) (see [34] and [35]). Also, the focus on the project level has led to the recognition that the strategic relationship of project portfolios has not been explored from the perspective of portfolio risk nor its impact on portfolio expected results [2]. So, additional aspects should be considered when a PPRA is conducted [2], [3], [12], [32]. Furthermore, the interaction with the parent organization and its strategy, as well as how the portfolio delivers value to the parent organization, which are inherent project portfolio characteristics, have also been scarcely explored or incorporated in an explicit way into PPRA approaches.

2.2 Aspects to take into account in PPRA

Risk assessment is not isolated from the other elements of risk management. Therefore, the aspects to consider when designing and carrying out a PPRA should cover PPRA aspects and portfolio risk management more broadly. Table 1 shows nine 'aspects for PPRA' identified in the literature.

Table 1. Aspects for PPRA

Aspect	Description
Risk and uncertainty approach	There are different views of the specific means of risk and uncertainty. Three different approaches were identified: firstly, risk as a consequence or measure of the impact of uncertainty [1]; secondly, risk as the foreseeable component of uncertainty [36] and, thirdly, risk and uncertainty as separate approaches [1]. The risk or uncertainty approach to be adopted must be defined to enable the scope of the PPRA to be determined.
Opportunities incorporation	Opportunities analysis incorporation allows for the identification of positive impacts on the project portfolio expected results, as well as allowing for an assessment of the compensatory effects arising from threats and opportunities [37].
Portfolio operational risk and risk in the portfolio business phase	Generally, project portfolio selection with risk considerations focuses on the risks associated with the business phase (commercial, financial, and market factors), while risk management in the portfolio execution phase deals with the operational or technical risk. Operational risk and business phase risks within the portfolio should be incorporated into PPRA for a complete PPR overview [29], [38].
Project interdependencies	Interdependencies between projects generate both positive and negative effects on the projects and the project portfolio, meaning that identification and assessment of interdependencies between projects need to be incorporated into the PPRA [3], [21], [24], [32], [39].
Threat/opportunity interdependencies	Evaluating interdependencies and the correlation between threats/opportunities allows for identifying the threats/opportunities that have a more significant influence over the portfolio's objectives by considering the indirect effect they may generate through their effect on other threats/opportunities [2], [12], [20], [39].
Impact on higher levels	The literature shows that PPR can influence project portfolio success and the achievement of PPM objectives or organizational strategic objectives [12], [13], [31], [34].
Relation of risk among	PPRA is not independent of project and program risk management. Thus, PPRA should allow for risk-

Aspect	Description
portfolio levels	integrated management between all levels of the project portfolio [33], [40].
Environmental characteristics	The competitive dynamics of an organization's environment are determining factors in PPRA. Uncertainty or risk sources constantly and dynamically modify, making it necessary to develop risk management capabilities appropriate to each organization's environment [3], [13], [41]–[43]. In addition, dynamic changes resulting from the influence of the internal and external environment should be considered when assessing PPR [34].
Project portfolio and organizational processes	The characteristics of each organizational context can modify PPRA, evidencing the need to incorporate both common and specific project portfolio characteristics and their relationship to the organizational processes; these characteristics can influence the PPRA and the risk impact on the projects and project portfolio expected results [1], [24], [28].

These nine aspects represent the different types of considerations to be taken into account when designing a PPRA. For example, decisions regarding the risk approach adopted, the type of project interdependencies to be incorporated and how these are reflected in the portfolio risk, and considerations related to the portfolio environment and how they are incorporated into the PPRA must be made and explicitly represented in the PPRA. Thus, the PPRA should incorporate the decisions made concerning each aspect; these aspects and the related decisions frame the scope and characteristics of a PPRA.

3. Research methodology

This research has sought to deepen understanding of how PPR can be assessed. Thus, the project portfolio is understood to be an organizational subsystem; consequently, PPRA is to be framed in that subsystem. Organizational studies have mainly been framed in line with a classic functionalistic approach [44]. However, several limitations and inadequacies have been identified in organizational and project portfolio studies [14], [45].

The above has led to the integration of a constructivist epistemology in organizational research, the so-called constructivism-founded scientific paradigm for organization research [46]. In the constructivist view of organizational design science, constructivist epistemologies and organizational design science complement each other to generate further knowledge [45]. Then, a constructivism-founded scientific paradigm for organization research was adopted for this research. As in organizational design science, the goal of research using this approach is to develop knowledge to guide design processes [45], [46]. Therefore, the constructivism-founded scientific paradigm for organization research is an approach that is mutually beneficial for both constructivist epistemologies and organizational or process design science [45].

3.1 Data collection

A qualitative interview method is appropriate in studies that incorporate exploratory searches since interviews can provide relevant and reliable information and offer a rich overview and understanding of organizational realities [47]. Thus, as part of a broader research project on risk assessment in the project portfolio context in which the study here reported is framed, 28 semi-structured interviews were conducted.

As in Bos-de Vos et al. [48], a semi-structured interview guide or protocol was used to cover the broader scope of the research project. The interview protocol consisted of four main questions covering the entire scope of the research project, one of which is relevant to the focus of this paper: “Can you identify the main aspects that should be considered in PPRA?” However, information regarding aspects for PPRA may also be mentioned by interviewees in the other interview blocks.

Seeking to ensure an adequate interpretation, a definition of ‘aspect for PPRA’ was included in the briefing document. In some cases, it was also necessary to complement the question with exemplification, using the information provided by the interviewee in previous questions. In addition, the nine aspects identified in the literature were used to encourage or broaden the discussion. Thus, if the interviewee did not mention information related to a particular PPRA aspect

identified in the literature, the interviewer briefly introduced the aspect and subsequently asked the interviewee about his/her perception of that aspect.

The sample was focused on portfolios of organizational development projects, also acknowledged as internal development projects [25]. These projects can be strategic or operational but are always directly related to the organizational strategic perspective or strategic-level decisions. A portfolio of internal development projects could comprise business process development, internal information technology development, organizational change or re-engineering, investments in new equipment, major software, and other capital projects [25].

This decision was adopted considering two aspects. Firstly, portfolios of organizational development projects are composed of diverse projects; therefore, it is a more comprehensive view than adopting a sample based on portfolios composed of more homogeneous projects. Secondly, regardless of the type of portfolios included in the sample, as this is an exploratory study, the results will not be generalizable; however, focusing on a single type of portfolio would allow contrasting the results with future studies of a similar nature focused on other types of portfolios.

As in Mac Donald et al. [49], convenience sampling was used to identify an initial group of possible interviewees, while snowball sampling provided additional participants for the study. The target was Colombian professionals with experience related to PPM. As in studies carried out by Tam et al. [50] and Hofman et al. [1], this study focused on the interviewees' professional experience. The above enabled the researchers to obtain insights into the interviewees' portfolio management experience with project portfolios in their current and previous organizations. Thus, this study focused on how PPRA is perceived and understood by project portfolio practitioners based on their professional experience managing project portfolios rather than on how PPRA is performed in their current organizations. The interviews were recorded with the prior authorization of each interviewee, and handwritten notes were taken during interviews.

It is worth mentioning that the diversity of the sample is not given by the diversity of portfolio types but by the diversity of business sectors of the parent organizations in which the interviewees gained professional experience. With this, it was expected to get a sample with a broad representation of organizational development project portfolios across different business sectors to capture data for establishing the figurative core of the constructs under analysis. Also, it is clear that empirical results cannot be directly extended to other types of portfolios.

The interviews lasted an average of 53 minutes. The interviewees had high levels of project and portfolio management experience: 57% had more than 9 years of project management experience and 43% had between 4 and 9 years of PPM experience. All had, at least, a first degree, 46% held a post-graduate qualification, and 86% had some form of academic qualification related to the PM field. All appeared well qualified to provide valuable information. Most of the interviewees were male (64%). Regarding the type of organization, based on the classification proposed by Müller et al. [51], 50%, 29%, and 21% of the interviewees had their primary experience in process-oriented, project-oriented, and project-based organizations, respectively. Table 2 shows the general characterization of the interviewees.

Table 2. Aspects for PPRA

Current Role		PM experience (years)	
Project portfolio manager	20	Less than 5	3
Project manager	1	Between 5 and 9	9
Head of improvement office	1	Between 10 and 14	8
Head of Project Management Office (PMO)	5	More than 14	8
Executive director	1		
Type of organization: primary experience		**PPM experience (years)**	
Process-oriented	14	Less than 4	14
Project-oriented	8	Between 4 and 9	12
Project-based	6	More than 9	2

On the one hand, twenty of the organizations in which the interviewees are currently employed are classified as large companies, and the remaining eight are medium-sized companies. On the other hand, six organizations are in the engineering sector, developing activities such as installing refrigeration systems on an industrial scale; seven and fifteen are classified as manufacturing and service organizations, respectively.

3.2 Data analysis

All interviews were fully transcribed by the same researcher (interviewer) and subjected to a thematic analysis. In-depth analysis of qualitative data sets produces well-grounded and contextualized explanations; for this purpose, fragmenting these data sets and rearranging them into analytical categories associated with the research question is generally accepted [47].

Thematic analysis allows for complete and analytic analysis, and aims to identify patterns, or themes across qualitative data sets, leading to a rich seam of results, explanations, and opportunities for theorizing [47], [52]. According to Terry et al. [52], thematic analysis approaches can be classified as either coding reliability, codebook, or reflexive, differing in the way the themes are conceptualized. For this research, a reflexive thematic analysis was adopted. In a reflexive approach, a theme is conceptualized as an analytic output representing shared meaning-based patterns organized around a core concept or idea [53]. Thus, the set of themes for a PPRA, or themes derived from interviews, correspond to an analytic output of the qualitative data analysis process.

Based on Braun et al. [53], a six-phase procedure was carried out to implement the reflexive thematic analysis: 1) familiarization; 2) generating codes; 3) constructing themes; 4) revising; 5) defining themes, and 6) producing the report.

The familiarization phase was based on listening to a sample of interview records and reading all the transcriptions and handwritten notes. As a result of this phase, and considering that "in practice, any researcher will approach the data with preconceived ideas based on their existing knowledge and viewpoints" [53, p. 853], it was defined that the qualitative data should initially be grouped according to the nine aspects identified in the literature. In addition to this, since thematic analysis phases represent "a reflexive and recursive, rather than strictly linear, process" [53, p. 852], it was established that the analysis process would be carried out in blocks of four interviews at a time.

To obtain groups of data with shared meaning-based patterns, it was defined that the codes would be generated under an inductive orientation. Thus, in the generating codes phase, based on the information grouped in the nine aspects, the first possible set of codes derived from the analysis of the first block of four interviews was pre-defined. Consequently, the codes were updated in each analysis cycle; codes were merged, added, or split according to each new data group. For this phase, 'a sentence' was defined as the unit of data analysis. Finally, the data was coded into 26 codes (see Appendix 1).

The phases of constructing, revising, and defining themes were carried out recursively to obtain the final set of PPRA themes. To this end, two strategies were considered – either the analysis of codes as building blocks could construct a possible PPRA theme, or the possibility that a code could be directly promoted to a PPRA theme. However, after conducting the analysis, no single code was not promoted to a PPRA theme. A specific definition of the candidate PPRA themes and a check of the candidate PPRA theme against the dataset were strategies of analysis implemented as part of the recursive process. This process was oriented to ensure that each PPRA theme was related to a central meaning and PPRA themes comprised the whole dataset. It also analyzed how themes are related between themselves and that PPRA themes do not overlap. For this reason, thematic maps were developed from the candidate PPRA themes.

Fig. 1 shows how the implementation of reflexive thematic analysis led to defining the PPRA themes. It gives an example of how the interview data were classified into the aspects identified in the literature and then into codes produced based on qualitative analysis of each group of data. Finally, based on the analysis of shared meanings between codes, the PPRA themes were established.

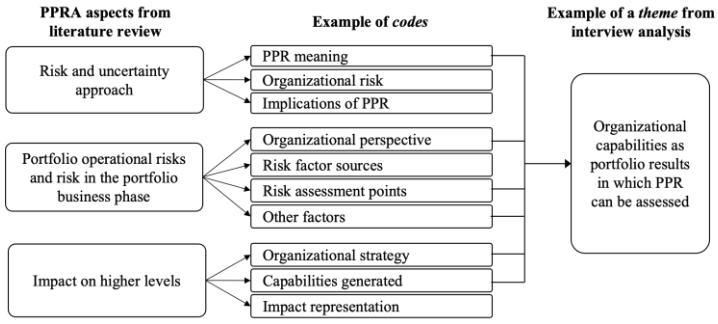


Fig. 1. Sample illustration of themes identification

Data analysis was supported by NVIVO software. The coding process for all interviews was carried out by the same researcher (interviewer), thus enabling consistency of coding. To ensure the validity of the coding process, the two other researchers involved in the project examined the audit trail of the key coding decisions and theme definitions arising from the research process. Through the analysis of shared meanings between codes, four themes were identified: 'Organizational capabilities as portfolio results in which PPR can be assessed'; 'project portfolio levels as risk factor sources in PPRA'; 'project portfolio as the organizational unit for PPRA'; and 'balance between project portfolio attributes and complexity'. Table 3 shows the relation between the nine PPRA aspects from the literature review and the codes for information classification, and it shows the categorization of the codes in themes.

Table 3. Structure for PPRA themes identification

PPRA aspect	**Codes**	**PPRA themes***			
		T1	**T2**	**T3**	**T4**
Risk and uncertainty approach	PPR meaning	X			
	Organizational risk			X	
	Implications			X	
Opportunities incorporation	Relevance				X
	Complexity				X
Portfolio operational risk and risk in the portfolio business phase	Organizational perspective	X			
	Risk factor sources		X		
	Risk assessment points	X			
	Other factors	X			
Impact on higher levels	Organizational strategy	X			
	Capabilities generated	X			
	Impact representation				X
Project interdependencies	Interdependencies as risk				X
	Source of complexity				X
	Organizational issues		X		
Threat/opportunity interdependencies	Relevance and complexity				X
	Second level				X
Relation of risk among portfolio levels	Interaction between levels		X		
	Projects and programs		X		
	Portfolio		X		
	Organization		X		
Environmental characteristics	Strategic management			X	
	Technological context			X	
	Organizational culture			X	
Project portfolio and organizational processes	Risk management process			X	
	Processes influence			X	

**__T1__: Organizational capabilities as portfolio results in which PPR can be assessed; __T2__: project portfolio levels as risk factor sources in PPRA; __T3__: project portfolio as the organizational unit for PPRA; __T4__: balance between project portfolio attributes and complexity.*

4. Findings

Fig. 2 shows the four interdependent PPRA themes and their main aspects, representing a comprehensive PPRA framework based on the analysis of the interviewees' perceptions. The relationships between themes are represented with arrows that link one theme's main aspects to another or the relationship between two themes. The themes, their main aspects, and the relationships between them are described in the following subsections. This section presents quotations from interviewees in brackets to distinguish them from quotations from the literature. For example, (I1) means the quote comes from Interviewee 1.

