Emerging Challenges in Innovation Portfolio Management: The Nordic Case

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Abstract: This empirical study revisits extant guidelines for portfolio management of research and innovation projects considering recent managerial challenges emerging such as artificial intelligence. The aim of the study is extending theory on project portfolio management (PPM) by examining knowledge-intensive Nordic organizations that focus on digitalization as a central part of their value creation, and subsequently assessing how well existing guidelines incorporate practices emerging from digitalization. Three aggregate dimensions are identified as important indicators of emerging challenges to the field of PPM research and practice – (1) *technology* – and more specifically the influence of artificial intelligence, (2) *roles* in social networks and (3) *variation* in different contexts. These dimensions offer improved granularity and nuanced understanding of how to handle technological complexity in the strategic portfolio management of research and innovation projects.

Keywords: Artificial intelligence; contextual complexity, contextual variation, digitalization; innovation management best practices; project portfolio management (PPM); social networks.

1. Introduction

More than 25 years have passed since Cooper, Edgett, and Kleinschmidt (1997, 1998) identified best practices for innovation management, and since then stage-gate guidelines have been a norm among practitioners and researchers alike. Extant research suggests common elements, themes and success factors related to best practices for portfolio management of research and development (R&D) (Cooper et al., 1998; Menke, 2013). In this context, project portfolio management (PPM) has been recognized as a valuable approach in research and innovation environments (Castro & Ferreira, 2020; Yamakawa et al., 2018).

However, two recent review articles addressing portfolio management guidelines (Hansen & Svejvig, 2022; Yamakawa et al., 2019) raise concerns about how extant guidelines sufficiently incorporate contemporary innovation portfolio challenges triggered by e.g. digitalization. Contemporary challenges are accentuated due to increased pressure for both continuous and radical change, increased pressure for solutions and explanations that handle complex problems as well as assuring that the portfolio management of research and innovation is aligned with strategy (Cooper, 2015; Floricel & Ibanescu, 2008; Smith & Sonnenblick, 2015). Current research suggests that emergent challenges are especially prevalent in knowledge-intensive organizations working with development of services, as the topics and issues that are researched – as well as their expected outcomes – are often more complex by nature and interconnected with digital technologies (Hansen & Svejvig, 2022; Killen & Hunt, 2010; Aas et al., 2015). However, research on PPM practices in service firms are still scarce (Killen et al., 2008; Yamakawa et al., 2019). Recent review articles on PPM highlight the importance of thinking more strategically about innovation processes, due to at least four emerging challenges: (1) the presence of multiple portfolio sub-categories as well as (2) the synergies between them, (3) increased complexity in decision making and (4) a future of more cyclical, temporary understandings of project portfolios (Castro & Ferreira, 2020; Hansen & Svejvig, 2022; Yamakawa et al., 2019).

Consequently, there is a need to assess how current guidelines provide an overarching strategic framework that address and handle the emerging contemporary challenges. Therefore, we aim at extending theory on PPM guidelines with an empirical study of current developments in portfolio management practices in research and innovation environments of selected Nordic service firms. We have completed the study in a Nordic setting of knowledge-intensive firms. The Nordic region is characterized by a high percentage of firms in knowledge intensive services, and the region is characterized as early adaptors of digitalization and correspondingly with a high penetration of digital tools both in organizations and the broader population. The study offers improved granularity by revealing three important emerging dimensions effecting current PPM practice in the selected context. These dimensions are (1) technology – and more specifically the influence of artificial intelligence (AI), (2) roles in social networks and (3) variation in different contexts.

2. Theory

R&D work has long constituted an important part of the strategic growth tactic utilized by organizations to build and maintain competitive advantage (Nobelius, 2004; Roussel et al., 1991). In this context, portfolio management is considered a popular method for managing larger R&D portfolios (Cooper et al., 1998) and linking individual initiatives with the strategic priorities of the organization with the purpose of sustained competitiveness through innovation (Roussel et al., 1991). More specifically, PPM has become a particularly popular branch within the field of portfolio management in organizations that are working with new product development (NPD), policy development and R&D (Cooper et al., 1998; Yamakawa et al., 2019). Early versions of classic "portfolio management" can be dated back to Markowitz (1952) who used mathematics to better understand the optimal compositions of financial portfolios. PPM has since developed through a focus on NPD and stage-gate models (Archer & Ghasemzadeh, 1999; Cooper et al., 1999) to more practice-oriented models (Martinsuo, 2013) with increased focus on adaptability (Petit, 2012) and higher levels of uncertainty and complexity (Kaufmann et al., 2020; Killen et al., 2015). Researchers belonging to the latter categories often argue that it is difficult to identify a single, rational best practice approach to the utilization of PPM in R&D environments, mainly due to its context dependent nature (Martinsuo, 2013; Martinsuo & Geraldi, 2020).

