IT Project Portfolio Management: Development and Validation of a Reference Model

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Abstract: IT Project Portfolio Management has been implemented in most organizations to effectively manage complex portfolios of IT projects and balance them with business strategy. Several standards for portfolio management have been published, but the scientific literature still lacks a theoretically grounded and practically validated reference model for analyzing the implementation of IT Project Portfolio Management in an organization. Therefore, this study designs and validates a reference model for systematically analyzing IT Project Portfolio Management design choices in an organization in terms of processes, roles, responsibilities, and authority. Organizations can use the reference model to systematically assess their local implementation of IT Project Portfolio Management and identify areas for improvement.

1 INTRODUCTION

Organizations use projects to achieve their strategic objectives and increase their competitive advantage (Blomquist & Müller, 2006). Project portfolios are important vehicles for achieving strategy as they provide the link between strategy and operational projects (Kock & Gemünden, 2021; Micán, Fernandes & Araújo, 2022). Several studies have been conducted on factors that determine the success of a project portfolio (Hofman & Grela, 2015; Reyck et al., 2005; Wissenburg, Kusters, Martin & Evers-Wagemakers, 2022). Nevertheless, many organizations struggle to effectively manage and balance complex portfolios of IT projects (Erasmus & Marnewick, 2020; Hoffmann, Ahlemann & Reining, 2020). As a necessity, IT project portfolio management (ITPPM) has been implemented in most large organizations (Blomquist & Müller, 2006; Frey, 2014; Hoffmann et al., 2020). ITPPM provides organizations with a holistic view of their IT resources, should enable them to make more informed IT-related decisions by identifying risks, benefits, costs, and alignment IT resources (Ajjan, Kumar & Subramaniam, 2016; Reyck et al., 2005). Thus, to be successful, it is important for organizations to adequately implement ITPPM.

Despite the fact that a global standard (PMI, 2017) and several portfolio management frameworks, have been established, knowledge about the successful implementation of ITPPM is limited so far. Organizations still lack a reference to support the development of their ITPPM governance (Ajjan et al. 2016; Kumar, Ajjan & Niu, 2008). The literature on ITPPM lacks a theoretically based and practice-validated reference model for ITPPM governance (Ajjan et al., 2016; Hoffmann et al., 2020). This study aims to establish such a model. We will demonstrate the practical relevance of the reference model by testing it against real-world ITPPM design choices.

The central research objective of this study is: "*Design and validate a reference model for ITPPM governance, in terms of processes, roles, responsibilities, and authority that can be used to systematically analyze ITPPM design choices in organizations.*"

To achieve this objective, the literature was searched for ITPPM processes, roles, and responsibilities, and authority. A prototype reference model was then designed based on the literature studied. This prototype was validated with actual ITPPM practices in a multiple-case study.

Organizations can use the reference model to systematically describe their local design in terms of processes, roles, responsibilities, and authority. Then the differences with the reference model can be identified and meaningfully discussed. By comparing the local design of ITPPM with the reference model, areas for improvement can be identified.

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2 RELATED WORK

This section examines the availability of ITPPM reference models in the literature.

Reyck et al. (2005) developed a PPM implementation plan in three stages. In each stage, certain PPM processes should be installed. However, their framework lacks the roles, responsibilities, and authority for ITPPM. Maizlish and Handler (2005) described a step-by-step method for the design of IT portfolio management. This method consists of eight phases for building the ITPP. They also defined the roles within PPM processes based on a stakeholder analysis. Frey (2014) described four focus areas with respect to ITPPM. For each focus area, governance structures are applied that include interrelationships. Frey (2014) also distinguished several roles, responsibility, and authority within ITPPM. The Project Management Institute (2017) standard described knowledge areas and process groups (Lima, Monteiro, Fernandes, and Machado, 2016). Roles, responsibilities, and authority for portfolio management are also described in this standard.

In summary, the recent literature contains a (limited) set of elements of a reference model, but lacks a complete and validated reference model. This gap in research prompted this study with the central research objective posed in the introduction.

3 METHODOLOGY DESIGN

This study aims to establish a practice-validated reference model for systematically analyzing the design of ITPPM governance in terms of processes, roles, responsibilities, and authority. A so called RACI matrix can be used to achieve this objective because it reflects four types of process responsibilities: the role who owns the problem (responsible), the role of who must approve the work before it is effective (accountable), the role that provides input to help complete the task (consulted), and people who need to be kept informed (informed) (Cabanillas, Resinas & Ruiz-Cortés, 2012). Therefore, the artifact of this study (i.e., the reference model) will include a RACI matrix with process activities, roles, responsibilities, and authority.