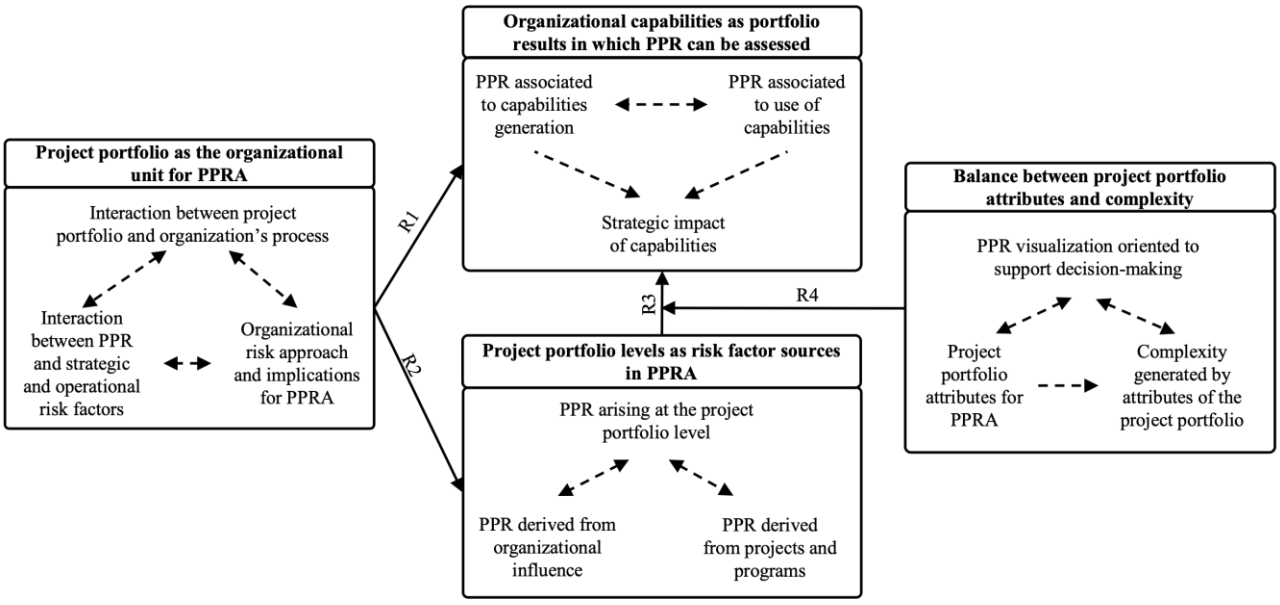


Fig. 2. A comprehensive framework for PPRA

4.1 Organizational capabilities as portfolio results in which PPR can be assessed

The project portfolio risk representation as a result of PPRA was anchored by the interviewees to the impact on the expected project portfolio outcomes at the organizational level. For example, interviewee 26 mentioned "*I would imagine it as the risk of fulfilling and implementing the entire portfolio, if we are really achieving the expected results*". In this matter, it was specifically mentioned that "*as result, a portfolio produces organizational capabilities to be used in the operation, but that is very difficult to measure*" (I9). Then, influence on the organizational capabilities generated by the project portfolio could be denoted as a construct for the primary representation of the PPRA outcome.

Regarding the impact on the expected results of the portfolio, represented by the PPRA in the impact on the expected organizational capabilities, it is stated that "*it translates into the non-achievement of the expected impact on the organization's strategy, but the business measures are mediated by other factors that are no longer purely of the portfolio*" (I9). Thus, the expected organizational capabilities to be generated by the portfolio are the path through achieving the expected strategic impacts derived from the project portfolio. PPRA oriented to capabilities also reflected the fact that "*the capabilities are not delivered, we understand that it is the <<project or portfolio>> manager's responsibility, but if the capabilities are delivered but not properly exploited, we have a shared responsibility*" (I16). This suggests that a capabilities-based PPRA approach would recognize the project portfolio limits in terms of its organizational contribution.

In this regard, a PPRA based on the expected organizational capabilities also involves the organizational use of the capabilities generated by the portfolio. Specifically, interviewee 28 exemplifies this with one of their project portfolios

through which "*we are going out with digital channels and in all these issues as so disruptive and innovative, there are some really delicate cyber-security risks*", mentioning in this regard that "*those risks sometimes one does not see them, because they are end-user risks*". Regarding the above, the same interviewee highlighted "*it is not about waiting to close the portfolio and say: parent organization there are the results, now invest quickly in some cybersecurity to be able to use them*".

In the case exemplified by interviewee 28, it is shown that a PPRA oriented to organizational capabilities would allow not only to assess risk factors associated with the projects that seek to generate digital channels, but also to incorporate the risk factors associated with cybersecurity, which is related to the use of the capability generated by the project portfolio. Thus, a risk assessment approach oriented to establish the impact on the organizational capabilities derived from the project portfolio could allow capturing into the PPRA how portfolios deliver value to its parent organization.

Therefore, PPR representation as a PPRA result was anchored by the interviewees to the impact on the expected project portfolio outcomes at the organizational level, being organizational capabilities produced by the project portfolio highlighted as an adequate representation of the portfolio outcomes. Thus, the 'organizational capabilities as portfolio results in which PPR can be assessed' is framed as such: The PPR associated to capabilities generation, i.e., the risks that affect capabilities generation; and PPR associated with the use of capabilities, i.e., the risks that might endanger adequate use of capabilities by the organization; and the organizational capabilities generated by the project portfolio leading to strategic impacts on the organization.

4.2 Project portfolio levels as risk factor sources in PPRA

The risk factors derived directly from the projects within the portfolio and from the interdependence between projects are proposed as the first level of factors to be considered in PPRA. However, other levels of influence could be incorporated into the PPRA, since, as stated by interviewee 9 "*not necessarily the operational risk of the projects is what I would do the portfolio analysis with, suddenly there are other elements that determine that [...] some very important of them are those that I can control into my portfolio and others that are business or external which I do not control; some that are due to portfolio external factors but not necessarily external to the company; others related to industrial sector; and others at macro-economic level*". This suggests the PPRA could recognize the influence of risk factors derived at the project portfolio level and derived from the organizational level (internal and external).

Also, it was emphasized the inter-relationship between risk factors levels – project, portfolio, and organization, which is reflected in the PPRA both in the influence between risk factors derived from the different levels and how risk factors derived from these levels impact the project portfolio expected results. Regarding the representation of the influence between risk factors derived from the different levels, it was mentioned that "*it is clearer in terms of delivering the capabilities; because I go from portfolio to project, and from project to portfolio, it is necessary that one does not lose sight of that integration*" (I16). Additionally, that "*at the project portfolio risk level, the first thing is the financial aspects, the financing of the portfolio. Inadequate cash flow management has an impact on the entire portfolio. In this concern, the right execution of the financial milestones of the projects is required according to the portfolio cycle*" (I17), interrelating with this, project portfolio and project level risk factors.

As to how these levels are interrelated in terms of the impact on the project portfolio, it was identified that the risk factors derived from the different levels influence the project portfolio in different types of impacts. Interviewee 17 exemplifies the interconnection between project level and portfolio level by mentioning that "there are those that are common factors between projects and that can rise to the portfolio level, or risks that by their nature are very complex or large"; while, from a broader perspective, interviewee 14 mentioned "*we value each risk factor as such, but not only associated to a single project, it may affect several and we modify the projects that are included in the portfolio*". This raises the first form of impact, which is associated with the influence on the portfolio through common risk factors of a specific subset of projects.

Other risk factors influence the portfolio's capability to produce the expected results, i.e., they have a generalized impact on all projects within the portfolio. For example, "*the issue of capacity in terms of staff, in terms of equipment, and in terms of organizational infrastructure is one that should be considered at the project portfolio level to know whether*

everything that is being planned for the project portfolio can be, or cannot be, actually implemented" (I27). Another group of risk factors impact the project portfolio through the changes generated directly on the portfolio's expected results or related to conditions regarding how the parent organization will be able to use those expected results. For instance, interviewee 6 posed that "*a risk is that what was strategic before may not remain strategic for now and that change not be transmitted to the portfolio, for instance, to suspend it at the right time*". And interviewee 7 mentioned that "*some risks are left as a go-live commitment [...] and others that the PMO can assume in stabilization. [...] I go out to operations with those risks; the company has accepted them, but the PMO must close them in the stabilization phase and deliver them to operations*".

Thus, the PPRA would have to recognize that the risk factors derived from the three identified levels are integrated into different impacts on the project portfolio – impact on a subset of projects, impact on all projects within the portfolio and, associated with how parent organization will use the portfolio results. The first two types of impact are related to portfolio's capability to produce the expected results, and the last one is associated with how the expected results will be used.

The PPRA could be oriented to establish the influence and importance of risk factors from each project portfolio level considering the extent in which these factors impact the project portfolio through their influence either on the projects or directly on the portfolio. Then, 'Project portfolio levels as risk factor sources in PPRA' is defined as another theme for PPRA which is defined as: Project portfolios are affected by a set of specific risk factors arising at the project portfolio level, as well as risk factors that emerge from the projects and programs as the operational units of the portfolio, and risk factors derived from the organizational influence, so that, PPRA should integrate the diverse ways in which these levels jointly influence the project portfolio.

Hence, considering that the integration between the risk sources from different levels would be represented in the way in which it influences the project portfolio, as well as that "*projects are grouped for a reason, so the risk assessment should be performed on that reason*" (I1) and that one of the themes for PPRA states that 'organizational capabilities as portfolio results in which PPR can be assessed'; the way in which risk factors generate different impacts on the portfolio of projects could be represented through the primary impact on the expected organizational capabilities and how the parent organization will used them (see relationship R1 in Fig. 2).

4.3 Project portfolio as the organizational unit for PPRA

In line with what has been identified in the literature regarding risk conceptualization perspectives (see Table 1), the interviewees put forward the risk conceptualization from different perspectives. However, they converge and emphasize that the risk approach to be adopted for PPRA should be aligned with the risk approach adopted at the organizational level. For instance, referring to the risk approach to adopt for PPRA, interviewee 16 mentioned "*it is important to make visible how the <<PPR>> approach has to be aligned with the organizational level in terms of the corporate approach that the organization takes. I believe that this link is necessary because it already recognizes the particularities of the organization [...] if one becomes detached from the other, I think there is a problem there*".

The above suggests that a first element that would allow recognizing the relationship between the project portfolio and the parent organization is the integration or transversality of the risk approach adopted. Specifically, to formalize this interconnection beyond just the risk approach to be adopted, it is proposed that the PPRA could incorporate organizational risk factors that, although not exclusively inherent to the portfolio, influence the project portfolio risk. For instance, interviewee 16 referred "*what we try to do, a little bit from experience, is to recognize from the beginning not only the risk derived from the projects but also the corporate risks that one would be accepting*". While, referring to this type of risk factor, interviewee 19 stated that "*I know that it is said that there are some portfolio inherent risks, and I wonder, what are these risks? What are the risks that are only for the portfolio, and which are aside from the whole environment in which it is being framed?*".

Thus, these organizational risk factors would make it possible to incorporate characteristics of the parent organization and its environment into the assessment, recognizing in turn, through the PPRA, that these factors associated with the organizational level influence the project portfolio risk. One of these organizational risk factors was exemplified by

interviewee 7, who mentioned that "*one that is always there and that we never included, but that, because lessons learned, we are now incorporating, is staff turnover at the organizational level, [...] it is a latent risk and for our company, it is one of the most significant risks*"; to which the interviewee 7 subsequently supplemented "*that always has an impact of slowing down the knowledge transfer when we close the projects [...] the turnover can slow down the knowledge transfer and stabilization for up to six months, so there are impacts that we already know about*".

This suggests that organizational risks not solely influence how the project portfolio is executed, but also influence how it delivers or transfers results to its parent organization. That is, recognizing 'Project portfolio as the organizational unit for PPRA' would, in turn, lead to recognizing into PPRA the interaction between the project portfolio and its parent organization arising from the delivery or transfer of results, i.e., arising from the delivery organizational capabilities. In this regard, 'organizational capabilities as portfolio results in which PPR can be assessed' would acknowledge and operationalize this kind of interaction into the PPRA (See relationship R2 in Fig. 2).

Another aspect that would allow recognizing the interaction between the project portfolio and its parent organization is evidenced "*When I have internal resources, especially staff, I have a problem in terms of the fact that the staff will continue in their regular duties and they will participate in the portfolio, in one or more of the projects they are involved in. And there I have a risk in terms of the portfolio versus operation. They are going to have two bosses, and each one is going to pull in their own direction, and if another portfolio appears in which they also have to participate, then the risk level that I have in my portfolio will become more and more entangled*" (I1).

In this regard, interviewee 14 mentioned, "*if we are talking about a small company, with authoritarian leaders, for example, where there is no leadership model that allows these issues to flow more generally within the organization and that they are being worked on permanently, then the <<project portfolio>> risk increases*". That is, project portfolio interaction with other organizational units can generate some risk factors for the project portfolio, so that, how this type of risk factors influences the project portfolio could be explored into PPRA. In this regard, organizational factors related to organizational culture, the current digital context, and strategic management were emphasized by the interviewees, and therefore, could be explored into PPRA.

Based on what has been described above, the 'project portfolio as the organizational unit for PPRA' is defined explicitly as a theme to be integrated into the design and analysis of the PPRA. This theme is defined as: the PPRA should recognize the organizational risk approach and its implications for PPRA, as well as acknowledge the interaction between project portfolio and the organization's processes and the influence of the organizational risk factors in the PPR.

In addition, considering 'project portfolio as the organizational unit for PPRA' implies recognizing that risk factors derived from the organizational level can influence the project portfolio results, which implies their incorporation into PPRA to provide a comprehensive assessment. This is reflected in the inclusion of such factors as one of the 'project portfolio levels as risk factor sources in PPRA'. Considering the above, a relationship between the themes 'project portfolio as the organizational unit for PPRA' and 'project portfolio levels as risk factor sources in PPRA' is suggested (See relationship R3 in Fig. 2).

4.4 Balance between project portfolio attributes and complexity

Attributes that have been previously recognized in the literature related to PPRA were also recognized by the interviewees. These attributes are associated to interdependencies between projects, the positive impact (opportunities) and negative impact (threats) of risk factors, and interdependencies between risks. Likewise, the fact that in PPRA, project interdependencies can be represented as part of the risk factors, was also highlighted by the interviewees.

However, interviewees highlighted as a critical issue the complexity of incorporating these attributes into PPRA. For instance, the risk interdependencies "*should only be worked on if you have a high maturity level both in the organization and in the portfolio management*" (I17). Likewise, it was also mentioned that its incorporation into the PPRA may take into account that "*The project world is dynamic, so, for me the point is in the balance in which it <<the risk assessment>> provides me with information in an agile and dynamic way and considers or not the inter-*

relationships between risks" (I17). That is, although the incorporation of these attributes in the PPRA could allow for a more detailed representation of the influence of risk factors, the incorporation of these attributes into the PPRA require to be analyzed considering the characteristics of each project portfolio and its parent organization, the complexity generated by their incorporation and the value they can add to the decision-making process.

In this regard, the considerations adopted in relation to the attributes to be incorporated in a PPRA would be reflected in the representation of how risk factors impact the expected outcomes of the project portfolio, i.e., in how PPRA represents the influence of the risk factors derived from the project portfolio levels on the expected organizational capabilities to be generated by the project portfolio (See relationship R4 in Fig. 2). In addition, from the perspective of the PPRA as a support for decision making, interviewee 9 stated that "*I do not know if it is by areas, by processes or by types of projects, but there has to be a risk classification and it has to be linked to the organization*". Therefore, the PPRA requires to be supported on a strategy for the representation or visualization of risk factors and their importance, which is in line with the decision-making processes at both the portfolio and organizational levels.

Hence, the 'balance between project portfolio attributes and complexity' is established as the fourth theme for PPRA. This theme frames project portfolio attributes such as project interdependencies, opportunities incorporation, and risk interdependencies, which have been considered as part of the PPRA in the literature. However, the complexity generated by attributes of the project portfolio may also be considered. Particular attention should be paid to the visualization of the PPRA results, since PPR visualization oriented to support decision-making adds relevance and value to project portfolio decisions when considered from the organizational perspective. Thus, it is necessary to balance the relevance, complexity, and value added of PPRA. So, the fourth theme for PPRA is posited as the extent of incorporation of project interdependencies, opportunities, and risk interdependencies is relative to the balance between relevance for the project portfolio, organizational conditions, and added value for the decision-making process at the organizational level.

5. DISCUSSION

The empirical data suggested that a comprehensive PPRA framework, which considered the inherent project portfolio characteristics, could be obtained following four interdependent themes for PPRA (See Fig. 2). Recognizing PPRA as an element of project portfolio risk management [10], the study extends understanding of PPRA based on the adoption of the project portfolio as an organizational subsystem, which recognizes both that the project portfolio seeks to deliver value to the company, as well as the portfolio interaction with the parent organization and its strategy [10], [14], [16]. Based on the comprehensive PPRA framework derived from the findings, the discussion below led to building two propositions to be considered for PPRA. However, to become more generalizable, they may require further research.

5.1 Towards a PPRA based on expected organizational capabilities generated by the portfolio

As a consequence of considering 'project portfolio as the organizational unit for PPRA', it was identified that the PPRA could represent the interaction between the portfolio and the parent organization, based on the impact of risk factors on the delivery or transfer of project portfolio results to the parent organization. Although this portfolio-organization relationship has been recognized in the general project portfolio literature [14], it has not yet been explicitly integrated into PPRA approaches. In this regard, considering 'organizational capabilities as portfolio results in which PPR can be assessed' would acknowledge and operationalize this interaction into the PPRA.