Nonetheless, empirical studies have been published throughout the years describing how PPM is best utilized from different positions (e.g., Cooper et al., 1998; Killen et al., 2008; Menke, 2013). A classic contribution is from Cooper et al. (1998), in which they describe six performance metrics that delineate the portfolio performance of the successful R&D organization. Killen et al. (2008) present a "best practice" PPM benchmark study, in which they relate practices across several Australian cases to specific performance outcomes. In addition, they explicitly advocate for a strong degree of commonality across a broad range of industries, albeit with a primary focus on private sector markets. In addition, Menke (2013) has completed a comprehensive benchmarking study detailing a range of top-practices (scored on performance and importance) related to the process of conducting strategic R&D portfolio management.

More recent reviews of the flourishing literature on PPM distinguish between different sub-categories (Yamakawa et al., 2019), theoretical streams (Hansen & Svejvig, 2022) and importance in the "front-end of innovation" (Castro & Ferreira, 2020) in order to add granularity in the understanding of important distinctions between different complex contexts. While portfolio management has long been considered a popular go-to method for ensuring proper management of larger R&D portfolios (Cooper et al., 1998), such projects often fail as they are considered difficult to predict due to their up-front costly, risky and long-term nature (Menke, 2013). An example relating to how service firms rely on knowledge is; "*Production of services demands, in general, a more holistic exchange of intangibles, skills and knowledge, and processes across organizational boundaries*" (Hansen & Svejvig, 2022, p. 285). Moreover, existing best-practices descriptions in literature related to PPM do not sufficiently describe the impact that digitalization can have, for example through the influence of AI, and modern, knowledge-based organizations face an increasingly complex task when it comes to effectively prioritizing resources across project portfolios without AI influencing the targets and decision

making. Therefore, the purpose of this study is to supplement extant portfolio management guidelines with an improved understanding of emerging challenges that foster new practices by answering the RQ: *What are emerging challenges for innovation portfolio management practices in knowledge intensive firms?*

3. Method

Our aim is to explore the phenomenon of emerging challenges for PPM making use of an embedded case study design in the context of knowledge-intensive service firms engaging in research and innovation work, with the purpose of extending theory on portfolio management (Yin, 2018). The case selection is informed by recent literature reviews (Hansen & Svejvig, 2022; Yamakawa et al., 2019) and earlier PPM best practice studies focusing on R&D environments (Cooper et al., 1998; Menke, 2013). The selected organizations are service firms from different industries (telecom, data protection and transport solutions), and they all rely heavily on digitalization. In addition, they are all incumbent in Nordic countries (Sweden, Denmark, Norway, Finland and Iceland), which is important to the study as we consider the Nordic context unique in terms of leadership culture and the trust-based nature of Nordic organizations (Gustavsen, 2011) as well as being highly dependent on knowledge-intensive services for employment (Benner, 2003).

The case is *embedded* as we have interviewed people working in R&D functions in the selected organizations, for example Heads of R&D, R&D portfolio coordinators and researchers in charge of large strategic projects – roles that exist in all the selected organizations – ultimately to better understand the phenomenon of current PPM practices in service firms. The names of the firms have been anonymized on their request. Informants were selected based on their role in the organization and their insights concerning the portfolio management practices. From the initial interview in all organizations, we used a “snowballing" approach (Noy, 2008) by asking the informant whom else we should contact to get a full image of the situation and, ultimately, achieve veracity. While the qualitative interviews make up the primary data for the study, we also completed several informal conversations with people from C-suite to operational levels and collected secondary data sources in the form of articles and reports written by and about the organization. For the interviews we designed a semi-structured interview guide using the most recent R&D PPM best practice study (Menke, 2013) in the Nordic organizational context. Interviews are in progress, and so far, 11 interviews have been completed. All interviews took approximately an hour and were recorded using either third-party software (online) or a dictaphone (physical).