We wanted to get well-founded information from practitioners based on their experience with the actual design of ITPPM in their organizations. The design of this study focuses on practice-based evidence (Aken & Andriessen, 2011). Design science is an appropriate research strategy for this purpose, because it involves scientifically designing and testing a solution to a practice problem through systems and IT artifacts (Aken & Andriessen, 2011; Hevner, March, Park & Ram, 2004). The cyclical process followed in this study is based on design science (Wieringa, 2014), consisting of the steps:

1) structured literature review;
2) designing the prototype reference model;
3) design-oriented case study;
4) reanalysis and additional structured literature review (SLR);
5) redesign of the prototype reference model;
6) validation-oriented multiple-case study;
7) cross-case analysis;
8) redesign of the prototype reference model.

As described here, we designed a first prototype based on the SLR, conducted an first validation in practice, followed by a redesign and a final validation in a multiple-case study. The choice for a case study as a means of validation is justified by the richness of the information that can be obtained. These research steps are described in more detail below.

- *Structured literature review (step 1):*

To compose the components of a prototype reference model, a s SLR was conducted to search the academic literature for ITPPM processes, roles, responsibilities, and authority. ITPPM is a widely studied topic in the academic literature: therefore, exploratory research methods such as the Delphi technique, the nominal group technique, and focus groups were not necessary. The SLR in this study was conducted according to Kitchenham's (2004) guidelines.

The purpose of our literature review was to include a wide range of publications on ITPPM. Therefore, we used the generic search terms "IT project portfolio", "portfolio management processes", "IT portfolio management step-by-step", "portfolio management roles", and "project portfolio management" process role responsibility competence. The Open University's digital library was used to collect the scientific literature. This provides access to IEEE, Elsevier, ACM, JSTOR, Springer, and Web of Science, among others.

The articles found were screened based on a number of inclusion criteria. Namely, the articles had to be peer reviewed, written in the English language, published after 2000, and have ITPPM as their topic. The review process first checked whether the articles had been published in peer-reviewed journals. Second, the title and abstract were reviewed to determine if the article was related to ITPPM. Articles that did not address ITPPM were rejected. Third, the remaining articles were scanned for ITPPM processes, roles, responsibilities, and authority.

- *Designing the prototype reference model (step 2):*
The ITPPM process models found in the literature were compared for completeness in terms of processes, roles, responsibilities, and authority. Then the most complete model was chosen and it was determined what additions from other models were needed. A RACI matrix was then created in which the reference roles from the literature were placed on the horizontal axis and all processes and activities on the vertical axis. The boxes in the RACI matrix indicated whether the roles involved in ITPPM were responsible, accountable, consulted or informed for the process activity in question.

This approach resulted in a prototype ITPPM reference model in terms of processes, roles, responsibilities, and authority.
- *Design-oriented case study (step 3):*
The purpose of this research step was to obtain feedback on the quality of the prototype reference model. To test the quality of the design, experiences with ITPPM in the real context of an organization were collected. A case study approach was used for this strategy. The case organization had to include an active ITPP, so it was plausible that they had practical experience with ITPPM.

Testing the prototype reference model consisted of five steps:
a) establishing the organizational model;
b) validating the organizational model;
c) comparing the organizational model with the prototype reference model;
d) discussing the differences between the organizational model and the reference model;
e) analyzing the interview data.

- *Establishing the organizational model (3a):*
The first step was to establish the organizational model based on the organization's, which resulted in a first version of the case organization's RACI matrix.
- *Validating the organizational model (3b):*
To ensure that the established organizational model could serve as a solid foundation for the interviews with the practitioners, this model was first discussed with an experienced portfolio manager from the case organization. In the interview, the various components of the reference model were discussed. Inaccuracies or additions were then incorporated into the organizational model.
- *Comparing the organizational model with the reference model (3c):*
An analysis was then made of this organization-specific model in relation to the prototype reference model. The purpose of this analysis was to arrive at some general statements that indicate notable differences in the organization of ITPPM from a theoretical reference model versus the practical situation. This was accomplished by comparing the two RACI matrices side by side and noting the differences. This analysis resulted in a list of general statements that was used to create the interview protocol.
- *Discussing the differences between the organizational model and the reference model (3d):*
To gather in-depth information about practitioners' experiences and opinions about actual ITPPM practices in an organization, interviews are useful (Saunders et al., 2011; Wieringa, 2014; Yin, 2018). Observation of ITPPM practices was not feasible given the time available for this study. This is because the ITPPM-cycle has a lead time of at least one year.