Thus, in contrast to the traditional PPRA approaches which are mainly associated, on one hand, with portfolio risk at project-level attributes such as the duration or total cost of projects [20], [21]; or on the other hand, to business-level attributes such as the influence on the expected profitability derived from the portfolio [37]; This research findings, contrast with these PPRA proposals, by identifying that PPRA could represent the impact of risk factors in terms of the way in which these factors impact the achievement of the expected organizational capabilities to be generated by the project portfolio. This raises the recognition of a construct for impact representation into risk assessment which is explicitly associated with the project portfolio level more than a general level or project level.

A PPRA oriented to assess the impact on the organizational capabilities to be generated by the project portfolio is in line with the PPRA approach in which the impact on the organization's strategic goals is assessed. In this concern, a PPRA approach based on expected capabilities does not ignore the relationship between projects within the portfolio and the organizational strategy recognized in the literature [22], but it would recognize that strategic impacts are the result of the parent organization's management of the organizational capabilities generated by the project portfolio.

The above means that risk impact on a set of organization's strategic goals could be assessed based on the direct impact on the expected organizational capabilities to be generated by the project portfolio, impact that, later, is transferred to the strategic goals. This perspective allows to assess the portfolio risk based on the portfolio's expected results from the organizational perspective, i.e., directly on how the project portfolio delivers value to the parent organization – the expected organizational capabilities. Thus, this research extends that concept as a construct for the primary representation of PPRA outcomes.

In addition, according to Serra and Kunc [54], strategic impacts derived from projects within the portfolio are mediated by other factors which cannot be exclusively associated with the project portfolio, but rather with organizational, operational, or strategic factors. Hence, PPRA based on expected organizational capabilities would recognize that, although there is a relationship between portfolio and strategy, assessing risk directly on the expected strategic impacts would involve more than just assessing the risk of the project portfolio. Thus, this insight led to the first proposition:

Proposition 1: The capabilities to be generated by the project portfolio can be used as the portfolio primary results on which PPRA can assess the risk of the project portfolio, establishing the impact of PPR on the project portfolio value delivering to the parent organization.

5.2 Incorporating into PPRA diverse risk factor impacts

PPRA approaches have mainly focused on an inward risk assessment considering in most cases only the risk derived from projects and their interdependencies [8], [37]. In this concern, for instance, the literature has identified that the interdependence between risk factors influences the extent to which outputs are impacted [55], [56]. Likewise, current PPRA approaches suggest that project interdependencies represent project-derived risk factors which, in turn, influence both the projects and project portfolio expected outputs [12], [37]. These types of considerations typically addressed into PPRA were represented, according to the interviews analysis, in the theme 'balance of project portfolio attributes and complexity'.

However, although the literature recognizes that project portfolios are not an isolated element of its parent organization [14], [32], and that the study of risk factors at project portfolio level has recently been called upon [12], [57], PPRA approaches that comprehensively incorporate the influence of risk factors of an organizational nature, as well as those derived at the project portfolio level, as highlighted by interviewees, has been scarcely explored.

In this regard, according to the comprehensive framework for PPRA here presented, the deviation of the results derived from the project portfolio levels could lead to different impacts on project portfolio expected results. In this concern, the deviation between expected capabilities and realized capabilities provided by the project portfolio could be associated with both risk factors related to the capabilities development process and risk factors related to the preparation of the parent organization to use them. In this regard, the way in which capabilities are developed leads to generating the expected outputs, while the use of them to produce strategic benefits embodies the portfolio outcomes. The above is in line with the fact that project portfolios aim to achieve desired mid- or long-term outcomes [18].

Thus, analogous to the project-level analysis made by Serra and Kunc [54], but considering the project portfolio level, it is posed that deviations derived from both project portfolio outputs and outcomes may lead to not achieving the expected impacts on the parent organization. Therefore, both risk factors associated with the project portfolio outputs and outcomes could impact on project portfolio expected results, so that, both kinds of risk factors should be incorporated into risk assessment. Output-related risk factors are associated to impacts on the projects within the project portfolio that affect the organizational capabilities expected to be developed. Outcome-related risk factors are associated

with impacts on the use of the capabilities by the parent organization to produce the expected strategic benefits. Then, this insight led to the second proposition:

Proposition 2: The risk factors that impact the project portfolio expected results can be represented into PPRA as 'output-related' risk factors and 'outcome-related' risk factors.

6. Conclusion

Based on empirical evidence from project portfolio practitioners this study provides a conceptualization of PPRA considering the organizational perspective of the project portfolios. The study has identified four interrelated themes for a comprehensive PPRA: 'organizational capabilities as portfolio results in which PPR can be assessed'; 'project portfolio levels as risk factor sources in PPRA'; 'project portfolio as the organizational unit for PPRA'; and 'balance between project portfolio attributes and complexity'. These themes guide the design of PPRA for both scholars and practitioners.

This study contributes to existing knowledge by explicitly recognizing these four themes for PPRA, which have yet to be comprehensively recognized in the literature. Additionally, the two propositions for PPRA require further research to become more generalizable.

In this regard, new pathways are therefore open for further research, like the representation of risk factors influence on these expected organizational capabilities to be generated by the project portfolio, as well as the representation and assessment of the influence generated on strategic objectives derived from the risk impacts on these expected capabilities. Thus, for example, capability-based approaches, in which organizational capabilities are recognized as organizational competitive advantages, could be explored to be integrated in conceptualizing and operationalizing specific designs of PPRA proposals.

However, as in the study carried out by Van der Hoorn and Whitty [58], this study identified that theoretical and practical contributions are tempered regarding the qualitative nature of the study and the characteristics of the sample. In this concern, quantitative and qualitative studies are necessary to explore each PPRA theme addressed in this study further. In addition, research based on case studies could explore each established theme and its implications in depth.

As part of the theme "Project portfolio as the organizational unit for PPRA," organizational aspects were identified as influencing PPRA. In this concern, the authors of this research note that PPRA could be positively influenced in organizations whose risk management systems are more robust and have been internalized by the stakeholders. So, it is expected that differences in organizational aspects could influence how PPRA is conducted. Although the authors did not particularly perceive differences in PPRA due to, for instance, cultural differences, this aspect is worth exploring in further studies.

Furthermore, project portfolio managers were interviewed in this study, which, according to Teller [36], can represent a single informant bias. Therefore, further studies could be oriented to acquire a multi-perspective set of data from other portfolio stakeholders, for instance, research based on multi-stakeholder interviews or research based on case studies exploration. Each theme established for a comprehensive PPRA could then be analyzed to identify the key stakeholders and their roles.

Acknowledgments

This research was sponsored by Colfuturo-Colciencias, Colombia and by FEDER funds through the program COMPETE –Programa Operacional Factores de Competitividade– and by national funds through FCT –Fundação para a Ciência e a Tecnologia–, under the remit of projects UIDB/00285/2020 and UIDB/00319/2020. The authors gratefully acknowledge the contributions of the twenty-eight interviewees who participated in the study.

References

[1] M. Hofman, S. Spalek, and G. Grela, "Shedding New Light on Project Portfolio Risk Management," *Sustainability*, vol. 9, no. 10, p. 1798, 2017.

[2] C. Micán, G. Fernandes, and M. Araújo, "Modeling the Risk of an Organizational Development Portfolio," *Procedia Computer Science*, no. *219*, pp.1930–1937, 2023.

[3] M. Ebnerasoul, S. F. Ghannadpour, and A. Haeri, "A collective efficacy-based approach for bi-objective sustainable project portfolio selection using interdependency network model between projects," *Environment, Development and Sustainability*, vol. 25, no.12, pp.13981–14001, 2023.

[4] M. Martinsuo, and T. Ahola, "Multi-project management in inter-organizational contexts." *International Journal of Project Management*, Vol. 40, No. 7, pp.813–826, 2022.

[5] M. Martinsuo, and R. Anttila, "Practices of strategic alignment in and between innovation project portfolios," *Project Leadership and Society*, Vol. 3, p.100066, 2022.

[6] L. Bai, J. Bai, and M. An, "A methodology for strategy-oriented project portfolio selection taking dynamic synergy into considerations," *Alexandria Engineering Journal*, Vol. *61, no.* 8, pp.6357–6369, 2022.

[7] J. Teller and A. Kock, "An empirical investigation on how portfolio risk management influences project portfolio success," *International Journal of Project Management*, vol. 31, no. 6, pp. 817–829, 2013.

[8] X. Zou, Q. Yang, Q. Wang, and B. Jiang, "Measuring the system resilience of project portfolio network considering risk propagation," *Annals of Operations Research*, pp. 1–29, 2022.

[9] R.W.R. EMITA, R. Kusters, I.H. and Martin, I.H., "Relationships between IT Project Portfolio risk and IT Project Portfolio health." in *2023 IEEE 25th Conference on Business Informatics*, Institute of Electrical and Electronics Engineers Inc., pp. 1–10. IEEE.

[10] PMI, *The Standard for Portfolio Management*, Fourth Ed. Project Management Institute, Inc., 2017.

[11] L. Bai, C. Song, X. Zhou, Y. Tian, and L. Wei, "Assessing project portfolio risk via an enhanced GA-BPNN combined with PCA," *Engineering Applications of Artificial Intelligence*, Vol. *126*, p.106779, 2023.

[12] F. Ghasemi, M. H. M. Sari, V. Yousefi, R. Falsafi, and J. Tamošaitienė, "Project Portfolio Risk Identification and Analysis, Considering Project Risk Interactions and Using Bayesian Networks," *Sustainability*, vol. 10, no. 5, p. 1609, 2018.

[13] R. Han, Z. Shen, and X. Li, "A Two-Stage Method for Strategy-Oriented Dynamic Project Portfolio Selection Considering Project Substitution," *IEEE Transactions on Engineering Management*, In press, 2023.

[14] M. Martinsuo and J. Geraldi, "Management of project portfolios: Relationships of project portfolios with their contexts," *International Journal of Project Management*, vol. 38, no. 7, pp. 441–453, 2020.

[15] V. F. Dias, and A. B. Tenera, "An agile portfolio management model for the insurance sector: the APMI model," *International Journal of Information Systems and Project Management*, Vol. 11, no. 2, pp. 81–99, 2023.

[16] L. Wang, M. Kunc, and L. Jianping, "Project portfolio implementation under uncertainty and interdependencies: A simulation study of behavioural responses," *Journal of the Operational Research Society*, vol. 71, no. 9, pp. 1426–1436, 2020.

[17] L. Bai, Y. An, and Y. Sun, "Measurement of Project Portfolio Benefits With a GA-BP Neural Network Group," *IEEE Transactions on Engineering Management*, pp. 1–13, 2023.

[18] S. Richard, R. Pellerin, J. Bellemare, and N. Perrier, "A business process and portfolio management approach for Industry 4.0 transformation," *Business Process Management Journal*, vol. 27, no. 2, pp. 505–528, 2021.

[19] J. Tamošaitienė, V. Yousefi, and H. Tabasi, "Project portfolio construction using extreme value theory," *Sustainability*, vol. 13, no. 2, p. 855, 2021.

[20] A. Ahmadi-Javid, S. H. Fateminia, and H. G. Gemünden, "A Method for Risk Response Planning in Project Portfolio Management," *Project Management Journal*, vol. 51, no. 1, pp. 77–95, 2020.

[21] Q. Yang, X. Zou, Y. Ye, and T. Yao, "Evaluating the criticality of the product development project portfolio network from the perspective of risk propagation," *A: Statistical Mechanics and its Applications*, vol. 593, p. 126901, 2022.

[22] L. Bai, X. Han, H. Wang, K. Zhang, and Y. Sun, "A method of network robustness under strategic goals for project portfolio selection," *Computers & Industrial Engineering*, vol. 161, p. 107658, 2021.

[23] C. Micán, G. Fernandes, and M. Araújo, "A method for project portfolio risk assessment considering risk interdependencies - A network perspective," *Procedia Computer* Science, vol. 196, pp. 948–955, 2022.

[24] K. Zhang, L. Bai, X. Xie, and C. Wang, "Modeling of risk cascading propagation in project portfolio network," *Physica A: Statistical Mechanics and its Applications*, Vol. *612*, p.128450, 2023.

[25] S. Elonen and K. A. Artto, "Problems in managing internal development projects in multi-project environments," *International Journal of Project Management*, vol. 21, no. 6, pp. 395–402, 2003.

[26] C. Micán, G. Fernandes, and M. Araújo, "Incorporating the Influence of Risk Factor Interdependencies and Shared Risk Factors into Project Portfolio Risk Assessment," in *2021 IEEE International Conference on Industrial Engineering and Engineering Management, IEEM 2021*, Institute of Electrical and Electronics Engineers Inc., 2021, pp. 994–998.

[27] N. Loperfido, and T. Shushi, "Optimal portfolio projections for skew-elliptically distributed portfolio returns,". *Journal of Optimization Theory and Applications*, Vol. *199, no.* 1, pp.143–166, 2023.

[28] H. Sanchez and B. Robert, "Measuring portfolio strategic performance using key performance indicators," *Project Management Journal*, vol. 41, no. 5, pp. 64–73, 2010.

[29] J.-P. Paquin, C. Gauthier, and P. P. Morin, "The downside risk of project portfolios: The impact of capital investment projects and the value of project efficiency and project risk management programmes," *International Journal of Project Management*, vol. 34, no. 8, pp. 1460–1470, 2016.

[30] H. Sanchez, B. Robert, M. Bourgault, and R. Pellerin, "Risk management applied to projects, programs, and portfolios," *International Journal of Managing Projects in Business*, vol. 2, no. 1, pp. 14–35, 2009.

[31] C. Micán, G. Fernandes, and M. Araújo, "Project portfolio risk management: A structured literature review with future directions for research," *International Journal of Information Systems and Project Management*, vol. 8, no. 3, pp. 67–84, 2020.

[32] L. Bai, K. Zhang, H. Shi, M. An, and X. Han, "Project Portfolio Resource Risk Assessment considering Project Interdependency by the Fuzzy Bayesian Network," Complexity, pp 1-21, 2020.

[33] J. Teller, A. Kock, and H. G. Gemünden, "Risk management in project portfolios is more than managing project risks: A contingency perspective on risk management," *Project Management Journal*, vol. 45, no. 4, pp. 67–80, 2014.

[34] Y. Zhang, J. Liu, X. Xie, C. Wang, and L. Bai, "Modeling of Project Portfolio Risk Evolution and Response under the Influence of Interactions," *Mathematics*, Vol. 11, no. 19, p. 4091, 2023.

[35] M. Hofman and G. Grela, "Project portfolio risk categorisation – Factor analysis results," *International Journal of Information Systems and Project Management*, vol. 6, no. 4, pp. 39–58, 2018.

[36] J. Teller, "Portfolio risk management and its contribution to project portfolio success: An investigation of organization, process, and culture," *Project Management Journal*, vol. 44, no. 2, pp. 36–51, 2013.

[37] D. Guan, P. Guo, K. W. Hipel, and L. Fang, "Risk reduction in a project portfolio," *Journal of Systems Science and Systems Engineering*, vol. 26, no. 1, pp. 3–22, 2017.

[38] N. G. Hall, D. Z. Long, J. Qi, and M. Sim, "Managing Underperformance Risk in Project Portfolio Selection," *Operations Research*, vol. 63, no. 3, pp. 660–675, 2015.

[39] X. Zhang, M. Goh, S. Bai, Z. Wang, and Q. Wang, "Project Risk Response Decision Making Under Uncertain Project Interdependencies," *IEEE Transactions on Engineering Management*. In press, 2023

[40] H. Sanchez and B. Robert, "A matrix for monitoring the strategic performance of project portfolios," *International Journal of Project Organisation and Management*, vol. 2, no. 2, p. 135, 2010.

[41] S. Floricel and M. Ibanescu, "Using R & D portfolio management to deal with dynamic risk," *R&D Management*, vol. 38, no. 5, pp. 452–467, 2008.

[42] H. Li, R. Chen, and X. Zhang, "Uncertain Public R&D Project Portfolio Selection Considering Sectoral Balancing and Project Failure," *Sustainability*, vol. 14, no. 23, p. 15774, 2022.

[43] M. A. Saeed, H. Tabassum, M. M. Zahid, Y. Jiao, and S. Nauman, "Organizational Flexibility and Project Portfolio Performance: The Roles of Environmental Uncertainty and Innovation Capability," *EMJ - Engineering Management Journal*, vol. 34, no. 2, pp. 249–264, 2022.

[44] G. Burrell and G. Morgan, *Sociological Paradigms and Organisational Analysis. Elements of the sociology of corporate life*. Routledge Taylor & Francis Group, 2019.