The conversations were transcribed and coded inductively through NVivo, which is a qualitative data analysis software program. The first round of coding resulted in a comprehensive compendium of first-order instances from across the interviews to ensure qualitative rigor (Gioia et al., 2012). More specifically, we started by coding the interviews individually, and subsequently identifying patterns that emerge across organizations in the analysis (Eisenhardt, 1989).

4. Findings

The analysis consisted of several rounds of inductive coding of the transcribed interviews with the purpose of transforming the raw data into pattern codes (see also the following table 1).

Table 1 Codes that emerged through the inductive process.

Overview of emerging pattern codes	No. of interviews	References
Adaptive	8	32
Artificial intelligence	7	23
Barriers to PPM	5	16
Competences	6	16
Contextual approaches	3	5
Coordination	4	9
Decision making	4	7
Funding	6	16
Future technology scenarios	7	13
Governance	9	19
Knowledge transfer	7	20
Measurements & monitoring	4	13
Networks	8	28
Organization structures	7	30
Paradoxes	6	21
Partnerships	6	20
Politics	2	6
Portfolio planning	6	11
Prioritization	7	30
Risk	3	7
Strategy process	5	8
Technical systems	5	9
Trust	9	21
Value	8	33

As a result of multiple iterations performed both independently – and in collaboration – by the members of the research team, some codes have been both added and deselected due to lack of substance or coherence. Once we were satisfied with the initial coding of the individual instances from the interviews, we were able to compare codes and abstract them into overall aggregate dimensions. Codes that were incorporated in the dimensions contain at least one instance from each of the organizations. Currently, data has been collected and analyzed from 11 interviews across four Nordic organizations that all work with portfolio management of their research and innovation initiatives.

As a result of the second-order (aggregate dimension) phase of the analytical process that goes across the first-order codes highlighted in table 1, and inspired by the Gioia methodology (Gioia et al., 2012), we identified three valuable supplements to the field of PPM research and practice in the form of three important emerging themes. These second-order aggregate dimensions are (1) *technology* (and particularly AI changing the game), (2) *roles* in social networks, and (3) *variation* as a response to different local contexts. The analytical process is illustrated in the following figure 1.