Interviews can be categorized into three types: structured, semi-structured, and unstructured. Semi-structured interviews allow for asking additional questions and better interaction with respondents than structured interviews (Saunders et al., 2011). In this study, semi-structured face-to-face interviews were conducted with practitioners in the field of ITPPM to provide the opportunity to ask additional questions about their actual experience with ITPPM in the context of their organization and their arguments and preferences for ITPPM design choices.

Consistent with the expertise requirements of Skulmoski, Hartman, and Krahn (2007), respondents had to have worked within the organization for at least three years in a role with executive responsibility within ITPPM. The group of respondents had to include as much diversity of different roles as possible. Multiple perspectives ensure that ITPPM is viewed from more angles and potentially yield more consistent findings. In addition, sufficient time had to be allocated for each interview.

The purpose of the interviews was to determine whether the general statements about the differences in the design of ITPPM within the case organization compared to the prototype reference model were recognized by the respondent and what the respondent's opinion on this was. Therefore, a protocol was designed for the interview, consisting of the following questions:
1. introduction;
2. verification that the general statements regarding the differences in the design of ITPPM were recognized by the respondent;
   Why do you think this design was chosen within your organization?
3. Respondent's assessment of these differences;
   Which design choice do you think is better for the organization and why?

For each question, it was verified that the question had been fully answered. If not, additional questions were asked. The interviews were recorded and transcribed. The transcripts were then returned to the respondents for approval.

The result of the interviews was a clear picture of the differences between the organization's ITPPM model and the prototype reference model, along with the respondents' arguments and preferences for ITPPM design choices.

- *Analyzing the interview data (3e):*

The purpose of the data analysis was to determine the respondents' arguments and preferences for the differences in the design choices of the case organization compared to the prototype reference model. This can be analyzed by text analysis of the transcripts of the interviews with the practitioners. By extracting relevant words or (parts of) sentences from the text that reflect these expressed arguments and preferences, an overview can be created within the data (Alholjailan, 2012). Another aim was to categorize respondents' answers based on the same types of arguments and preferences. A method suitable for this purpose is the In vivo coding method combined with axial coding. In vivo coding was used to avoid researcher bias and axial coding was used to relate codes to each other and categorize them with an overarching description (Saunders et al., 2011).

- *Reanalysis and additional structured literature review (step 4):*

To improve the quality of the prototype reference model, a reanalysis was conducted independently by a number of research team members to reduce individual bias. First, a SLR was performed in the same manner as described in step 1. The search terms used can be requested from the corresponding author of this article. Second, the results of the SLR were compared to the initial reference model and modifications were suggested by the research team.

- *Redesign of the prototype reference model (step 5):*

Upon completion of the analysis, the results of all the analyses had to be merged into a single redesign of the reference model. To reduce the biases of the research team members during the analysis phase, a joint design session was held. After the session, a modified reference model was available and then validated in multiple-case studies. Validation was necessary given the scope of the redesign.

- *Validation-oriented multiple-case study (step 6):*

The purpose of this study is to develop a relevant reference model for ITPPM governance, validated by practical experiences and explanations of practitioners. This information can be obtained in organizations that employ ITPPM practitioners who may have actual experiences with ITPPM. Moreover, experiences and explanations of them were important to discover whether our reference model is relevant to support the development of ITPPM governance in an organization's real-world context. Therefore, a case study approach was used as a validation strategy, where all interviews within one organization were considered as one case. Furthermore, within design science, a case study approach is appropriate as a validation method to examine an artifact (i.e. the designed reference model) in an organizational environment (Wieringa, 2014). The unit of analysis was determined as the ITPPM processes of the case organization. Therefore, a holistic design was chosen over an embedded design.

Based on availability (Benbasat et al., 1987) and the time constraints of the study and in accordance with Eisenhardt's (1989) advice for the number of cases in a multiple-case study, we planned four cases in parallel. For the case organizations and respondents, the same criteria applied as for research step 3d. For the interviews, the same questionnaire was used as in step 3. The interview transcripts were analyzed in the same way as in research step 3e.

- *Cross-case analysis (step 7):*

Our multiple-case study involved collecting and analyzing data from four case organizations. In a multiple-case study, there are two stages of analysis - the within-case analysis and the cross-case analysis (Merriam, 2009). The within-case analysis was conducted with the previous research step. Each case was analyzed as a comprehensive case in itself. Once the analysis of each case is completed, the cross-case analysis began (Merriam, 2009). The purpose of the cross-case analysis was to analyze the differences and similarities between the reference model and the local design of ITPPM in the four case organizations and then to reach a conclusion about the validity of the reference model. In addition, we wanted to determine whether there were similarities among the organizations in preferences for the reference model or the organizational model. Comparison of the results of within-case analyses will further enhance the transferability of the study. For the cross-case analysis, a table was designed that showed the differences between the reference model and the respective organizational models. Based on this table, the similarities and differences between the case organizations became apparent and conclusions could be drawn about the validity of the reference model.