[45] M. J. Avenier, "Shaping a constructivist view of organizational design science," *Organization Studies*, vol. 31, no. 9–10, pp. 1229–1255, 2010.

[46] S. A. Mohrman, "Having Relevance and Impact: The Benefits of Integrating the Perspectives of Design Science and Organizational Development," *Journal of Applied Behavioral Science*, vol. 43, no. 1, pp. 12–22, 2007.

[47] M. Saunders, P. Lewis, and A. Thornhill, *Research Methods for Business Students*, Eighth Ed. Pearson education, 2019.

[48] M. Bos-de Vos, L. Volker, and H. Wamelink, "Enhancing value capture by managing risks of value slippage in and across projects," *International Journal of Project Management*, vol. 37, no. 5, pp. 767–783, 2019.

[49] K. Mac Donald, D. Rezania, and R. Baker, "A grounded theory examination of project managers' accountability," *International Journal of Project Management*, vol. 38, no. 1, pp. 27–35, 2020.

[50] C. Tam, E. J. da C. Moura, T. Oliveira, and J. Varajão, "The factors influencing the success of on-going agile software development projects," *International Journal of Project Management*, vol. 38, no. 3, pp. 165–176, 2020.

[51] R. Müller, N. Drouin, and S. Sankaran, "Modeling Organizational Project Management," *Project Management Journal*, vol. 50, no. 4, pp. 499–513, 2019.

[52] G. Terry, N. Hayfield, V. Clare, and V. Braun, "Thematic analysis," in *The SAGE Handbook of Qualitative Research in Psychology*, 2017, pp. 17–36.

[53] V. Braun, V. Clarke, N. Hayfield, and G. Terry, "Thematic analysis," in *Handbook of Research Methods in Health Social Sciences*, P. Liamputtong, Ed., Springer, 2019, pp. 843–860.

[54] C. E. M. Serra and M. Kunc, "Benefits Realisation Management and its influence on project success and on the execution of business strategies," *International Journal of Project Management*, vol. 33, no. 1, pp. 53–66, 2015.

[55] X. Zou, Q. Yang, and Q. Wang, "Analysing the risk propagation in the project portfolio network using the SIRF model," *ICORES 2021 - Proceedings of the 10th International Conference on Operations Research and Enterprise Systems*, pp. 226–232, 2021.

[56] Q. Wang, G. Zeng, and X. Tu, "Information Technology Project Portfolio Implementation Process Optimization Based on Complex Network Theory and Entropy," *Entropy*, vol. 19, no. 6, p. 287, 2017.

[57] M. Hofman and G. Grela, "Project portfolio risk identification-application of Delphi method," *Journal of Business and Economics*, vol. 6, no. 11, pp. 1857–1867, 2015.

[58] B. van der Hoorn and S. J. Whitty, "The five modes of comportment for project managing: Disclosing the tacit in project work," *International Journal of Project Management*, vol. 37, no. 3, pp. 363–377, 2019.

Appendix 1. Codes, sources, and references

Codes	Codes description	Sources	References
Risk and uncertainty approach			
PPR meaning	Means and definitions of PPR or risk and uncertainty in portfolio context.	14	21
Organizational risk	Relationship between PPR approach and organizational risk approach adopted.	5	8
Implications	Impacts of PPR approach on decision-making related to project portfolio.	7	9
Opportunities incorporation			
Relevance	Reason(s) why it is important to consider opportunities in a PPRA.	17	20
Complexity	Concerns and considerations regarding value added and difficulties when opportunities are incorporated.	10	11
Portfolio operational risk and risk in the portfolio business phase			
Organizational perspective	Scope of project portfolio in the organizational context and the perception of PPR in that context.	16	23
Risk factor sources	Project portfolio phases are in themselves sources of risk for project portfolio.	12	16
Risk assessment points	Expected results of each phase and the impact of PPR on them.	9	14
Other factors	Influence of factors external to project portfolio on organizational measures of portfolio impact.	5	7
Impact on higher levels			
Organizational strategy	Strategic expected results as a possibility of representation of PPR impact.	14	20
Capabilities generated	Capabilities generated by project portfolio as a direct result with which risk can be assessed.	7	10
Impact representation	PPR representation or visualization oriented to support decision-making process.	13	20
Project interdependencies			
Interdependencies as a risk	Relevance of interdependencies between projects for PPRA and their representation as a source of PPR.	13	17
Source of complexity	Concerns about complexity generated by project interdependencies representation in PPRA.	7	10
Organizational issues	The influence of interdependencies between the projects and the organizational processes (areas) on PPR.	9	11
Threats/opportunities interdependencies			
Relevance and complexity	Relevance and complexity of incorporating risk interdependencies in a PPRA and the complexity generated.	13	17
Second level	Incorporation of risk interdependencies conditioned to the incorporation of other attributes, such as project interdependencies.	4	4
Relation of risk among portfolio levels			
Interaction between levels	Different levels identified from portfolio as an organization and relationships between these levels.	11	15
Projects and programs risk	Projects and programs as an operational level of project portfolio representing a primary source of PPR.	11	15
Portfolio risk	Risks at project portfolio level represent more than the	9	12

Codes	Codes description	Sources	References
	sum of risks derived from projects and programs.		
Risk derived from organization	Risk derived from organization as an external source of risk for project portfolio and its interrelation with PPR.	13	15
Environmental characteristics			
Strategic management	Influence of strategic context on PPR and strategic management as a bridge between organizational context and project portfolio.	10	13
Technological context	Importance of issues related to current technological context of a PPR.	8	13
Organizational culture	Organizational culture and its relationship with aspects related to PPR.	9	10
Project portfolio and organizational processes			
Risk management process	Organizational risk management processes as a basis for PPRA.	10	14
Processes influence	Influence of characteristics of organizational processes on PPRA.	18	24

Biographical notes

Camilo Micán
Camilo Micán is an Industrial Engineering from Universidad del Valle (Colombia), holds a master's in engineering from the same university, and a Doctorate in Industrial and System Engineering of the University of Minho (Portugal). He is an Associate Professor at the Universidad del Valle, School of Industrial Engineering. His research interests are in Project Management, Project Risk Management, Project Portfolio Management, and related topics. He is a member of the Quantitative Finance Research Group at Universidad del Valle and of the ALGORITMI Research Centre at University of Minho. Has professional experience as a project manager and consultant in projects focused on process improvement both manufacturing and service organizations.

Gabriela Fernandes
Gabriela Fernandes is Professor at the Faculty of Sciences and Technology, and Pro-rector for the Entrepreneurship and Promotion of Institutional Projects at University of Coimbra. Her research interests are in Organizational Project Management and Innovation Management, particularly in the University-Industry R&D Collaborations context. She spent 10 years in the coordination and management of projects in different industries. Throughout her career, she served as an Executive Director. She developed and taught several project management training courses and as a consultant, coordinated the implementation of project management systems and project management office structures. She is author of highly ranked international journals in a total of more than hundred publications, including the book edition "Managing Collaborative R&D Projects: Leveraging Open Innovation Knowledge-Flows for Co-Creation".

Madalena Araújo
Madalena Araújo is a Chemical Engineer and holds M.Sc. in Industrial Management and Ph.D. in Production Engineering, both from Birmingham University (U.K.). She is Full Professor on Industrial and Technology Management at Minho University (Portugal), Production and Systems Department, School of Engineering. She is leader of the Industrial Engineering and Management Research Line of ALGORITMI Research Centre. Her research interests are on Economics of Engineering Systems and Management, mainly Decision and Utility Modelling, Project Evaluation and Management, Risk Analysis and their applications. She authored and coauthored over a hundred papers and supervised few dozen M.Sc. dissertations and Ph.D. theses.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

The impact of Project Management Offices on organizational performance: a comprehensive review of the literature

Rahmad Syalevi
Faculty of Computer Science, Universitas Indonesia
Depok, Indonesia
rahmadsyalevi@gmail.com

Teguh Raharjo
Faculty of Computer Science, Universitas Indonesia
Depok, Indonesia
teguhr2000@gmail.com

Wahyu Setiawan Wibowo
Faculty of Computer Science, Universitas Indonesia
Depok, Indonesia
wahyusetiawanwibowo@gmail.com

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

Rahmad Syalevi, Teguh Raharjo, Wahyu Setiawan Wibowo, "The impact of Project Management Offices on organizational performance: a comprehensive review of the literature", *International Journal of Information Systems and Project Management*, vol. 12, no. 3, pp. 72-94, 2024.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

The impact of Project Management Offices on organizational performance: a comprehensive review of the literature

Rahmad Syalevi
Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia
rahmadsyalevi@gmail.com

Teguh Raharjo
Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia
teguhr2000@gmail.com

Wahyu Setiawan Wibowo
Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia
wahyusetiawanwibowo@gmail.com

Abstract:
In today's dynamic environment, information technology (IT) stands as the cornerstone for organizational success and competitive advantage, with project management playing a crucial role in efficiently deploying IT resources. Recognized across diverse sectors like telecommunications, aerospace, and construction, Project Management Offices (PMOs) facilitate task organization and supervision, whether it is for IT product development, service improvement, system design, or implementing organizational changes. Despite extensive research on the positive impact of PMOs on organizational performance, a significant research gap exists due to the absence of a direct comparison between the influence of PMOs on IT and non-IT industries, indicating the necessity for further investigation in this domain. This study delves into the contribution of PMOs to organizational performance using the Competing Values Framework and evaluates five models and 17 performance metrics within the IT industry and across sectors. When comparing PMO performance, non-IT sectors precede interpersonal relationships, competency-based training, and workplace environment, whereas IT sectors emphasize the knowledge of PMO resource teams, efficient training, technology utilization, and collaboration for project success. Additionally, IT industries underline the role of technology in averting project management failures and prioritizing the punctual delivery of client requirements. These differences highlight the variations in PMO priorities between these industries, underscoring the significance of PMOs in enhancing organizational performance.

Keywords:
project management office; PMO; information technology; organizational performance; systematic literature review; competing values framework.

DOI: 10.12821/ijispm120304

Manuscript received: 31 October 2023
Manuscript accepted: 12 April 2024

1. Introduction

In this rapidly advancing Era, the significance of information technology (IT) cannot be overstated, as it serves as a vital catalyst for organizational success and competitive advantage [1]. IT has transformed how businesses work, allowing them to streamline procedures, increase productivity, and make more informed decisions. With the rapid evolution of IT, companies may use data analytics to acquire essential insights into customer behavior, market trends, and internal processes [2], [3]. Khin et al. [2] demonstrate the use of artificial intelligence (AI) technology as a unique digital solution within market intelligence software. This technology connects smoothly with organizations, allowing them to identify prevailing trends among their target clientele. As a result, it enables firms to modify their product offerings to fit these trends efficiently, boosting their market competitiveness. In their study, Shen et al. [4] reveal the tactics used by airlines to gain a competitive advantage, allowing for the seamless integration of operational procedures. This integration, in turn, helps to improve aircraft utilization efficiency, knowledge development, data integration, and personnel productivity. Thus, managing IT-related projects and initiatives becomes crucial to harnessing the full potential of these technological advancements in enhancing organizational efficiency and competitiveness.

Project management has become critical in efficiently deploying IT resources [5]. Organizations acknowledge its importance in task structuring and oversight, whether for IT product development, service development, information system design, or organizational change implementation. As a result, IT has emerged as a critical domain for implementing project management, spawning significant interdisciplinary research at the IT-project management confluence [6], [7], [8]. In the realm of IT project management, previous research has highlighted that organizations place significant emphasis on four key aspects: project people management, IT project knowledge management, IT project control management, and ensuring the attainment of optimal project performance [5], [9], [10]. Numerous organizations have established specialized PMOs dedicated to overseeing and coordinating IT-related endeavors. PMOs can embrace sustainable project management approaches by upholding methodologies or standards, executing strategies, facilitating benefit realization management, managing human resource development & training, offering project assistance, and handling knowledge management [11]. IT-focused PMOs are pivotal in ensuring that IT projects are harmonized with business strategies and contribute to the organization's overall performance [6], [12].

Initially developed within the IT sector, PMOs are now in various industries that demand technology and engineering projects, including telecommunications, aerospace, and construction [13]. The primary goals of IT PMOs are typically to improve project success by implementing effective project management methods, to provide support for IT projects, to manage multiple projects efficiently, to increase project delivery effectiveness, and to centralize decision-making authority in project management-related activities [14]. Santos & Varajão [15] emphasized the role of PMOs in public administration as a shared service. PMOs serve a dual purpose within universities by executing projects and identifying and capturing new ones [7]. Additionally, when universities collaborate with the industry, they are expected to establish a PMO to oversee research and development initiatives and projects [16]. In the construction and engineering sector, the suggested PMO aims to provide templates, optimal approaches, training, project data centralization, and knowledge exchange. Its primary future goals involve increasing the number of employees with project management training and tailoring project management methodologies to project complexity [6], [17]. In summary, while PMOs share common underlying objectives across sectors, their specific roles and goals may alter to meet each industry's unique needs and difficulties. PMOs serve as a central hub for project management, assisting organizations in meeting their objectives by promoting efficient and successful project implementation.

Although multiple studies have thoroughly examined the beneficial effect of PMOs on organizational performance [8], [18], [19], a substantial research gap exists in the current literature as no research has been conducted to directly compare the influence of PMOs on IT and non-IT industries. This gap indicates that, despite a wealth of research confirming the benefits of PMOs across sectors, there is a scarcity of studies comparing the impact of PMOs in the context of IT and non-IT sectors. Addressing this gap could lead to a better understanding of the role of PMOs in various industry settings. Aubry & Hobbs [20] presented the Competing Values Framework (CVF) [21] as an approach for analyzing PMO performance, and multiple studies [19], [21], [22] have effectively utilized this approach for evaluating PMO performance. This framework is based on 17 distinct criteria divided into three key dimensions: the structural dimension

(emphasizing the balance of flexibility and control), the focus dimension (emphasizing the balance of internal and external considerations), and the dimension of purpose and direction. The CVF is not a static performance measurement instrument but a dynamic process that promotes trust and a shared understanding of a PMO's expected contribution to overall success [23]. These criteria, indicators, and a multicriteria decision support method were valuable in constructing a performance evaluation model for PMOs [19].

Thus, this study postulates the following research question: How does the influence of PMOs on organizational performance differ between IT and non-IT industries, and what factors contribute to these distinctions?

The subsequent sections of this paper are organized as follows: Section 2 offers background information and a review of related research. In Section 3, the authors detail the research methodology employed. Section 4 presents the study's outcomes. Lastly, Section 5 comprises the conclusion and outlines directions for future research.

2. Literature Review

2.1 Project Management Office (PMO) and Organizational Performance

A PMO is a well-recognized entity established to address specific organizational needs by enhancing project management and aligning it with corporate strategy [8], [19]. PMOs have varied primary focuses, including project monitoring, progress reporting, and method development [24]. They also promote standardization and resource-sharing in project management, boosting efficiency [25].

Research on PMOs spans areas like project success, organizational performance, and PMO models [14], [20], [22], [23], [25], [26]. PMOs are acknowledged for driving project success and improving organizational performance. In the IT sector, PMOs are seen as tools to refine project management, ensuring structured project objectives, resource allocation, and monitoring [12], [20], [25], [26].

The presence of a PMO and its maturity level can impact organizational performance, a subjective metric with varying interpretations among different stakeholders [27]. Aubry & Hobbs [20] have suggested the adoption of the CVF to assess PMO performance [20], [21]. This framework, encompassing 17 criteria categorized into three dimensions: structure (balancing flexibility and control), focus (considering internal and external aspects), and purpose & orientation, enables a holistic evaluation of PMO performance, fostering dialogue among stakeholders with diverse values and perspectives [19]. Furthermore, to refine the assessment of PMO performance, Aubry & Hobbs [20] have employed five distinct models, namely human resources, internal processes, rational goals, open systems, and output quality, as proposed by Quinn and Rohrbaugh [21]. These models provide specific and concrete indicators, as illustrated in Figure 1, for evaluating different facets of PMO performance, emphasizing aspects such as human resource management, internal processes, goal setting, and adaptation to the external environment [20], [28]. Integrating these models within the CVF makes a comprehensive and dynamic evaluation of PMO performance possible, offering a nuanced understanding of its impact on organizational performance [19].