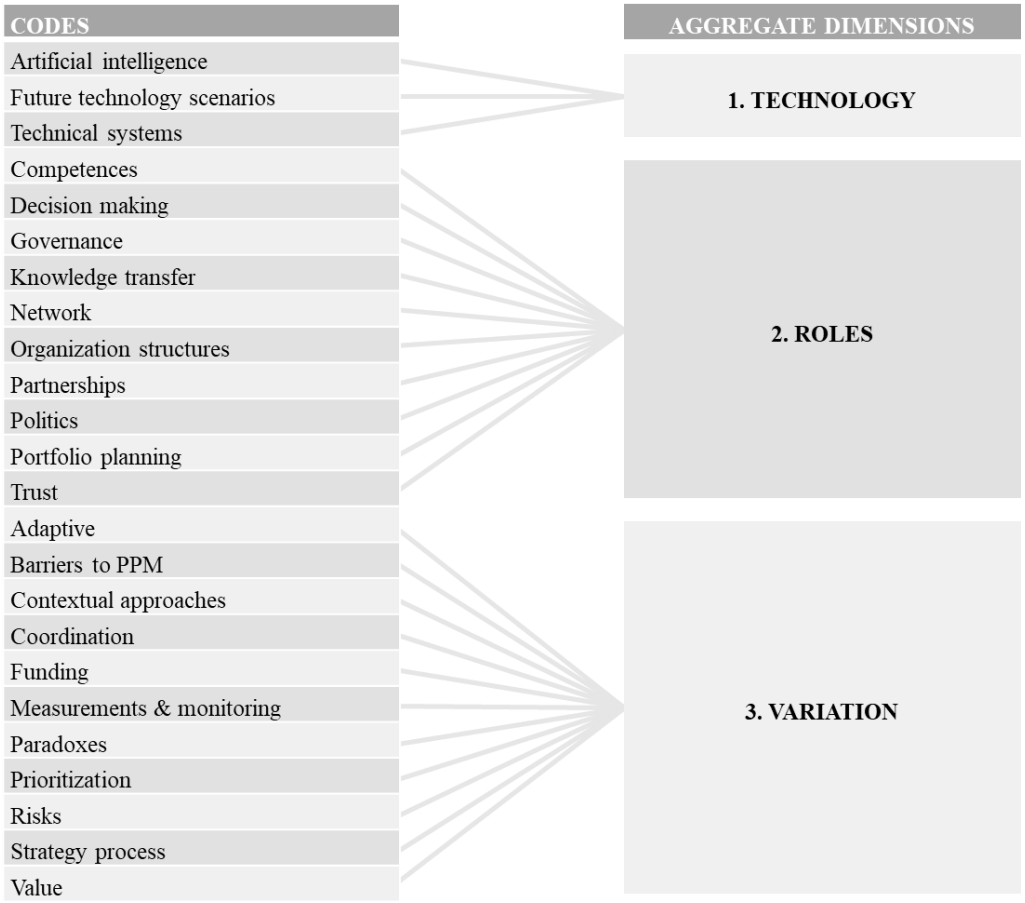

Figure 1 Formation of second-order aggregate dimensions through the Gioia methodology

4.1. Technology uncertainty –AI changing the game

The first finding is identifying how technology – and more specifically AI – is changing the game of managing a strategic innovation portfolio. While earlier studies have emphasized the influence increased complexity can have on portfolio management practices (Killen et al., 2015; Martinsuo, 2013), the prospects and direct influences of AI and the substantial complexity it brings to the organization suggests radical changes to the role of portfolio management in research and innovation environments. In this case, the "technology" dimension therefore varies from *simple* to more *complex* influences of technology and technological development. One example observed is in a Norwegian telecom operator, where projects involving AI are handled very differently as they work with programming and creating algorithms. "*It is within the department that works with AI and machine learning (…) they work in a very agile way through the OKR [objectives and key results, red.] framework. It is an approach we have tried to implement in the entire Research department, but it has not been adopted. It is too intricate*" (Respondent D). From the perspective of a different organization, another respondent refers to the unique complexity in their approach to advanced engineering. "*About a third of that total amount of money is for advanced engineering. The advanced engineering money, we don't follow up, and I think this is where the issue of trust is even more important. We just distribute that to the line organization to spend where they think it's most appropriate*" (Respondent F). In several of the observed cases, AI as a topic transcends individual strategic programs and instead forces the organization to think across formal areas and programs. "*especially with new topics related to digital transformation. It goes across siloes, across research programs. For example with sustainability and digital transformation. All this new kind of AI. They don't fit into one single programs, so they have a strong element in trying to find synergies."* (Respondent A). Accordingly, at a Norwegian company working with assurance and risk management, the possibilities of AI are

accompanied by the challenge of securing organizations and knowledge against the inherent complexities of big data. This begs the question if AI should play an active role in the targeting, selection or decision-making processes.

4.2. Roles – in social networks

The second finding concerns the importance of social networks in portfolio-related processes and the many differing (*formal* and *informal*) roles that arise as a consequence. Several respondents consider the network aspect a key determinant in terms of both what projects are initiated and ultimately become successful. The aggregate "roles" dimension therefore varies from formal to informal roles related to the portfolio management practices of the organization. From the telecom perspective, "*personal relations are very important. Internally in the company possibilities often arise when you have good relations and personal relations linked to environments outside the research department*." (Respondent D). An earlier empirical study from the telecom industry similarly considers the company a social community that relies heavily on the effective creation and transfer of knowledge. (Elter & Myhre, 2014). The importance of long-term mutual and trust-based relationships are highlighted several times in the interview process. "*Successful research is a function of personal networks. (…) the ability for us to influence decision makers is through socialization. It's through building and nurturing personal networks*" (Respondent G). However, it is also recognized as a much more "soft value" that is difficult to track and follow up on, as one respondent highlights, "*To count the value, you have the hard value and the soft value. (…) It's the soft value that's even harder. The job satisfaction, the networking, the competence development, the code creation opportunities. This gets much more difficult*." (Respondent F). In this case, the role of portfolio management serves an entirely new role as "boundary spanner" that creates value through facilitation of the network.