- *Redesign of the prototype reference model (step 8):*

The purpose of this research step was to determine whether a redesign was needed based on the results of the cross-case analysis.

In this study, the criteria credibility, transferability, dependability, and confirmability were used to ensure trustworthiness of our study (Guba,1981).

To promote credibility, perspectives were obtained from multiple participants from different case organizations (Maimbo & Pervan, 2005). In addition, source triangulation was used through a documentary study and interviews, which increased support for the conclusions of our study (Benbasat et al., 1987). To reduce researcher bias, the organizational model was validated by a portfolio manager from the case organization prior to the interviews. Moreover, the process activities in the prototype reference model were provided with definitions. Also, the interview questions were based on the central research objective. During the interviews, questions were clarified as needed. Furthermore, the interviews were recorded and transcribed. Subsequently, the transcripts were returned to the respondent for approval. During the analysis phase, in vivo coding was used to stay close to respondents' words. In addition, the case analyses was reviewed by another researcher to reduce possible researcher bias.

To promote transferability, information was provided about the case organizations and respondents who participated in this study, as well as the methods used for data collection. Transferability was also enhanced by repeating the analysis within four case organizations and comparing them to the other organizations in a cross-case analysis.

Research's dependability was increased by defining and substantiating the research approach, data collection and analysis, and conclusions. In addition, the derivation of the conclusions from the case data was made explicit.

Confirmability of the respondents' arguments and preferences was increased by contributions from respondents from different organizations. Confirmability was also promoted by a description of deficiencies in the research methods and their possible effects, and an in-depth methodological description.

4 RESULTS

This section presents the results of the research steps.

- *Structured literature review (step 1):*

The number of articles found, reviewed and used per search query can be requested from the corresponding author of this article. Some of the literature on ITPPM exists in the form of practitioner guidelines and professional standards developed and disseminated by leading organizations that have a significant influence on the field (ul Musawir, Abd-Karim & Mohd-Danuri, 2020). Therefore, this type of literature was not excluded from selection in this study.

- *Designing the prototype reference model (step 2):*

The ITPPM process models found in the literature were compared for completeness in terms of processes, roles, responsibilities, and authority. Maizlish and Handler's (2005) model was chosen as the basis for the reference process. This model is more comprehensive than the models in the other articles and it is composed of detailed subprocesses and activities, where activities can be assigned to roles. Next, the process descriptions in the found articles were compared with the descriptions of the processes and activities of Maizlish and Handler (2005) and in this way missing processes and activities in the model of Maizlish and Handler (2005) were searched for. Two components were missing, namely the resource management process and the activity manage strategic change (Lima et al., 2016) as part of the process assessing execution. Both components were added to obtain a complete ITPPM process. For the purpose of the resource management process, Pennypacker (2005) provided a well-fitting classification of sub-activities.

The literature found was then searched for role descriptions and descriptions of responsibilities and authority within the processes. These descriptions were collected and interpreted to arrive at a RACI matrix. From the literature, an A (Accountable) and R (Responsible) were then added to the RACI matrix for each activity, with the exception of the communicating process. For this process, it could not be determined from the literature which role is responsible and which role is accountable. It was assumed that stakeholder identification is an activity that occurs at a more strategic/tactical level and that the portfolio review board (PRB) is accountable and the portfolio manager responsible. Because determining the message to be communicated and actually communicating this message to stakeholders occurs at the tactical/operational level of ITPPM, it was assumed that the portfolio manager is both accountable and responsible for the creating communication packages and delivering communication subprocesses. In addition, it was assumed that how the responsibilities for the C and I roles are assigned in an organization depends on local conditions. Therefore, no additions were included for the C and I roles based on the researchers' interpretation. Based on the results of the SLR, a RACI matrix was designed as a reference model.

- *Design-oriented case study (step 3):*

The case organization, an university in the Netherlands, originated from a research team

members' professional network based on availability and within the specified requirements for a case organization. Respondents with different roles in ITPPM were approached to promote source triangulation. The five respondents who participated in the interviews were identified in cooperation with the case organizations.

The case study was conducted in accordance with the design. All interview transcripts were read in full and the relevant text fragments were highlighted. That is, the text fragments in which respondents argued the design choices in the case organization and their preferences. The same types of arguments were then categorized by axial coding.