In the context of PMO, the instrument provided by CVF assists in highlighting paradoxes among values [20]. PMO enhances staff competencies in the *human resources* domain by aligning them with future project goals, considering employee preferences, and ensuring effective human resource management [20], [29]. The *internal process* view of organizational performance emphasizes project management and the PMO's role in managing processes. Regarding *rational goals*, project selection, portfolio, and program management recognize their role in improving organizational performance by optimizing resource allocation and utilization for higher productivity. *Open system* domain indicators prioritize flexibility, adaptation, and innovation, primarily assessing corporate growth, sales, quality outcomes, and overall effectiveness due to project benefits [20]. The criterion of *output quality* introduced by Aubry & Hobbs [20] is not directly related to any of the models, focusing instead on product quality and reflecting the satisfaction of the PMO's sponsor and its clients.

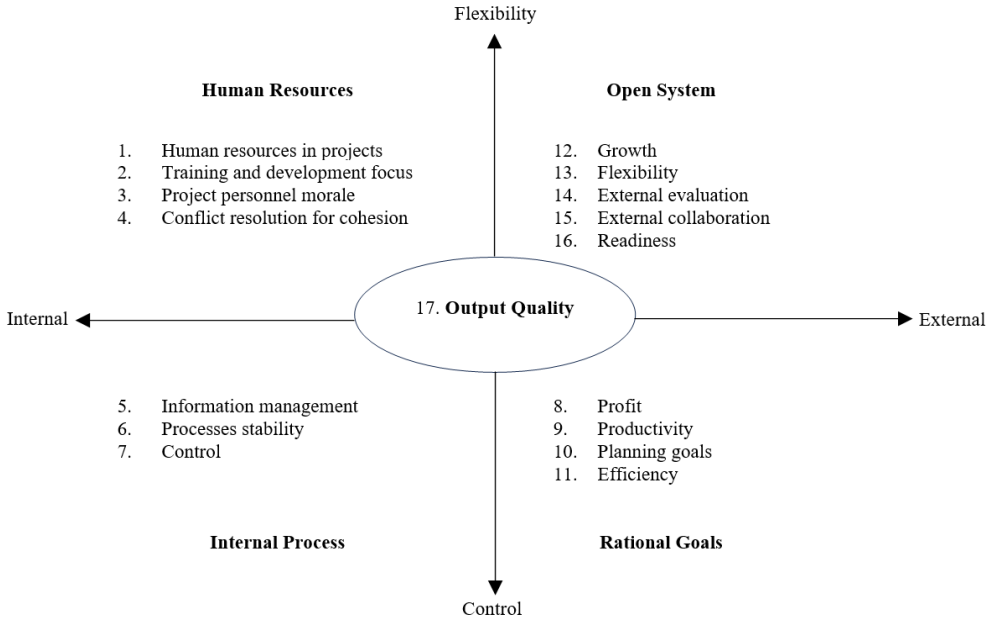


Fig. 1. Competing Values Framework proposed by Aubry & Hobbs [20]

2.2 PMO in different industries

According to Dai and Wells [18], many organizations began using PMOs in the mid-1990s. Recent polls, however, show that roughly two-thirds of big firms involved in IT-enabled business change projects and programs have now implemented some type of PMO. Due to the increasing complexity of IT projects, it is reasonable that many organizations have recognized the importance of designing and implementing a centralized set of support services for IS development activities, usually referred to as a PMO. A PMO's principal goal is to enable systematic coordination and unified administration of important project-related tasks [30].

Across all industries, the role of PMOs goes beyond ensuring successful project completion within schedule and budget [31]. Their primary focus is attaining the organization's strategic goals by aligning initiatives with broader business objectives. The significance of this function cannot be overemphasized, as the efficiency of a PMO is directly determined by project alignment with the enterprise's business objectives. According to research, the degree of strategic alignment and agreement between projects and business priorities has a statistically significant impact on the performance of a PMO [32].

Recent studies have extensively examined the impact of PMOs on organizational performance across various sectors. For instance, Dai & Wells [18] assessed different PMO functions and services, finding a positive correlation with project performance. Barbalho et al. [24] investigated PMOs in new product development (NPD), identifying performance drivers and their influence on project success. Scholars also analyzed operational transitions and PMO performance in a technology-oriented company [8]. Viglioni et al. [19] proposed a performance evaluation method for PMOs in the software industry, while Ko et al. [6] assessed PMO effectiveness in large-scale information systems and its impact on organizational performance. Kutsch et al. [30] employed the Balanced Scorecard technique to highlight PMOs' successes and failures. Conversely, Moura et al. [22] conducted a systematic assessment of PMOs, finding a significant correlation between PMOs and project performance. In summary, while recent research has extensively explored PMOs' influence on organizational performance in various sectors, there remains a notable research gap concerning direct comparisons between PMOs in the IT and non-IT sectors. Thus, further research is imperative to offer comprehensive insights into PMOs' effectiveness across diverse industry contexts.

3. Methodology

According to Kitchenham [33], a systematic literature review (SLR) is a methodology used to systematically explore, analyze, and interpret all relevant research variables that align with the research questions or topics of interest. The purpose of conducting an SLR is to gain up-to-date insights into the existing research within a specific area. A SLR, as defined by Kitchenham consists of three primary stages [33], [34], [35]: planning, conducting, and reviewing the review. To reduce bias, the authors of this study completed all three stages of the SLR and conducted inter-rater reliability evaluations during the initial and final selection phases. The authors closely adhered to the procedures in all three SLR parts, shown in Figure 2.

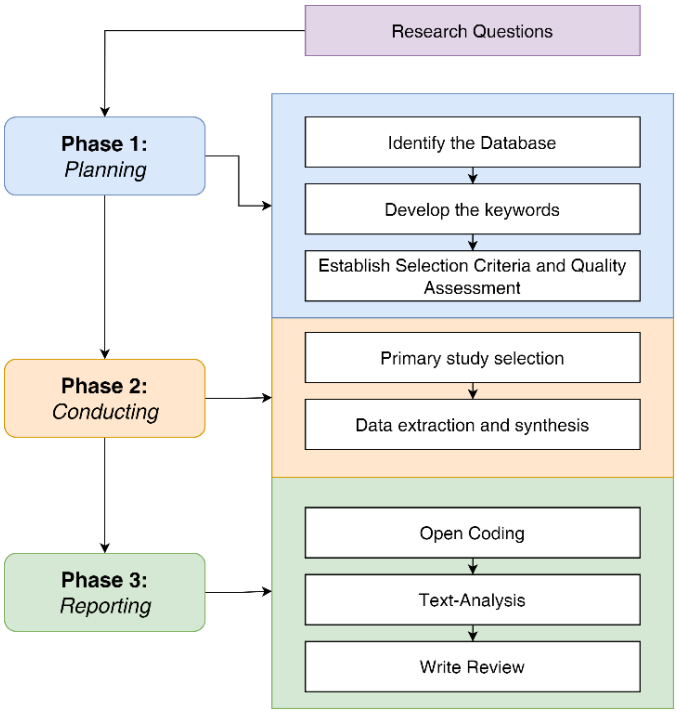


Fig. 2. SLR Methodology

3.1 Phase 1: Planning

While the impact of PMOs on organizational performance has been widely studied in earlier research [6], [8], [18], [19], [20], [22], [30], there is a compelling need for a comprehensive literature review that explicitly focuses on the performance of PMOs in both IT and non-IT industries. This SLR will provide insights into the similarities, differences, and performance implications of PMOs across IT and other domains based on a detailed analysis of existing research. The following research questions guide the research objectives of mapping studies in this field: how does the influence of PMOs on organizational performance differ between IT and non-IT industries, and what factors contribute to these distinctions?

3.1.1 Identify the Database

The data for this study is gathered using an automated search strategy. To find the most relevant literature, researchers utilize an optimized search strategy that applies a specialized search query. Eight digital repositories in total were chosen. The following digital sources have been chosen:

- ACM Digital Library;
- IEEE Explore;
- ProQuest;
- Sage Journals;
- ScienceDirect;
- Springer Link;
- Taylor & Francis;
- Emerald Insight.

3.1.2 Develop the keywords

To extract relevant literature from selected digital sources, the authors develop a streamlined search query matched to the research inquiries offered. The authors combined the keywords into search strings with the Boolean "OR" and "AND" operators. The combination of key terms was formulated as ((“PMO” OR “Project Office” OR “Project Management Office” OR “PMO Function”) AND (“Corporate” OR “Institutional” OR “Company-Wide” OR “Enterprise-level”) AND (“Effectiveness” OR “Productivity” OR “Efficiency”) AND (“Impact” OR “Effect” OR “Role” OR “Implication”)). The search keywords are then summarized in Table 1. This targeted search query was utilized to identify studies related to and applied to article titles, abstracts, and keywords.

Table 1. Category and sample search keyword

Category	**Search Keyword**
Project management office	PMO, Project Office, Project Management Office, PMO Functions
Organizational	Corporate, Institutional, Company-Wide, Enterprise-level
Performance	Effectiveness, Productivity, Efficiency
Influence	Impact, Effects, Role, Implication

3.1.3 Establish Selection Criteria and Quality Assessment

The authors followed the criteria used by other researchers to establish criteria for inclusion and exclusion [22], [36], [37], shown in Table 2.

Concurrently, the data extraction and quality assessment (QA) of the chosen papers were conducted. The authors developed a checklist for objective and subjective ratings of the key research to ensure a thorough examination. This checklist was formed following the guidelines [36] that were provided to ensure consistency and accuracy in our assessment process. Six questions were developed as QA criteria (see Table 3). The assessment was conducted by assigning a score of 1 for a comprehensive response to a checklist question, 0.5 for a partial answer, and 0 when the question was not addressed on the checklist. The quality assessment evaluates how well the chosen studies suit the study topics, and Appendix A shows the quality questions and scores of the papers included.

Table 2. Selection Criteria

Category	Criterion
Inclusion	Papers in English.
	Published from 2013 to 2023.
	Access to whole text documents from available databases.
	Studies that match the keywords within the specified search domains.
	Papers that provide empirical insight into PMOs and their impact on organizational performance.
	Conference and journal papers were peer-reviewed.
Exclusion	The papers do not discuss PMOs' impact on organizational performance in their findings.
	Papers related to organizational project management but with less focus on PMOs.
	Case studies of PMO implementation in specific contexts without a theoretical framework.
	Articles that don't match specific aspects of PMO on organizational performance based on title and abstract are excluded.
	Duplicate articles.
	Papers written in languages other than English.

Table 3. Quality assessment criteria

QA Code	Checklist of Question
QA1	Is the paper empirically supported?
QA2	Is the research's purpose clearly stated?
QA3	Was the research design acceptable for addressing the research goal?
QA4	Was the data analysis carried out with sufficient rigor?
QA5	Is there a clear presentation of the findings?
QA6	Are the limitations of the study acknowledged?

3.2 Phase 2: Conducting

3.2.1 Primary study selection

Afzal et al. [38] developed the tollgate approach, which consists of the five processes listed below, to improve the research papers identified during the primary study collection:

Step 1: Use search terms to find relevant articles.

Step 2: Article inclusion and exclusion based on title and abstract.

Step 3: Applying inclusion and exclusion criteria to articles based on the introduction and conclusion sections.

Step 4: Determine article inclusion or exclusion based on a thorough full-text review.

Step 5: Using QA criteria, finalize the selection of primary studies for inclusion in the SLR.

A search string was initially developed, and 2205 papers were obtained from selected online databases. The primary study utilized a list of 31 articles gathered through the tollgate method. Following that, a quality assessment was conducted to determine the relevant papers. The list of selected primary studies is provided in Appendix A.

3.2.2 Data extraction and synthesis

The research questions for evaluating study quality were combined with inclusion and exclusion criteria to extract the papers. This involved using inclusion and exclusion criteria based on the title and abstract, followed by inclusion and exclusion criteria based on the introduction and conclusion. Finally, inclusion and exclusion criteria are based on the complete text, and the final phase involves utilizing quality assessment criteria to finish the selection of primary studies. Next, the authors categorized the preliminary studies into two themes: PMO related to the IT industry and PMO in non-IT industries to facilitate a comparative analysis of PMO performance in both sectors. The selected articles using a tollgate approach are shown in Table 4.

Table 4. Articles are chosen using a tollgate approach

No	Database	Step 1	Step 2	Step 3	Step 4	Step 5
1	ProQuest	436	207	39	13	10
2	Sage Journals	355	155	92	26	3
3	Science Direct	255	117	85	18	5
4	Springer Link	96	72	32	15	0
5	ACM Digital	47	36	24	18	1
6	IEEE Explore	6	5	4	3	3
7	Taylor & Francis	474	215	26	13	5
8	Emerald Insight	539	319	32	26	4
	Total	**2205**	**1322**	**334**	**132**	**31**

3.3 Phase 3: Reporting

In the final phase, the authors administer open and text analysis. Open coding, a qualitative data analysis technique commonly employed in grounded theory research, seeks to develop a complete set of concepts and categories that accurately reflect the data [39]. This approach is well-suited for SLR since it aids in discovering new ideas and patterns in the literature, acting as a foundation for subsequent analysis during the research process. This method can be helpful for SLR as it identifies new ideas and trends in literature, laying the framework for further research. The data will be coded and categorized based on the CVF domain and its subdomain [20] to analyze PMO performance within the organization. NVivo will be the open coding tool used in this research.

Text data descriptive analysis is used to aid further study, with a particular emphasis on identifying differences in PMO performance between firms in the IT and non-IT sectors. The research uses NVivo treemaps, which provide a visually appealing and simply interpretable depiction of coding themes [40]. These treemaps highlight the subfactors commonly referenced in the literature, providing significant insights into the elements driving PMO performance in the IT and non-IT sectors.

4. Result and Analysis

The study's conclusion will include presenting research articles comparing PMO performance in IT and non-IT sectors using the CVF. The final selection consists of 31 papers, comprising ten conference papers and 21 journal articles. These papers will be subject to further analysis to address the research questions. Furthermore, the initial identification process for selected articles involved categorizing them based on article types and publication years. Subsequent steps aim to distinguish PMO studies in IT or non-IT sectors and streamline the classification process.

Objects of study are classified as "IT" when the research pertains to the IT sector or is associated with IT projects. Conversely, articles are labeled as "non-IT" if the investigation occurs in a general firm unrelated to the IT sector or IT

projects. The distribution of selected articles by year and type is depicted in Figure 3 and Figure 4. Figure 4 reveals that the pertinent journals for this inquiry encompass only the most recent decade.

Figure 3 indicates a notable portion of prior research concentrated on industries not related to IT. This observation underscores the extensive body of literature regarding the efficacy of PMOs in non-IT realms. Furthermore, Figure 4 delineates a fluctuating trend in scholarly articles spanning from 2013 to 2023. Although the number of articles initially surged, notably peaking in 2015, the trend has since oscillated in response to variations in publishing figures. This finding underscores the dynamic nature of research output within the specified timeframe.

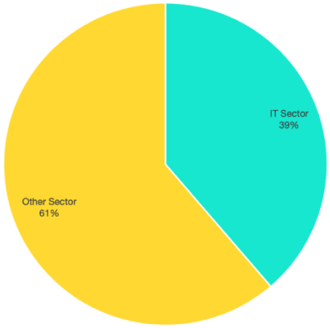


Fig. 3. Total articles by category IT and non-IT sector

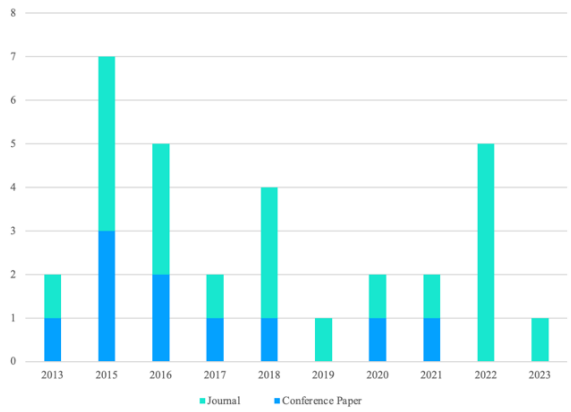


Fig. 4. Distribution of selected articles based on the year and article type

4.1 PMO performance in non-IT and IT sector with CVF

Our research successfully applied the CVF, encompassing four models: human resources conception, internal processes conception, rational goals, and open system. These models revealed various indicators within each one. In addition, the authors included an additional model, output quality, based on the work of Aubry & Hobbs [20]. However, it is unfortunate that our review did not identify any previous systematic reviews explicitly addressing the assessment by external entities in both IT and non-IT sectors, the link with internal entities in the IT sector, and readiness in non-IT sectors. This section presents a comprehensive discussion of the findings related to the factors within PMOs that influence organizational performance and addresses the research questions stated earlier. The mapping studies are shown in Table 5. To conduct this analysis, the authors utilized 17 criteria derived from the five models proposed by Aubry & Hobbs [20], [19]. The

discussion includes a comparative analysis of relevant studies, categorizing them into two groups: PMOs in general and PMOs in the IT industry. By employing this approach, the authors can provide valuable insights into the similarities and differences in the impact of PMOs on organizational performance across these two contexts. In the analysis of the results, it is evident that the most discussed article criteria center around training, information and communication management, control, productivity, planning, efficiency, and flexibility. These aspects take the forefront of discussions. Meanwhile, criteria such as stability in processes, output quality, and the value of human resources come in second place, as indicated by the number of articles addressing them.