4.3. Variation – as a response to different contexts

The third finding, also speaking to a growing field of practice-oriented literature, highlights how portfolio management practices (or needs) are also sensitive to context. Both in relation to the unique context of the individual organization as well as different types of research or innovation projects within the organization. This final "variation" dimension therefore varies from *low* to *high* degrees of variation depending on the organizational context. According to respondents, the context can differ significantly depending on what part of the organization – and even what part of the Research department – you're focusing on. "*Portfolio management at the project level takes place through a dynamic process wherein the researchers themselves come up with a set of ideas. And then a set of external drivers from the company and society (…) This is where a new project is created.*" (Respondent B). "*it's different cultures depending on what kind of area you're dealing with – how you do work and control projects."* (Respondent D). Several examples are highlighted of different types of projects calling for adapted approaches to portfolio management depending on the unique context. For example, in the telecom operator it is highlighted how the departments that work with AI and machine learning work in a different, much more informal and adaptive way compared to the low risk and short-term development activities. "*We are still testing technologies related to 5G, 6G, Cloud Edge technologies, AI and machine learning. These are the focus areas for us (…) And then the third type of projects in the bucket, which I think is more in the portfolio management type of activities, are shorter term development, innovation projects where we typically have the business unit or customer need well-defined*" (Respondent G). Similarly, respondents from the organization working with transport solutions emphasize that the level of intervention from portfolio management changes significantly as projects mature. "*From the beginning it's more supporting and at the end it's more demanding. (…) that is the big difference in how you treat it."* (Respondent I). Consequently, we highlight variation as a third overall aggregate dimension of significance when it comes to adjusting the portfolio management practices in the case organizations.

5. Discussion

Several of the codes that emerged from the interview process correspond well with existing classic research on PPM, focusing for example on resource allocation (Cooper et al., 1997), prioritization (Cooper et al., 1999), project evaluation (Archer & Ghasemzadeh, 1999), risk management (Olsson, 2008) and alignment with strategy (Meskendahl, 2010). However, in addition to these classic formal PPM sub-categories (Yamakawa et al., 2019), a number of informal elements emerged through the inductive analysis representing "softer" approaches to handling portfolio-related issues, e.g. related to digitalization. Examples include "adaptiveness", "networks" and "trust", the latter two of which arguably only exist in the periphery of extant literature, whereas more adaptive approaches to PPM have begun to take hold in the predominant scholarly paradigm (Kaufmann et al., 2020; Petit, 2012; Romano, 2017). Finally, several codes contained both informal and formal instances – a dichotomy that is also represented in the existing PPM literature for instance when it comes to "value" (Cooper et al., 1998; Martinsuo & Killen, 2014), "knowledge transfer" (Davenport et al., 1998; Pemsel & Wiewiora, 2013) and "decision making" (Archer & Ghasemzadeh, 1999; Blichfeldt & Eskerod, 2008).

In R&D management, technological advancements have long been expected to have a significant impact on portfolio management practices (Nobelius, 2004). In a study by Cooper (2015), he describes how some companies, when faced with high technical uncertainty, modify their portfolio management approach to "make it much more agile, adaptive, and entrepreneurial in order to handle bolder, riskier breakthrough projects" (p. 29). However, whereas Cooper continues to focus on more rational ways of handling such technical uncertainty and attempts at (re-)gaining *control*, the data from our embedded case study indicates that the purpose of portfolio management changes entirely. The complexity brought about by technology – and particularly AI – calls for more collaboration across topics and therefore the professional department structures. More specifically, instead of being fixated on controlling the portfolio through different structural (e.g., agile) processes and iterations, the organizations choose to actively let go of control when it comes to portfolios of innovative early-stage projects. In this case, the primary purpose of portfolio management becomes one of creating an *overview* and providing support to the projects and processes when necessary. These findings coalesce well with the recent PPM review study by Hansen and Svejvig (2022, p. 285), as they find a growing trend of portfolio management with focus on "relationships embedded in networks" and "downward in organizations to how people translate, improvise, and make sense of PPM in practice". (p. 285). They highlight the shift from tangible products to organizations as providers of services as an important explanation for increased complexity and the need for more holistic approaches (Hansen & Svejvig, 2022; Killen & Hunt, 2010). By focusing explicitly on the phenomenon of PPM in service firms, we can show empirically some of these trends in action.