Respondents' preferences for ITPPM design choices are shown in Table 1 Preferences for design choices. This table describes, for the first two differences identified, the design according to the prototype reference model versus the case organization's design and the respondents' preferences. The entire table with all identified differences and the respondents' preferences can be requested from the corresponding author.

Table 1: Preferences for design choices.

Reference model design	**Organizational model design**	**Preferences**
Steering by PRB	Steering by ICT governance board and domain-specific tables	1 x reference model and 4 x organizational model
Established project / portfolio management office	No established project / portfolio management office	5 x reference model

To illustrate, the first difference is explained below, supported by some interview quotes from respondents.

PRB, as recognized in theory, is split in the case organization into ICT Governance board and Tables. The following arguments were given for this:

- Involvement of stakeholders (5 respondents): "The table is primarily intended to create support for change and to promote cooperation across organizational divisions."
- Quantity and diversity of topics (2 respondents): "Due to the quantity and diversity of topics, the choice was made to set up with ICT Governance Board and tables."
- Attention to project portfolio (1 respondent): "If a choice would have been made for an ICT Governance Board without tables, then the portfolio and the projects would not (be able to) receive the attention they deserve."
- Attention to the long term (1 respondent): "With the tables included, there is more of a longer term view."

In conclusion, the prototype reference model was tested within a case organization and recognized as such by the respondents. The organization deviated from the reference model in a number of ways. The respondents provided arguments for these deviations.

- *Reanalysis and additional structured literature review (step 4):*

The reanalysis and additional structured literature review were conducted independently by four research team members, followed by a joint redesign based on the analysis results. During the joint redesign session, consensus was reached through open and honest discussion.

- *Redesign of the prototype reference model (step 5):*

The redesign resulted in a number of modifications to the prototype reference model, including:

- The role of project portfolio management office was added.
- The authority for the subprocess creation was transferred to the PRB instead of the portfolio manager.
- In the balancing process activity, the responsibility and authority for selecting and approving changes was split.
- Process activity managing strategic change was placed out of scope.
- Process activity allocating resources was split into allocating IT resources and allocating business resources.

In addition, the processes and roles were provided with a description derived from the literature and the reference model was translated into Dutch.

The redesigned reference model is shown in Table 2. The reference model, including definitions and scientific literature sources, can be requested from the corresponding author.

- *Validation-oriented multiple-case study (step 6):*

To validate the redesigned reference model, four case organizations were available. These case organizations originated from the research team members' professional network and met the requirements specified in research step 3. Respondents who participated in the interviews were identified in cooperation with the case organizations based on the roles in the RACI matrix (i.e., purposive sampling). The purposive sampling technique means that a participant is chosen because of the unique and rich information the participant possesses that is of value of the study (Etikan, Musa & Alkassim, 2016). The validation of the reference model consisted of the five steps described in research step 3 and were carried out in accordance with the methodology design.

Table 2: Redesigned reference model.

Process activities / Roles	PRB	Portfolio Manager	Program Manager	Senior Managers	Customer	Sponsors	Project Managers	PPM Office	PM Office	Project Team	Line Managers	Architects	Finance Manager	Business Partners
Portfolio management policy	R			A										
Business process integration	R			A										
Governance compliance triggers	R			A										
Governance processses	R			A										
Establishing organization	R			A										
Readiness assessment	R			A										
Validation and refinement assessment	R			A										
Maturity assessment	R			A										
Gap analys + capability assess.	R			A										
Defining objectives	R			A	C									
Defining process metrics	R			A										
Document Implementation plan	R			A										
Plan investment strategy	A	R											R	
Plan portfolio structure	A	R												
Plan individ. Subportfolio's	A	R												
Populating portfolio	A	R	C		C	C			C					
Identify expected result + risks	A	R	C		C	C			C					
Defining project metrics	A	R	C			C								
Building portfolio view	A	R												
Finalising portfolio	A	R												
Monitoring triggers	A	R												
Measuring portfolio	A	R												
Comparing measures - target	A	R												
Identifying refinement options		AR					C							
Determining trade-offs		AR					C							
Selecting / approving changes	A	R	C			C								
Implementing changes		AR												
Assessing implementation plan execution	A	R	C			C	C		C					
Comparison of performance assessment	A	R											R	
Report assessment	A	R											R	
Resource pool management														
Allocating IT resources	AR						R		R					
Allocating business resources											AR			
Identifying stakeholders	A	R												
Creating communication pack. package		AR												
Delivering communication		AR												

Nineteen semi-structured interviews were conducted with respondents in the four case studies. The research team members analyzed all interview transcripts from their case organization. That is, the text excerpts in which respondents argued the design choices in the case organization and preferences were highlighted. Then, the arguments were categorized. To illustrate, the first two differences in case organization 1 are explained below supported by some interview quotes from respondents.