As shown in Table 5, the study developed a comprehensive list of PMO performance criteria across enterprises, spanning both the IT and non-IT industries. A comparison between both sectors was conducted using NVivo tools to assist researchers in organizing and visualizing their findings. The references were analyzed to create a treemap, as depicted in Figure 5, illustrating the mapping of the findings.

Table 5. Mapping and categorizing studies into general PMO and IT-specific

Criteria	Freq.	Non-IT Sectors	IT Sectors
Human Resources [20]			
Value of human resources working on the project	10	[19], [31], [41], [42]	[8], [12], [17], [29], [30], [43]
Training and emphasis on development	18	[7], [13], [41], [42], [44], [45], [46], [47]	[8], [12], [17], [26], [27], [30], [48], [49], [50], [51]
Moral on project personal	2	[52]	[51]
Conflict resolution and search for cohesion	5	[13], [45], [52]	[8], [36]
Internal Processes [20]			
Information and communication management	22	[7], [13], [15], [25], [41], [42], [44], [45], [47], [53], [54]	[6], [8], [12], [17], [26], [27], [29], [30], [43], [48], [49]
Stability in processes	16	[7], [13], [15], [19], [25], [44], [45], [52], [53], [55]	[8], [12], [26], [27], [29], [43]
Control	17	[7], [13], [19], [41], [44], [45], [52], [55]	[6], [8], [17], [26], [27], [30], [43], [48], [50]
Rational Goals [20]			
Profit	5	[19], [25], [31], [53]	[17]
Productivity	17	[7], [19], [25], [32], [41], [44], [45], [47], [52], [53], [54]	[26], [27], [30], [43], [50], [51]
Planning goals to reach	17	[13], [15], [31], [32], [44], [46], [52], [54], [55]	[8], [12], [17], [26], [27], [30], [43], [56]
Efficiency	18	[7], [13], [25], [31], [32], [41], [42], [45], [46], [47], [53]	[6], [12], [17], [27], [43], [48], [49]
Open System [20]			
Growth	4	[15], [44], [55]	[8]
Flexibility/adaptation/innovation in project management	17	[13], [25], [32], [41], [45], [52], [54], [55]	[17], [26], [27], [29], [43], [48], [49], [50], [51]
Assessment by external entities	0	-	-
Links with the external environment	2	[15], [52]	-
Readiness	3	-	[30], [43], [51]
Output Quality [20]			
Output quality	14	[13], [15], [19], [42], [45], [54], [55]	[6], [8], [27], [30], [48], [49], [56]

Figure 5—NVivo treemap—reveals that the rational goal domain receives the most mentions in IT and non-IT sectors. Efficiency, productivity, planning goals, and profit emerge as essential subdomains, indicating that stakeholders prioritize these factors when assessing PMO performance. Specifically, 17 articles explore rational goals in non-IT sectors, while 13 delve into rational goals in IT sectors. The extensive research on this domain in both industries underscores its significance in shaping PMO performance strategies. Hence, acknowledging and enhancing rational goals are crucial for enhancing PMO performance across all enterprises.

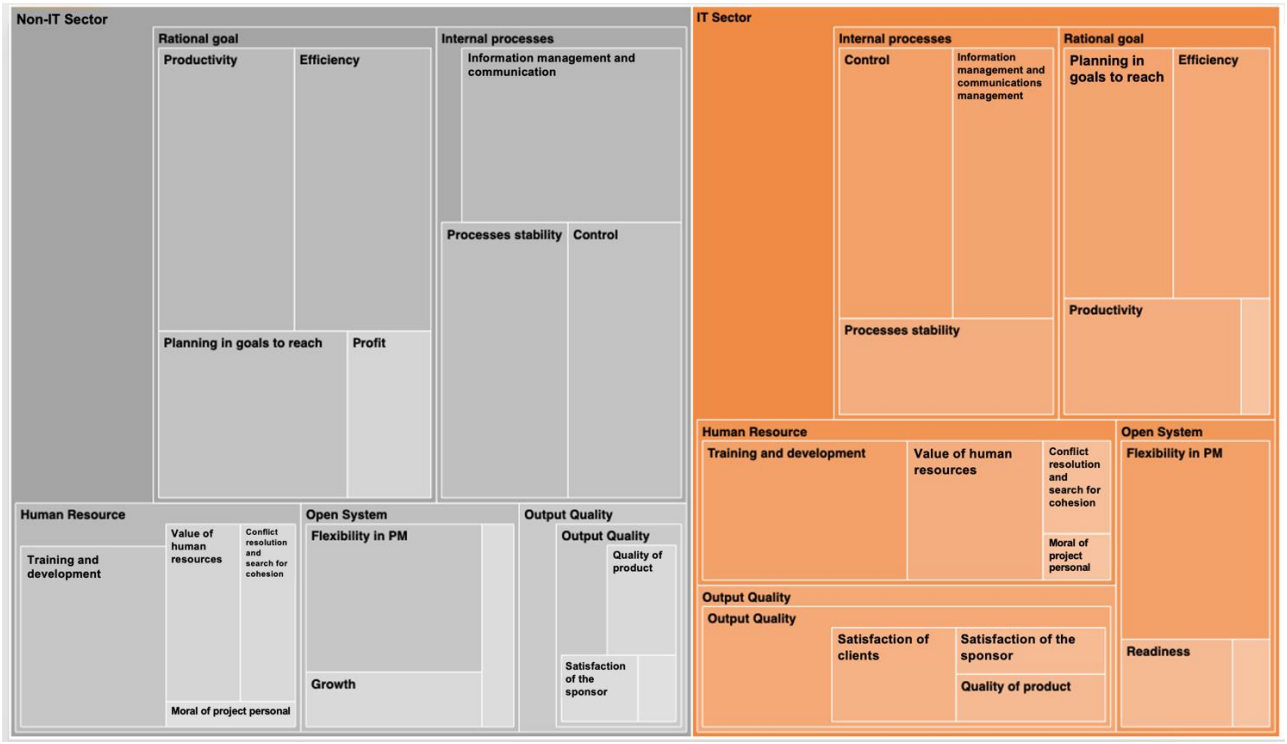


Fig. 5. Treemap of PMO performance in IT and non-IT sectors with CVF

4.1.1 The conceptualization of human resources

The value of human resources inside PMOs is underlined in the non-IT and IT industries, but the focus and emphasis differ. PMO members in the non-IT sector [19], [31], [41], [42] highlight the importance of human interactions and individual maturity for efficiency while managing workforce assets such as skills and availability. In contrast, the IT industry [8], [12], [17], [29], [30], [43] emphasizes the PMO's resource team, emphasizing the importance of their knowledge and competencies in producing value.

PMOs in non-IT and IT sectors acknowledge the importance of training and development, while their methodologies differ. PMOs prioritize human competency and support in the non-IT industry [7], [13], [41], [42], [44], [45], [46], [47], providing services such as personnel provision, training, and expert assistance for skill gaps, promoting knowledge transfer, and supporting career progression. The emphasis in the IT sector [8], [12], [17], [26], [27], [30], [48], [49], [50], [51] is on minimizing project durations and increasing efficiency through knowledge transfer. They focus on leadership development, long-term project manager training, increased PM-trained staff, and adapting efficient approaches, with digital technology playing a significant role in their operations.

Work climate difficulties in the PMO can impact morale and job satisfaction in the non-IT sector [52]. In contrast, the IT industry [51] has seen an increase in virtual teams, demanding advanced digital technologies to provide connectivity among team members and maintain productivity levels. Both sectors [8], [36], [52] emphasize the value of PMOs in conflict resolution and project management. PMO transformation addresses organizational and stakeholder disputes in the non-IT sector [13], [45], whereas PMO transitions minimize conflicts and enhance project management effectiveness.

4.1.2 Internal processes conception

Regarding information and communication management, both the non-IT and IT sectors recognize the value of PMOs in improving project management through standardized processes and reporting [7], [15], [26], [27], [41], [43], [49], [54]. They also stress the PMO's consolidation and management of project information for more outstanding communication and decision-making [8], [13], [17], [27], [30], [42], [44], [47], [53]. Furthermore, PMOs in all sectors attempt to learn from project successes and mistakes by providing written processes and recommendations for project teams to follow [13], [25], [29], [44], [45].

Regarding process stability, both the non-IT and IT sectors recognize the critical role of PMOs in standardizing procedures and enhancing project efficiency through good communication and information sharing [12], [26], [27], [29], [43], [52]. Nonetheless, in the non-IT industry [19], [44], [52], [55], PMOs are highlighted for their role in adjusting to cultural changes, leading organizational change by adopting best practices, and maintaining independence to address complicated project management difficulties. In contrast, the IT industry emphasizes the importance of PMO experiences in merging interface functions to improve collaboration [8].

There are some similarities and differences between the non-IT and IT sectors in the dimension of control. PMOs are valued in both industries [6], [7], [8], [13], [27], [30], [41], [45], [50], [55] for improving project success, organizational performance, and alignment with strategic goals. While the non-IT sector [19], [44], [52] emphasizes centralized project support, coordination, and stakeholder alignment, the IT sector [17], [26], [43], [48] emphasizes knowledge investment, adaptability to changing environments, and using PMO technologies to avoid software project management failures.

4.1.3 Rational goals

In the dimension of profit, both the non-IT and IT sectors recognize the significance of PMOs in improving project performance and promoting organizational alignment and transformation. PMO implementation in the non-IT sector [19], [25], [53] is associated with solid executive board support and considerable organizational changes. Meanwhile, the IT industry [17] emphasizes that establishing a PMO extends beyond better project management and is critical to organizational transformation and evolution.

In the productivity dimension, there are similarities and differences between the non-IT and IT sectors. Both sectors emphasize the relevance of PMOs in improving project delivery, maturity, and project management processes. While the non-IT industry [7], [32], [45], [47], [53], [54] emphasizes resource management and the strategic role of PMOs, the IT sector [26], [27], [43], [50], [51] focuses on aligning projects with business strategy, consulting, and resource support, as well as the direct impact of PMO establishment on streamlining project management and improving customer satisfaction.

In the dimension of planning goals to reach, both the non-IT and IT industries emphasize the value of PMOs in aligning projects with organizational or company objectives and the benefits of good PMO utilization. The non-IT sector [13], [15], [31], [32], [44], [52], [54], conversely, emphasizes pragmatic project planning, role adaptation, and strategic planning. In contrast, the IT sector [8], [12], [17], [26], [27], [43] emphasizes the competitive advantage achieved by aligning projects with business goals.

Regarding efficiency, both the non-IT and IT industries recognize the value of PMOs in improving project performance and efficiency. Their approaches and priorities, however, differ. The formation of PMOs for increased organizational efficiency is essential in the non-IT industry, emphasizing trust, practicality, and the role of scale in inefficiencies [7], [13], [25], [32], [41], [42], [45], [47], [53]. PMO success in the IT sector [6], [12], [43], [48], [49] is linked to efficient PMO methods, and PMO success depends on alignment with the organization's particular demands in diverse circumstances.

4.1.4 Open system

PMOs are viewed as growth accelerators in the non-IT sector [15], [44], [55], enabling agile project management and stimulating innovation. The IT sector [8] focuses on the difficulties and disagreements that develop inside a successful PMO around its growth and status.

Both industries emphasize the need for project management PMOs that balance standardization and customization. They recognize the need for adaptation in achieving project objectives. A successful PMO is crucial for Agile project management in the non-IT industry [25], [32], [41], [45], as it requires adaptive personnel for complex and small projects. It is assumed that implementing a PMO will improve project management through tools, auditing, standardization, and adaptability [13], [54]. PMOs in the IT sector [17], [26], [27], [29], [43], [49], [50], [51] assess, modify, and assist project processes while ensuring compliance using standardized methods, systems, and tools; nevertheless, a predictive approach is discouraged because it may slow down change management.

In the dimension of links with the external environment, In the non-IT sector [15], [52], PMO changes are driven by a complex combination of external influences, internal dynamics, and organizational politics, with a significant emphasis on stakeholder communication coordination. However, no information about this topic can be discovered in the IT sector. Also, there is no information on the research subject for the non-IT and IT industries regarding external entity assessment. The absence of information on external entity assessment in non-IT and IT industries could be attributable to various factors. The research may have concentrated on internal PMO performance rather than external reviews. Furthermore, it is possible that external entity assessment was not deemed critical in the industries under consideration.

Within the research subject, no information or conclusions are connected to readiness in the non-IT industry. PMOs are described in the IT sector [30], [43], [51] as responding to agile project management and focusing responsiveness to changing user needs as well as the dynamic business and project environment.

4.1.5 Output quality

There are similarities and differences between the non-IT and IT sectors regarding output quality. PMOs in the non-IT sector oversee maintaining quality, client interactions, contracts, and advising on company and supplier qualifications [15], [42], [45], [54]. They focus on standardizing processes, optimizing resources, and improving project quality to meet customer expectations [13], [19], [55]. The primary purpose of IT PMOs in the IT sector is to deliver client demands efficiently [48], [56]. Furthermore, project performance is inextricably linked to sponsor and team satisfaction, influencing management satisfaction. Notably, customer satisfaction is critical in determining project success and the structure of PMOs in the IT sector [6], [8], [27], [30], [49]. Customer satisfaction directly influences project success by meeting customer expectations, ensuring timely delivery, and staying within budget. Effective project management relies on a well-structured PMO, providing support, guidance, and resources for project teams to overcome challenges and achieve successful outcomes. The goal thus remains to optimize performance metrics like project delivery time, budget adherence, and deliverable quality. Consequently, organizations strive to cultivate high levels of customer satisfaction.

Table 6 depicts a comprehensive overview of PMO performance in various organizations, covering IT and non-IT sectors. Researchers used NVivo technologies to compare these sectors, which helped organize and visualize the results. The table summarizes the impact of PMOs in both IT and non-IT sectors.