Andriani (2011, p. 454), states that, "*The more a society turns knowledge-intensive, the more dominant network effects become*." When it comes to the dimension of roles in social networks, researchers have argued for the critical role of boundary spanning in the development and diffusion of research and innovation (Tushman, 1977). And more recently, researchers have begun focusing on the role of the central project management office (PMO) as a knowledge broker across the portfolio (Julian, 2008; Pemsel & Wiewiora, 2013). In our data, this role is showcased in the example of a project called "Redo 2" carried out by a Swedish global provider of transport solutions. The project is the result of a merger between an on-going initiative related to human-machine interface (HMI) at the company and a connectivity-related project at a large Swedish university. The merger was initially identified and facilitated at the portfolio level, "when our ongoing HMI project wanted to do the extension, we knew that [the university] would be a good partner to work with in the follow-up study. So, the technology leader made the bridge between these two projects." (Respondent F). The technology leader in this case brokering the contact and link between research projects. While networks are by nature often characterized as an inherently social entity, network management can still be a continuous and planned activity in response to increasingly complex circumstances (Klijn & Koppenjan, 2014). More specifically, Julian

(2008) emphasizes key capabilities such as promoting social relationships across the network, encouraging learning from project successes and failures and acting as a facilitator to support reflection at the project level.

Finally, in relation to the third dimension of variation across the organizational contexts, researchers from the practice-oriented branches of literature argue that more context-aware forms of PPM should be equally viewed as local processes of negotiation and bargaining as much as rational processes when it comes to making decisions and handling uncertainties and complexities (Martinsuo, 2013). Martinsuo and Geraldi (2020) emphasize that "*Project portfolios exist to make an impact in their context (…), but the context evolves over time*" (p. 441), thereby rendering the "one size fits all" notion behind standardized portfolio management rather outdated. This can become a significant challenge to companies that rely on existing guidelines, as they often lean towards the standardized models of managing innovation portfolios. Turning again to the publication by Cooper (2015, p. 32), he rounds off the article by stating that "*at the end of the day, it all boils down to climate and culture*" as integral to successful portfolio management, thereby also acknowledging the importance of looking beyond the formal/central office to achieve portfolio success.

6. Conclusion

While portfolio management has long played an important and noticeable role in innovation management, the field still suffers from scarcity in contemporary empirical studies of innovation portfolio management practices from environments working with AI technology. With this study we addressed the initial RQ of what are emerging challenges for innovation portfolio management practices in knowledge intensive firms. Our study reveals how current practices increasingly reflect (1) the impact of complex *technology* (and AI more specifically), (2) informal *roles* in social networks, and (3) *variation* as a response to different contexts. With the study we therefore offer improved granularity within the field of innovation portfolio management research by showing empirically what practices are used to address current challenges faced by modern, knowledge-based organizations that all focus on (and are significantly influenced by) digitalization. The main implications of these findings are, first, a shift in the role of the formalized portfolio management structure (for example in the form of top leadership or a PMO) from having a dominantly controlling towards a more overviewing and supportive function. Second, to properly activate and utilize the idea of an internal network, the entire research and innovation organization must understand their part as individual contributors to a holistic portfolio of initiatives.

The contribution of our study is an emerging empirically based understanding of how extant portfolio management guidelines can be updated to handle current emerging challenges when managing a portfolio of innovation projects. The contribution of this study to innovation management is a nuanced understanding of how portfolio management practices can best be utilized to accommodate for the influence of digitalization, and AI more specifically, when working with research and innovation, thus improving the link to organization strategy.

The findings have important implications for innovation management practitioners and managers seeking to optimize portfolio management practices in organizations working with research and innovation as a strategic growth tactic. Organizations are faced with increasingly complex contexts, as AI is increasingly influencing the target-setting for research and innovation activities and strategic prioritizations of the innovation portfolio. Consequently, supplementary approaches to portfolio management can be applied to accommodate for such changes.

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