Steering by PRB (reference model) versus steering by a table structure (organizational model)
Four out of five respondents pointed to workload as the reason for the existence of different tables. Pragmatic reasons were also mentioned. The chair of the intake table explained, "Otherwise it becomes very complicated which people to have at such a table." Other possible reasons mentioned were the required knowledge of the respondents, alignment with chain goals and decision making at different levels.

Financial manager (reference model) versus no financial manager in the chain structure (organizational model)
The lack of a financial manager in the chain has two primary causes according to respondents. The controller, "For the chain, it is more about setting substantive priorities within the framework than real financial management." In addition, the context of a government organization was also mentioned as a cause. The architect articulated this as "In a commercial organization, if you don't get financial management right, you immediately have a potential business risk. For a government agency, this is a different situation. "

In summary, the prototype reference model was recognized within the four case organizations by the respondents and thus validated in practice. The organizations deviated from the reference model at a number of points and the respondents provided credible arguments for these deviating design choices. Moreover, it became apparent during the interviews that the reference model served well as an instrument for systematically analyzing the current design of ITPPM governance in the respective organization. A total overview of the explanations for the differences and their substantiation with interview quotes can be requested from the corresponding author of this article.
- *Cross-case analysis (step 7):*
During the cross-case analysis, the differences and similarities were analyzed between the prototype reference model and the local design of ITPPM in the four case organizations. This revealed some corresponding differences.

Firstly, the ITPPM maturity assessment and gap analysis and capability assessment subprocesses were not set up in two case organizations. However, eight of the nine respondents expressed a preference for setting up these subprocesses in their organizations. Secondly, in the reference model, the PRB has authority for a number of activities, while in three case organizations, senior management has authority for these activities. A possible explanation for this is what a respondent reported, “This design has to do with the way the organization prefers to organize decision-making, which is along the lines of management teams and they don't want to be taken by surprise". Thirdly, in the reference model, the PRB is responsible for the governance and organization and implementation plan subprocesses. In two case organizations, this responsibility lies with individual functions, such as the portfolio manager. A possible explanation for this is what a respondent mentioned, “Within the organization, we describe things focused on individual officers.” Fourthly, according to the reference model, a limited number of roles are consulted during process activities. In two case organizations, however, more extensive role consultations takes place. A possible explanation for this is what a respondent reported, "Sometimes too many roles gets a change to say something. This fits the organization's culture." Another respondent pointed out that this is related to the complexity of the organization. Lastly, the reference model does not include roles for the process activity resource pool management. Two organizations did assign roles to this process activity. This can be explained by the lack of an adequate role description of this activity in the literature.
- *Redesign of the prototype reference model (step 8):*
The cross-case analysis revealed limited corresponding differences between the prototype reference model and the local design of ITPPM in the four case organizations. We argue, therefore, that the reference model is of sufficient quality and has been validated in this way. A redesign of the reference model was not necessary for that reason.

5 CONCLUSIONS

The research approach and research results are discussed in this section. Conclusions are also drawn and recommendations made for the use of the reference model in practice and future research.

This study first conducted a SLR, which resulted in an overview of ITPPM processes, roles, responsibilities and authority, and their descriptions. Second, a RACI matrix was created based on these components. Third, this prototype reference model was tested in a single case study. Fourth, the reference model was reanalyzed and redesigned, and fifth, this redesigned prototype reference model was validated in a multiple-case study by the experiences of ITPPM practitioners. Finally, the practitioners’ arguments for local design choices were categorized and listed. These research steps were conducted according to the methodology design and proved suitable for arriving at a validated reference model for ITPPM governance in terms of processes, roles, responsibilities, and authority, so that redesign was not necessary.

Recent literature lacks a comprehensive, practice-validated reference model for ITPPM governance. Therefore, this study has provided a comprehensive and empirically validated reference model for ITPPM governance in terms of processes, roles, responsibilities, and authority. In addition, local deviations from the reference model are indicated. Practitioners were able to provide credible evidence

for these deviations. These deviations can be considered local practices and may be applicable to other organizations as well. Moreover, during the multiple-case study, our model proved to be an appropriate reference to systematically analyze and discuss past design choices in an organization, and identify areas for improvement. It prompted respondents to reflect on past ITPPM design choices within the organization. Therefore, we argue that the research findings of this study provide a strong indication of the validity of the reference model. Thus, we achieved the objective of this study.