Table 6. Summary of the impact of PMO on IT and non-IT Sector

Criteria	Non-IT Sectors	IT Sectors
Human Resources [20]		
Value of human resources working on the project	▪ PMO members emphasize the importance of human relations and individual maturity for efficiency [19]. ▪ Workforce assets, including skills and availability, significantly affect PMO efficiency, and PMO is responsible for managing these human resources [31], [41], [42].	▪ PMO's resource team is crucial for delivering value through their expertise and capabilities [8], [12], [17], [29], [30], [43].
Training and emphasis on development	▪ The PMO, emphasizing human competence and support, offers people-oriented services like staff provision, training, and expert assistance for team members with qualifications gaps [7], [13], [44], [45]. ▪ The PMO's mediation role is vital in adapting knowledge management infrastructure and processes for effective knowledge transfer [46], [47]. ▪ The PMO supports career growth and provides mentorship for implementing best project management practices from the program governance model [41], [42].	▪ Knowledge transfer among projects reduces individual project durations and total batch durations [48]. ▪ The PMO concentrates on enhancing leadership, long-term training for project managers, increasing employees with PM training, and adapting methodologies for efficiency and knowledge sharing [8], [12], [17], [26], [27], [30], [49], [50]. ▪ Digital technology plays a significant role in PMO operations [51].
Moral on project personal	▪ Work climate issues in the PMO and project-based management can harm morale and job satisfaction [52].	▪ The rise in virtual teams has created a great demand for digital technologies to link team members and allow them to stay productive [51].
Conflict resolution and search for cohesion	▪ PMO transformation resolves organizational and stakeholder conflicts, enhancing project management. It handles multi-project selection, resource allocation, coordination, and conflict resolution [13], [45], [52].	▪ PMO transitions play a role in mitigating conflicts and tensions within the organization, leading to enhanced project management performance [8], [36].
Internal Processes [20]		
Information and communication management	▪ PMOs support project managers with planning, recovery, and reporting [13], [25], [45]. ▪ They enhance project management maturity and decision-making through knowledge sharing [13], [42], [44], [47], [53]. ▪ The PMO ensures accurate project information availability through standardized reporting systems, aiding decision-making and communication across projects [7], [15], [41], [54].	▪ PMO standardizes processes and reporting for consistency, including the use of execution reports, joint meetings, one-page status reports, and earned value analysis [26], [27], [43], [49]. ▪ PMO centralizes and manages project information, facilitating communication and offering added value through data integration and administrative relief [8], [17], [27], [30]. ▪ A PMO improves project management by learning from successes and failures and providing documented processes and guidelines for project teams [29].
Stability in processes	▪ PMO should adapt to cultural changes, focus on effective processes, and lead organizational change by adopting best practices [19], [44], [52]. ▪ PMO governance can remain independent, oversee the project portfolio, and address project management complexities [44], [55]. ▪ The PMO oversees multi-project assessment, resource allocation, conflict resolution, and standardization for efficient project management and goal achievement [7], [13], [15], [25], [45], [53].	▪ PMO contributes to project success by standardizing processes, sharing valuable knowledge, and facilitating decision-making through effective communication [12], [26], [27], [29], [43]. ▪ The PMO's previous experiences influenced the integration of interfacing functions to enhance collaboration [8].
Control	▪ Focus on improving organizational performance through centralized project support and control,	▪ Adapting to changing environments requires knowledge investment and utilization [48].

Criteria	Non-IT Sectors	IT Sectors
	primarily in project performance monitoring and control [19], [44], [52]. ▪ The PMO's role involves coordinating, supporting, and controlling projects within a network of collaborating firms, identifying areas of cooperation, and defining project structures, roles, responsibilities, and stakeholders to align project managers in the organization [7], [13], [41], [45], [55].	▪ PMOs primarily aim to align project management with strategic goals to improve efficiency and project success, focusing on core success criteria like cost, content, and schedule [6], [8], [27], [30], [50]. ▪ Implementing PMO tools and processes to prevent software project management failures should be required for specific risk categories across all projects [17], [26], [43].
Rational Goals [20]		
Profit	▪ The PMO was created to improve project performance and align with the organization's rational goals with strong executive board support [19], [25], [53]. ▪ The introduction of the PMO brought significant organizational changes, including a specific project management methodology and governance [31].	▪ Establishing a PMO improves project management techniques and encourages organizational transformation and evolution [17].
Productivity	▪ PMO performance aims to enhance project delivery and maturity [19], [25], [32], [44], [52]. ▪ PMOs consolidate project management, improve processes, support teams, manage resources, and increase knowledge transfer to improve project planning and definition [32], [45], [47], [54]. ▪ PMO's strategic importance is acknowledged in improving project management, especially in the public sector [7], [41], [53].	▪ PMO is essential for aligning projects with business strategy and resource management and providing consulting and external resource support for complex projects [26], [27], [43], [50], [51]. ▪ Establishing a PMO in three cases likely streamlines project management, optimizes resources, and improves customer satisfaction [27], [50].
Planning goals to reach	▪ Effective PMO change influences pragmatic project planning for the future [31], [52], [54]. ▪ PMOs adapt roles, assess capabilities, and facilitate strategic planning [13], [15], [32], [44], [54]. ▪ The PMO uses knowledge strategies but mainly focuses on planning and reporting despite the benefits of project management methodology [46], [54].	▪ The PMO aligns projects with business goals for a competitive edge [8], [12], [17], [26], [27], [43]. ▪ Effective PMO utilization enhances satisfaction and the likelihood of achieving realistic business case benefits [30], [56].
Efficiency	▪ The establishment of a PMO facilitates improved project performance, resulting in enhanced corporate efficiency, increased project success, and higher fundraising stability [7], [13], [25], [32], [41], [42], [45], [47], [53]. ▪ The PMO should prioritize trust and practicality for efficiency and recognize that inefficiencies are mainly due to scale, not technical factors [31], [46].	▪ Efficient PMO practices connected to program success are valuable when the PMO, management, and execution teams define and evaluate success criteria [6], [12], [43], [48], [49]. ▪ PMO success relies on aligning functions with the organization's unique needs in diverse contexts [17], [27].
Open System [20]		
Growth	▪ PMOs drive growth, shift to agile project management, and foster innovation [15], [44], [55].	▪ A successful PMO faces tensions and disputes over its growth and status [8].
Flexibility/adaptation/ innovation in project management	▪ PMOs prioritize standardization and adaptability balance [52], [55]. ▪ A successful PMO is crucial for Agile project management, requiring flexible staff and adaptability for complex and more straightforward projects [13], [54]. ▪ Implementing a PMO enhances project management with tools, auditing, standardization, and adaptability [25], [32], [41], [45].	▪ In a PMO, programs require adaptability to achieve objectives, while a predictive approach can slow down change management [17], [48], [51]. ▪ The PMO evaluates, adopts, and supports project practices, gaining authority and ensuring compliance through standardized methods, systems, and tools [26], [27], [29], [43], [49], [50].
Assessment by external entities	-	-

Criteria	Non-IT Sectors	IT Sectors
Links with the external environment	▪ PMO change is influenced by external factors, internal dynamics, and organizational politics, particularly in stakeholder communication coordination [15], [52].	-
Readiness	-	▪ PMOs adapt to agile project management and prioritize responsiveness to changing user needs and the dynamic business and project environment [30], [43], [51].
Output Quality [20]		
Output quality	▪ PMOs manage quality, client interactions, and contracts and advise on business and supplier qualifications [15], [42], [45], [54]. ▪ PMOs standardize processes, optimize resources, and enhance project quality to meet client expectations [13], [19], [55].	▪ IT PMOs prioritize delivering customer requests efficiently [48], [56]. ▪ Project success depends on sponsor and team satisfaction, which impacts management satisfaction, while customer satisfaction affects project performance and PMO structure [6], [8], [27], [30], [49].

4.2 Comparing PMO performance in IT and non-IT sectors

PMOs are considered valuable in IT and non-IT sectors, albeit with differing emphases. In non-IT sectors, PMOs prioritize human relationships, maturity, and workforce management [19], [41], [42], while IT sectors emphasize the knowledge and competencies of PMO resource teams [8], [29]. Training in non-IT sectors focuses on competency and assistance [37], [45], while IT training prioritizes efficiency through knowledge transfer and technology [5], [27], [48]. Workplace climate issues are addressed in non-IT but not in IT.

Both sectors stress PMOs' roles in dispute resolution and project management with distinct approaches. Regarding internal processes, both recognize PMOs' value in improving project management, standardized processes, and learning from past experiences [25], [43], [54]. Non-IT sectors emphasize agility and independence [13], [55], while IT sectors prioritize collaboration through PMO experiences [8]. Regarding project success and performance improvement, both sectors value PMOs, with non-IT focusing on centralized support [41] and the IT sector emphasizing technological measures to prevent project management failures [26].

PMOs ensure quality and maximize project performance in both sectors [42], [55]. Non-IT PMOs advise on corporate and supplier qualifications and standardized processes [13], [19]. In contrast, IT PMOs prioritize efficient client demand delivery and emphasize the interconnection between project success, satisfaction, and PMO structure [30], [56].

To summarize, while there are differences in emphasis and approach between the IT and non-IT sectors regarding PMO roles and functions, it is clear that PMOs play an essential and valuable role in both. Although human interactions and workforce management are more important in non-IT sectors than knowledge and abilities in IT sectors, PMOs are critical for project success, performance improvement, and quality assurance in both domains. Its engagement in conflict resolution, project management, and internal processes emphasizes its significance across industries. Thus, it is possible to conclude that PMOs have a similar impact on the IT and non-IT sectors but with subtle modifications customized to each sector's needs and priorities.

4.3 Implications

The implications of this research are significant both practically and theoretically. Practically, the findings provide more essential insights into the role of PMOs in both the IT and non-IT sectors, assisting firms in optimizing PMO services based on the unique needs of each industry. For example, understanding that PMOs in non-IT sectors concentrate on human interactions and workforce management can help firms build PMO strategies that emphasize these areas. Recognizing that PMOs in the IT sector prioritize knowledge and competency of PMO resource teams can help IT firms direct their training and human resource development activities.

Theoretically, this research contributes valuable insights into understanding the role and function of PMOs in IT and non-IT sectors. The implication is that models such as the Aubry & Hobbs model can be applied and further developed to depict the dynamics of PMOs in both industries. Thus, this research not only provides practical insights for practitioners but also has the potential to enrich academic literature on project management and the role of PMOs in different industry contexts.

4.4 Limitations

This study contains limitations due to a lack of complete evaluation of variances in PMO terminology, classification, and assessment methodologies, which may alter knowledge of how PMOs contribute to organizational performance. Understanding that these differences may impact the interpretation of findings and the evaluation of PMO success in delivering positive organizational outcomes is critical. These limitations also allow future research to provide a more holistic perspective on the relationship between PMO success and organizational performance, considering the complexities and varied opinions on PMO assessment and terminology.

5. Conclusion

This study explores the PMO's role in enhancing organizational performance within IT and non-IT sectors. It seeks to gain insights into how project management influences overall organizational performance through the Competing Values Framework. SLR was conducted using 31 articles published between 2013 and 2023. The study identified 32 conditions in the non-IT sector and 26 conditions in the IT sector, linked to 17 factors within the four domains of the CVF. In conclusion, PMOs are helpful in both the IT and non-IT industries, stressing conflict resolution and successful project management in various ways. Standardized practices and experience-based learning improve internal processes. Both industries emphasize the importance of project management offices in attaining project success and improving performance, as well as their role in maintaining quality standards and maximizing project performance.

To address the research question comparing PMO performance in IT and non-IT sectors, this study unveils that non-IT sectors prioritize human relationships, competency-focused training, workplace climate, agility, independence, centralized support, and standardized processes. Conversely, IT industries concentrate on the expertise and capabilities of PMO resource teams, efficient training, technology utilization, and collaborative endeavors to accomplish project success. They also stress the critical role of technology in averting project management failures and prioritizing the efficient delivery of client requests while recognizing the interconnectedness of project success, satisfaction, and PMO structure. These disparities underscore the differing priorities in PMO functions between the two sectors.

PMOs contribute substantial value in IT and non-IT sectors, albeit with distinct emphases. Non-IT sectors prioritize human interactions, competency-focused training, workplace ambiance, agility, and centralized support. In contrast, IT sectors highlight PMO resource team knowledge, efficient training, technology usage, and collaborative efforts for project success. Despite these discrepancies, PMOs play a crucial role in project success, performance enhancement, and quality assurance across both domains.

Finally, a comparison of PMO performance in IT and non-IT sectors reveals varying priorities and strategies. Non-IT industries emphasize human-centric elements and centralized support, while IT sectors prioritize PMO resource team capabilities, technology use, and collaborative activities. These differences hence underscore the customization of PMO responsibilities to meet each sector's specific needs and priorities, highlighting PMOs' adaptability and versatility in driving project success and organizational efficiency—*an impactful approach for organizational performance.*

Acknowledgments

This work was funded by Lembaga Pengelola Dana Pendidikan or Indonesia Endowment Fund for Education (LPDP) from the Ministry of Finance, Republic of Indonesia.

References

[1] N. F. Ayala, M. A. Le Dain, V. Merminod, L. Gzara, D. V. Enrique, and A. G. Frank, "The contribution of IT-leveraging capability for collaborative product development with suppliers," *The Journal of Strategic Information Systems*, vol. 29, no. 3, p. 101633, Sep. 2020, doi: 10.1016/j.jsis.2020.101633.

[2] S. Khin and T. C. Ho, "Digital technology, digital capability and organizational performance," *International Journal of Innovation Science*, vol. 11, no. 2, pp. 177–195, Jun. 2019, doi: 10.1108/IJIS-08-2018-0083.

[3] P. Saeidi, S. P. Saeidi, S. Sofian, S. P. Saeidi, M. Nilashi, and A. Mardani, "The impact of enterprise risk management on competitive advantage by moderating role of information technology," *Computer Standards & Interfaces*, vol. 63, pp. 67–82, Mar. 2019, doi: 10.1016/j.csi.2018.11.009.

[4] C.-C. Shen, C.-C. Yeh, and C.-N. Lin, "Using the perspective of business information technology technicians to explore how information technology affects business competitive advantage," *Technological Forecasting and Social Change*, vol. 184, p. 121973, Nov. 2022, doi: 10.1016/j.techfore.2022.121973.

[5] X. (Jason) Wu, J. C.-A. Tsai, and Y. Lei, "Information Technology Project Management Research: A Review of Works by Influential Pioneers," *Project Management Journal*, vol. 54, no. 4, pp. 366–391, Aug. 2023, doi: 10.1177/87569728231171056.

[6] J.-H. Ko, S.-H. Park, and D.-C. Kim, "Efficiency Analysis of Project Management Offices for Large-scale Information System Projects: Insights for Construction Megaprojects," *Construction Economics and Building*, vol. 15, no. 3, pp. 34–47, Aug. 2015, doi: 10.5130/AJCEB.v15i3.4610.

[7] J. M. de Oliveira, G. de A. Jurach, R. S. Pinto, and L. M. Kerchirne, "Project Offices and the Federal Universities: A Study on Project Management in the Context of Higher Education Institutions," *Revista de Gestão e Projetos*, vol. 08, no. 03, pp. 18–28, Dec. 2017, doi: 10.5585/gep.v8i3.582.

[8] S. C. M. Barbalho, J. Carlos de Toledo, and A. C. Cintra Faria, "Transitions in Project Management Offices: A Framework Relating Functions, Success Factors and Project Performance in a High-Technology Company," *Engineering Management Journal*, vol. 34, no. 3, pp. 357–373, Jul. 2022, doi: 10.1080/10429247.2021.1925497.

[9] A. Gemino and B. H. Reich, "Program Management Within Digital Transformation: The Emerging Importance Of Technology Architecture, Product Management, and Human Capital Transformation," *Project Management Journal*, vol. 54, no. 4, pp. 447–457, Aug. 2023, doi: 10.1177/87569728231173298.

[10] S. Bourdeau, H. Barki, and R. Legoux, "Investigating the Role of Tenure Diversity in Information System Project Teams: A Multilevel Analysis," *Communications of the Association for Information Systems*, vol. 49, no. 1, pp. 816–838, Dec. 2021, doi: 10.17705/1CAIS.04942.

[11] G. Silvius, "The role of the Project Management Office in Sustainable Project Management," *Procedia Computer Science*, vol. 181, pp. 1066–1076, Jan. 2021, doi: 10.1016/j.procs.2021.01.302.

[12] T. Raharjo, B. Purwandari, R. Satria, and I. Solichah, "Critical Success Factors for Project Management Office: An Insight from Indonesia," in *2018 Third International Conference on Informatics and Computing (ICIC)*, IEEE, Oct. 2018, pp. 1–6. doi: 10.1109/IAC.2018.8780504.

[13] S. P. Philbin, "Exploring the Project Management Office (PMO)-Role, Structure and Processes," *Proceedings of the American Society for Engineering Management 2016 International Annual Conference*, 2016.

[14] A. G. Spelta and A. L. Albertin, "Project Management Offices in the IT Area: A Context–Discriminant Model for their Establishment," *Information Systems Management*, vol. 29, no. 1, pp. 40–54, Jan. 2012, doi: 10.1080/10580530.2012.634296.

[15] V. Santos and J. Varajão, "PMO as a Key Ingredient of Public Sector Projects' Success – Position Paper," *Procedia Computer Science*, vol. 64, pp. 1190–1199, Jan. 2015, doi: 10.1016/j.procs.2015.08.546.

[16] G. Fernandes, S. Moreira, M. Araújo, E. B. Pinto, and R. J. Machado, "Project Management Practices for Collaborative University-Industry R&D: A Hybrid Approach," *Procedia Computer Science*, vol. 138, pp. 805–814, Jan. 2018, doi: 10.1016/j.procs.2018.10.105.

[17] C. Oliveira, A. Tereso, and G. Fernandes, "PMO Conceptualization for Engineering and Construction Businesses," *Procedia Computer Science*, vol. 121, pp. 592–599, Jan. 2017, doi: 10.1016/j.procs.2017.11.078.