A first limitation of this study is that it is based on respondents' recollection and perceptions of their experiences with ITPPM rather than on our own direct observations in the field. A second limitation is that it is based on the quality of practitioners' experiences. Proper selection of respondents is important in this regard. Therefore, we used respondents' experience as a selection criterion. Respondents had to have worked within the organization for at least three years in a role related to ITPPM. However, experience does not necessarily guarantee expertise. Sengupta, Abdel-Hamid, and Van Wassenhove (2008) pointed out that experts do not always learn from their experience effectively. Learning in practice means that actions and outcomes are systematically evaluated, which practitioners very often have difficulty to find time for. We were not able to test the concrete expertise of the respondents beforehand. A third limitation is that pragmatic validity (Aken & Adriessen, 2011) was not tested. Practitioners evaluated the prototype reference model based on their actual experiences, but the theoretical reference model was not used for the actual design of ITPPM in organizations.

Some interesting deviations were found during the case studies, where respondents substantiated their preference for local design in their organizations. Therefore, it can be concluded that our model is a good reference, but local conditions should be taken into account during development of ITPPM governance. There is no one size fits all approach, rather ITPPM processes and roles needs to be tailored to best fit an organization and its context (Blomquist & Müller, 2006; Castro & Carvalho, 2010; Killen & Hunt, 2011; Kock & Gemünden, 2021).

Academic research to date provides limited insight into the organizational factors that influence ITPPM implementation (Ajjan et al., 2016). Future research could focus on the factors that contribute to successful ITPPM implementation. Furthermore, organizations with mature ITPPM are more successful than those with less mature ITPPM (Jeffery & Leliveld, 2004; Mosavi, 2014; Zarghami & Dumrak, 2020). These differences in maturity leading to different levels of benefits highlight the importance of figuring out which ITPPM processes are needed to deliver higher levels of benefits to the organization.

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REFERENCES

Ajjan, H., Kumar Ram, L. & Subramaniam, C. (2016). Information technology portfolio management implementation: a case study. *Journal of Enterprise Information Management*, 29(6), 841-859.

Aken, J. van & Andriessen, A. (Eds.). (2011). *Handboek ontwerpgericht wetenschappelijk onderzoek*. Den Haag, The Netherlands: Boom Lemma.

Alholjailan, M.I. (2012). Thematic Analysis: A critical review of its process and evaluation. West East *Journal of Social Sciences*, 1(1), 39-47.

Benbasat, I., Goldstein, D. & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, 11(3), 369–386.

Blomquist, T. & Müller, R. (2006). Practices, Roles, and Responsibilities of Middle Managers in Program and Portfolio Management. *Project Management Journal*, 37(1), 52-66.

Cabanillas, C., Resinas, M., & Ruiz-Cortés, A. (2012, September). Automated resource assignment in BPMN models using RACI matrices. In *OTM Confederated International Conferences "On the Move to Meaningful Internet Systems"* (pp. 56-73). Springer, Berlin, Heidelberg.

Castro, H. G. D. & Carvalho, M. M. D. (2010). *Gerenciamento do portfólio de projetos (PPM): estudos de caso*. Production, 20(3), 303-321.

Cooper, R. G. & Edgett, S. J. (2001). *Portfolio Management for new Products: Picking the winners*. Ontario, Canada: Product Development Institute.

Cooper, R. G., Edgett, S. J. & Kleinschmidt, E. J. (1997). Portfolio management in new product development: lessons from the leaders – II. *Research Technology Management*, 40(6), 43-52.

Eisenhardt, K. M. (1989). Building theories from case study

research. *Academy of management review*, 14(4), 532-550.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, 5(1), 1-4.

Erasmus, W. & Marnewick, C. (2020). An IT governance framework for IS portfolio management. *International Journal of Managing Projects in Business*, 14(3), 721-742.

Frey, T. (2014). *Governance Arrangements for IT Project Portfolio Management: Qualitative Insights and a Quantitative Modelling* Approach. Wiesbaden, Germany: Springer.

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Communication and Technology Journal*, 29(2), 75–91.

Hevner, A. R., March, S. T., Park, J. & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, 28(1), 75-105.

Hoffmann, D., Ahlemann, F. & Reining, S. (2020). Reconciling alignment, efficiency, and agility in IT project portfolio management: Recommendations based on a revelatory case study. *International Journal of Project Management*, 38(2), 124-136.

Hofman, M., & Grela, G. (2015). Project portfolio risk identification-application of Delphi method. *Journal of Business and Economics*, 6(11), 1857-1867.

Jeffery, M. & Leliveld, I. (2004). Best Practices in IT Portfolio Management. *MIT Sloan Management review*, 45(3), 41-49.

Killen, C. P. & Hunt, R. (2009). Project portfolio management maturity model for dynamic environments. In *Australian Institute of Project Management conference*. The Australian Institute of Project Management.

Killen, C. P., Jugdev, K., Drouin, N. & Petit, Y. (2012). Advancing project and portfolio management research: applying strategic management theories. *International Journal of Project Management*, 30(5), 525-538.

Kitchenham, B. (2004). *Procedures for performing systematic reviews*. Keele, UK, Keele University.

Kock, A. & Gemünden, H. G. (2021). How entrepreneurial orientation can leverage innovation project portfolio management. *R&D Management*, 51(1), 40-56.

Kopmann, J., Kock, A., Killen, C. P. & Gemünden, H. G. (2017). The role of project portfolio management in fostering both deliberate and emergent strategy. *International Journal of Project Management*, 35(4), 557-570.

Kumar, R., Ajjan, H. & Niu, Y. (2008). Information Technology Portfolio Management: Literature Review, Framework, and Research Issues. *Information Resources Management Journal*, 21(3), 64-87.

Lima, A., Monteiro, P., Fernandes, G. & Machado, R. J. (2016, September). Mapping between artefacts and portfolio processes from the PMI standard for portfolio management. In *EuroSymposium on Systems Analysis and Design* (pp. 117-130). Springer, Cham.

Maimbo, H. & Pervan, G. (2005). Designing a case study protocol for application in IS research. *Proceedings of the Ninth Pacific Asia Conference on Information Systems (PACIS 2005)*, 1281-1292.

Maizlish, B. & Handler, R. (2005). *IT Portfolio management Step-By-Step: Unlocking the business value of technology*. Hoboken, NJ, USA: Wiley.

Martinsuo, M. (2013). Project portfolio management in practice and in context. *International Journal of Project Management*, 31(6), 794-803.

Merriam, S.B. (2009). *Qualitative Research. A Guide to Design and Implementation* (2nd ed.). San Francisco, Jossey-Bass.

Meskendahl, S. (2010) The influence of business strategy on project portfolio management and its success – a conceptual framework. *International Journal of Project Management*, 28(8), 807–817.

Micán, C., Fernandes, G. & Araújo, M. (2022). A method for project portfolio risk assessment considering risk interdependencies–a network perspective. *Procedia Computer Science*, 196, 948-955.

Mosavi, A. (2014). Exploring the roles of portfolio steering committees in project portfolio governance. *International Journal of Project Management*, 32(3), 388-399.

ul Musawir, A., Abd-Karim, S. B. & Mohd-Danuri, M. S. (2020). Project governance and its role in enabling organizational strategy implementation: A systematic literature review. *International Journal of Project Management*, 38(1), 1-16.

Pennypacker, J.S. (2005). *Project portfolio management maturity model. Pennsylvania*, USA: Center for Business Practices.

PMI. (2017). *A guide to the project management body of knowledge* (6th ed.). Pennsylvania, USA: Project Management Institute.

Reyck, de B., Grushka-Cockayne, Y., Lockett, M., Calderini, S. R., Moura, M. & Sloper, A. (2005). The impact of project portfolio management on information technology projects. *International Journal of Project Management*, 23(7), 524-537.

Saunders, M., Lewis, P., Thornhill, A., Booij, M. & Verckens, J. P. (2011). *Methoden en technieken van onderzoek* (M. Booij & J.P. Verckens, Trans. 5e ed.). Amsterdam, The Netherlands: Pearson Education.

Sengupta, K., Abdel-Hamid, T. K., & Van Wassenhove, L. N. (2008). The experience trap. *Harvard Business Review*, 86(2), 94-101.

Skulmoski, G. J., Hartman, F. T. & Krahn, J. (2007). The Delphi method for graduate research. *Journal of information technology education*, 6, 1-21.

Wieringa, R. J. (2014). *Design Science Methodology for Information Systems and Software Engineering*. London, England: Springer.

Wissenburg, R., Kusters, R., Martin, H., & Evers-Wagemakers, J. (2022, June). IT Project Portfolio Assessment criteria: development and validation of a reference model. In 2022 *IEEE 24th Conference on Business Informatics (CBI)* (Vol. 1, pp. 136-145). IEEE.

Yin, R. K. (2018). *Case Study Research and Applications: Design and methods* (6th ed.). Thousand Oaks, CA, USA: Sage.

Zarghami, S. A., & Dumrak, J. (2020). Application of system dynamics in the assessment of project portfolio performance. *International Journal of Industrial Engineering and Management*, 11(4), 253-262.