[18] C. X. Dai and W. G. Wells, "An exploration of project management office features and their relationship to project performance," *International Journal of Project Management*, vol. 22, no. 7, pp. 523–532, Oct. 2004, doi: 10.1016/j.ijproman.2004.04.001.

[19] T. G. A. Viglioni, J. A. O. G. Cunha, and H. P. Moura, "A Performance Evaluation Model for Project Management Office Based on a Multicriteria Approach," *Procedia Computer Science*, vol. 100, pp. 955–962, Jan. 2016, doi: 10.1016/j.procs.2016.09.257.

[20] M. Aubry and B. Hobbs, "A Fresh Look at the Contribution of Project Management to Organizational Performance," *Project Management Journal*, vol. 42, no. 1, pp. 3–16, Feb. 2011, doi: 10.1002/pmj.20213.

[21] R. E. Quinn and J. Rohrbaugh, "A Spatial Model of Effectiveness Criteria: Towards a Competing Values Approach to Organizational Analysis," *Management Science*, vol. 29, no. 3, pp. 363–377, Mar. 1983, doi: 10.1287/mnsc.29.3.363.

[22] H. Moura and J. Centreofinformatics, "Project Management Office: The State of the Art Based on a Systematic Review," 2014, Accessed: Oct. 12, 2023. [Online]. Available: https://www.researchgate.net/publication/292982708

[23] M. Aubry, M. C. Richer, M. Lavoie-Tremblay, and G. Cyr, "Pluralism in PMO performance: The case of a PMO dedicated to a major organizational transformation," *Project Management Journal*, vol. 42, no. 6, pp. 60–77, Dec. 2011, doi: 10.1002/PMJ.20269.

[24] S. C. M. Barbalho and G. L. Silva, "Control of project data and team satisfaction as results of PMO effort in new product development projects," *International Journal of Managing Projects in Business*, vol. 15, no. 1, pp. 121–149, Jan. 2022, doi: 10.1108/IJMPB-02-2021-0045.

[25] J. Van Der Linde and H. Steyn, "The effect of a project management office on project and organisational performance: a case study," *The South African Journal of Industrial Engineering*, vol. 27, no. 1, pp. 151–161, May 2016, doi: 10.7166/27-1-1114.

[26] A. Monteiro, V. Santos, and J. Varajão, "Project Management Office Models – A Review," *Procedia Computer Science*, vol. 100, pp. 1085–1094, Jan. 2016, doi: 10.1016/j.procs.2016.09.254.

[27] G. Karayaz and O. Gungor, "Strategic Alignment and Project Management Offices: Case Studies from Succesful Implementations in Turkey," in *2013 46th Hawaii International Conference on System Sciences*, IEEE, Jan. 2013, pp. 4374–4383. doi: 10.1109/HICSS.2013.499.

[28] K. S. Cameron and R. E. Quinn, *Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework*. Massachusetts: Addison-Wesley, 1999.

[29] R. Hans and E. Mnkandla, "The role of the PMO in enforcing and standardizing attendance to the needs of software project teams by project managers," *Procedia Computer Science*, vol. 196, pp. 782–790, Jan. 2022, doi: 10.1016/j.procs.2021.12.076.

[30] E. Kutsch, J. Ward, M. Hall, and J. Algar, "The Contribution of the Project Management Office: A Balanced Scorecard Perspective," *Information Systems Management*, vol. 32, no. 2, pp. 105–118, Apr. 2015, doi: 10.1080/10580530.2015.1018768.

[31] J. H. Ko and D. Kim, "The Effects of Maturity of Project Portfolio Management and Business Alignment on PMO Efficiency," *Sustainability*, vol. 11, no. 1, p. 238, Jan. 2019, doi: 10.3390/su11010238.

[32] V. Anantatmula and P. Rad, "Linkages among project management maturity, PMO, and project success," in *2013 International Conference on Engineering, Technology and Innovation (ICE) & IEEE International Technology Management Conference*, IEEE, Jun. 2013, pp. 1–12. doi: 10.1109/ITMC.2013.7352602.

[33] B. Kitchenham and P. Brereton, "A systematic review of systematic review process research in software engineering," *Information and Software Technology*, vol. 55, no. 12, pp. 2049–2075, Dec. 2013, doi: 10.1016/j.infsof.2013.07.010.

[34] B. Kitchenham, "Guidelines for performing Systematic Literature Reviews in Software Engineering," 2007, Accessed: Oct. 12, 2023. [Online]. Available: https://www.researchgate.net/publication/302924724

[35] B. Kitchenham, O. Pearl Brereton, D. Budgen, M. Turner, J. Bailey, and S. Linkman, "Systematic literature reviews in software engineering – A systematic literature review," *Information and Software Technology*, vol. 51, no. 1, pp. 7–15, Jan. 2009, doi: 10.1016/j.infsof.2008.09.009.

[36] C. Iriarte and S. Bayona, "IT projects success factors: a literature review," *International Journal of Information Systems and Project Management*, vol. 8, no. 2, pp. 49–78, Oct. 2021, doi: 10.12821/ijispm080203.

[37] M. Ershadi, M. Jefferies, P. Davis, and M. Mojtahedi, "Project management offices in the construction industry: a literature review and qualitative synthesis of success variables," *Construction Management and Economics*, vol. 39, no. 6, pp. 493–512, Jun. 2021, doi: 10.1080/01446193.2021.1916052.

[38] W. Afzal, R. Torkar, and R. Feldt, "A systematic review of search-based testing for non-functional system properties," *Information and Software Technology*, vol. 51, no. 6, pp. 957–976, Jun. 2009, doi: 10.1016/j.infsof.2008.12.005.

[39] P. McCarthy, D. Sammon, and I. Alhassan, "Digital Transformation Leadership Characteristics: A Literature Analysis," *Journal of Decision Systems*, vol. 32, no. 1, pp. 79–109, Dec. 2022, doi: 10.1080/12460125.2021.1908934.

[40] J. Gortler, C. Schulz, D. Weiskopf, and O. Deussen, "Bubble Treemaps for Uncertainty Visualization," *IEEE Transactions on Visualization and Computer Graphics*, vol. 24, no. 1, pp. 719–728, Jan. 2018, doi: 10.1109/TVCG.2017.2743959.

[41] E. J. Darling and S. J. Whitty, "The Project Management Office: it's just not what it used to be," *International Journal of Managing Projects in Business*, vol. 9, no. 2, pp. 282–308, Apr. 2016, doi: 10.1108/IJMPB-08-2015-0083.

[42] G. Fernandes, E. B. Pinto, M. Araújo, and R. J. Machado, "The roles of a Programme and Project Management Office to support collaborative university–industry R&D," *Total Quality Management & Business Excellence*, vol. 31, no. 5–6, pp. 583–608, Apr. 2020, doi: 10.1080/14783363.2018.1436963.

[43] V. Gruhn and N. S. von Brisinski, "How to reduce risk effectively in fixed price software development," in *Proceedings of the ACM/IEEE 42nd International Conference on Software Engineering: Software Engineering in Practice*, New York, NY, USA: ACM, Jun. 2020, pp. 132–141. doi: 10.1145/3377813.3381361.

[44] M. Ershadi, M. Jefferies, P. Davis, and M. Mojtahedi, "Modeling the Capabilities of High-Performing Project Management Offices in General Contracting Companies," *Project Management Journal*, vol. 54, no. 3, pp. 268–284, Jun. 2023, doi: 10.1177/87569728221148666.

[45] A. Zare Khafri, A. S. Aboumasoudi, and S. Khademolqorani, "Prioritizing Multi-Interwoven Factors in the Project Management Office Using Delphi and Fuzzy DEMATEL," *Journal of Mathematics*, vol. 2022, pp. 1–12, May 2022, doi: 10.1155/2022/6482419.

[46] B. Tshuma, H. Steyn, and C. C. van Waveren, "The mediation role of the PMO in the transfer of knowledge between projects – a case study of five PMOs," *International Journal of Managing Projects in Business*, vol. 15, no. 1, pp. 150–174, Jan. 2022, doi: 10.1108/IJMPB-03-2021-0063.

[47] B. Tshuma, H. Steyn, and C. Van Waveren, "The role played by PMOs in the transfer of knowledge between projects: a conceptual framework," *South African Journal of Industrial Engineering*, vol. 29, no. 2, pp. 127–140, Aug. 2018, doi: 10.7166/29-2-1966.

[48] Q. Yang, Y. Bi, Q. Wang, and T. Yao, "Batch-based agile program management approach for coordinating IT multi-project concurrent development," *Concurrent Engineering*, vol. 29, no. 4, pp. 343–355, Dec. 2021, doi: 10.1177/1063293X211015236.

[49] J. Pereira, J. Varajão, and N. Takagi, "Evaluation of Information Systems Project Success – Insights from Practitioners," *Information Systems Management*, vol. 39, no. 2, pp. 138–155, Apr. 2022, doi: 10.1080/10580530.2021.1887982.

[50] G. Widforss and M. Rosqvist, "The Project Office as Project Management Support in Complex Environments," *Procedia Computer Science*, vol. 64, pp. 764–770, Jan. 2015, doi: 10.1016/j.procs.2015.08.626.

[51] T. Wu, "Digital project management: rapid changes define new working environments," *Journal of Business Strategy*, vol. 43, no. 5, pp. 323–331, Aug. 2022, doi: 10.1108/JBS-03-2021-0047.

[52] M. Aubry, "Project Management Office Transformations: Direct and Moderating Effects that Enhance Performance and Maturity," *Project Management Journal*, vol. 46, no. 5, pp. 19–45, Oct. 2015, doi: 10.1002/pmj.21522.

[53] A. Lacruz and E. Cunha, "Project management office in non-governmental organizations: an *ex post facto* study," *Revista de Gestão*, vol. 25, no. 2, pp. 212–227, Jun. 2018, doi: 10.1108/REGE-03-2018-033.

[54] J. Phan, "Using the project management office to connect the dots between projects and strategy," *Healthcare Management Forum*, vol. 28, no. 2, pp. 65–68, Mar. 2015, doi: 10.1177/0840470414562638.

[55] T. Braun, "Configurations for Interorganizational Project Networks," *Project Management Journal*, vol. 49, no. 4, pp. 53–61, Aug. 2018, doi: 10.1177/8756972818781710.

[56] J. Ward and E. M. Daniel, "The role of project management offices (PMOs) in IS project success and management satisfaction," *Journal of Enterprise Information Management*, vol. 26, no. 3, pp. 316–336, Apr. 2013, doi: 10.1108/17410391311325252.

Appendix A. Research and quality assessment score

No.	Paper Title	Year	QA1	QA2	QA3	QA4	QA5	QA6	Total Score
1.	A Performance Evaluation Model for Project Management Office based on a Multicriteria Approach	2016	1	1	1	1	1	1	6
2.	Project Management Office Transformations: Direct and Moderating Effects That Enhance Performance and Maturity	2015	1	1	1	1	1	1	6
3.	Configurations for Interorganizational Project Networks: The Interplay of the PMO and Network Administrative Organization	2018	1	1	0.5	0.5	0.5	0	3.5
4.	Modeling the Capabilities of High-Performing Project Management Offices in General Contracting Companies	2023	1	0.5	1	1	1	1	5.5
5.	Exploring the Project Management Office (PMO) – Role, Structure and Processes	2016	0.5	1	1	0.5	1	0	4
6.	Linkages Among Project Management Maturity, PMO, and Project Success	2023	1	0.5	1	1	1	0	4.5
7.	PMO as a key ingredient of public sector projects' success – position paper	2015	0.5	0.5	1	0.5	1	0	3.5
8.	Prioritizing Multi-Interwoven Factors in the Project Management Office Using Delphi and Fuzzy DEMATEL	2022	1	1	1	1	1	0.5	5.5

No.	Paper Title	Year	QA1	QA2	QA3	QA4	QA5	QA6	Total Score
9.	Project management office in non-governmental organizations: an ex post facto study	2018	0.5	1	0.5	0.5	1	0.5	4
10.	Project Offices and The Federal Universities: A Study on Project Management in the Context of Higher Education Institution	2017	0.5	0.5	1	0.5	1	0	3.5
11.	The Effect of a Project Management Office on Project and Organizational Performance: A Case Study	2016	1	1	1	0.5	1	0	4.5
12.	The Effects of Maturity of Project Portfolio Management and Business Alignment on PMO Efficiency	2019	1	1	1	1	1	1	6
13.	The mediation role of the PMO in the transfer of knowledge between projects – a case study of five PMOs	2021	1	1	1	0.5	1	0.5	5
14.	The Project Management Office: it's just not what it used to be	2015	1	1	1	1	1	0.5	5.5
15.	The Role Played by PMOs in the Transfer of Knowledge Between Projects: A Conceptual Framework	2018	0.5	1	1	0.5	1	1	5
16.	The roles of a Programme and Project Management Office to support collaborative university–industry R&D	2020	1	1	1	0.5	1	0	4.5
17.	Using the project management office to connect the dots between projects and strategy	2015	0.5	0.5	1	0.5	1	0.5	4
18.	Batch-based agile program management approach for coordinating IT multi-project concurrent development	2021	1	0.5	1	1	1	0	4.5
19.	Critical Success Factors for Project Management Office: An Insight from Indonesia	2018	1	1	1	1	0.5	0.5	5
20.	Digital project management: rapid changes define new working environments	2022	0.5	0.5	1	0.5	1	0	3.5
21.	Efficiency Analysis of Project Management Offices for Large-scale Information System Projects: Insights for Construction Megaprojects	2015	0.5	1	1	1	1	1	5.5
22.	Evaluation of Information Systems Project Success – Insights from Practitioners	2022	1	1	1	1	1	1	6
23.	How to reduce risk effectively in fixed price software development	2020	1	0.5	1	1	1	0	4.5
24.	PMO Conceptualization for Engineering and Construction Businesses	2017	0.5	1	0.5	0.5	1	0	3.5
25.	Project Management Office Models – a review	2016	1	1	1	1	1	0	5
26.	Strategic Alignment and Project Management Offices: Case Studies from Successful Implementations in Turkey	2013	1	0.5	0.5	0.5	1	0	3.5
27.	The Contribution of the Project Management Office: A Balanced Scorecard Perspective	2015	1	0.5	1	0.5	1	1	5
28.	The Project Office as Project Management Support in Complex Environments	2015	1	1	1	0.5	0.5	0	4
29.	The role of project management offices (PMOs) in IS project success and management satisfaction	2013	1	1	1	0.5	1	1	5.5
30.	The role of the PMO in enforcing and standardizing attendance to the needs of software project teams by project managers	2021	0.5	1	0.5	0.5	0.5	0.5	3.5
31.	Transitions in Project Management Offices: A Framework Relating Functions, Success Factors and Project Performance in a High-Technology Company	2022	1	0.5	1	1	0.5	1	5

Biographical notes

Rahmad Syalevi
Rahmad Syalevi was awarded the Paramadina Fellowship in 2009 and completed his undergraduate studies in informatics engineering at Universitas Paramadina. He studies information technology at Universitas Indonesia's Department of Information Technology under the Faculty of Computer Science. He has been awarded a prestigious LPDP scholarship by Indonesia's Ministry of Finance. In his professional career, he has worked as a software engineer focusing on mobile and web development.

Teguh Raharjo
Dr. Teguh Raharjo is a lecturer and researcher at the Faculty of Computer Science, University of Indonesia. He received his Ph.D. in Computer Science from Universitas Indonesia in 2023 and has substantially benefited the academic community through his research on project management techniques and agile practices. His expertise and interests concentrate on Project Management and Agile methodologies.

Wahyu Setiawan Wibowo
Wahyu Setiawan Wibowo earned a Bachelor of Applied Science in Computational Statistics from the renowned Institute of Statistics (STIS) and completed his master's degree at the University of Indonesia. He subsequently began his professional career at Indonesia's National Office of Statistics, Statistics Indonesia (BPS). He actively participated in various government efforts throughout his career, notably the revolutionary One Data Policy. His research interests include software engineering, IT adoption, smart government, open data, information security, information visualization, human-computer interface, and data management.

International Journal of
Information Systems and Project Management
ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X
Available online at ijispm.sciencesphere.org

International Journal of
Information Systems and Project Management

ISSN (print):2182-7796, ISSN (online):2182-7788, ISSN (cd-rom):2182-780X

Available online at ijispm.sciencesphere.org