Distinguishing Innovation Portfolio Configurations in the Knowledge-Intensive Organization

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Abstract: For several decades extant guidelines have been formulated to prescribe the best approaches to innovation portfolio management (IPM) in organizations that rely on research and innovation to compete in the market. More recent review studies on the field of IPM show that practice is evolving rapidly to accommodate for digitalization. Empirical data is collected from six Nordic organizations that are knowledge-intensive and all rely on digitalization in value creation. In an attempt to buffer uncertainty under varying circumstances, the organizations apply different approaches to structural elements such as interdependence and coordination. For example, in organizations facing reciprocal interdependence, and generally complex circumstances, action is coordinated through mutual adjustment. In light of the findings, we propose three configurations of product, platform and problem portfolios, relating these to the technology typology proposed by Thompson (1967).

Keywords: Innovation portfolio management (IPM); digitalization; knowledge-intensive; innovation management; product portfolios; platforms; problem orientation.

1. Introduction

This empirical paper extends the stage-gate approach that was established as a gold standard for innovation portfolio management (IPM) since Cooper, Edgett and Kleinschmidt's (1998) seminal work. The reason these guidelines (Cooper et al., 1998) are well established and practiced among both researchers and practitioners, is because they guide managers working with IPM in organizations that rely on research and innovation to compete in the market. However, recent review studies on the field of IPM indicate that practice is evolving at an unprecedented rate to accommodate for trends such as digitalization and organizations becoming more knowledge-intensive, which results in portfolios that are much more oriented towards agility, adaptability and emerging strategies (Hansen & Svejvig, 2022). While the broader field of organization studies have long acknowledged the presence (and necessity) of nuanced approaches to organization development (Thompson, 1967), the field of IPM is still in a relatively nascent stage and has held on to a predominantly functionalist view of the world. This is particularly relevant in a world that is becoming increasingly complex with modern industries and organizations shifting from a technical product-focus to becoming more knowledge-intensive and focused on delivering digital services (Eckert and Hüsig, 2022; Aas et al., 2017). Consequently, there is a need to extend current knowledge on IPM practices.

2. Theoretical framework

Innovation Portfolio Management

For several decades research and innovation have been the cornerstone of value creation for any organization that wishes to stand the test of time given volatile market conditions (Roussel et al., 1991). Incumbent organizations often invest vast amounts of resources in the development of new products

and services to stay competitive, but the management of such developments, often recognized by their inherent uncertainty, is considered a challenging task (Cooper et al., 1998). IPM can be defined as "a dynamic decision process, whereby a business's list of active [innovation] projects is constantly updated and revised. In this process, new projects are evaluated, selected, and prioritized; existing projects may be accelerated, killed, or deprioritized; and resources are allocated and reallocated to the active projects." (Cooper et al., 1999, 334). However, trends related to digitalization and organizations becoming knowledge-intensive have only made the task more difficult, as indicated by recent reviews of the literature on IPM (Eckert and Hüsig, 2022; Hansen and Svejvig, 2022).

While the field of portfolio management has moved significantly from a pure financial, to a more practice-oriented perspective (Martinsuo, 2013), it is particularly difficult for the modern knowledge-intensive organization that develops services to understand what constitutes good IPM practice in their context (Yamakawa et al., 2019). Hansen and Svejvig (2022, 285) note the following: "Production of services demands, in general, a more holistic exchange of intangibles, skills and knowledge (…) This change has implications for core elements of the [IPM] discipline, for example, by making the selection and resource allocation processes more complex and dispersed." Consequently, there is a growing call for contributions on the management of innovation portfolios in the context of organizations that are increasingly deliver services as a supplement to physical products, and with a particular focus on digital service innovations (Eckert & Hüsig, 2022; Aas et al., 2017). There is a need to distinguish different types of value creation, which is why we highlight the seminal work of Thompson (1967) to make such a distinction in the following section.

Value Creation Logics

With his research, Thompson (1967) sought to better understand the technologies in complex organizations. In this context, "complex organizations" can be defined as "open systems, hence indeterminate and faced with uncertainty, but at the same time as subject to criteria of rationality and hence needing determinateness and certainty." (Thompson, 1967, 10). It is a natural system that comprises a set of interdependent parts meaning that it is impossible for any organization to comprehend the multitude of variables that are at play and their influences. Nonetheless, Thompson (1967) argues that there are ways for the complex organization to navigate through uncertainty as it is forced to interact in a reciprocal relationship with its environment. By focusing on the technical functions, or technologies, of the organization it is possible to satisfy the rationality criteria of the definition above. At the technical level of the organization, Thompson (1967) distinguishes three different variations: First, the "long-linked technology" that is often likened to the assembly line with its serial interdependence. These circumstances call for management to find ways of optimizing output and effectiveness. Second, the "mediating technology" with the primary purpose of linking different actors together and creating value through aggregate connections in a network. As this technology deals with bringing a wide array of actors together it must operate in a standardized way. And finally, the "intensive technology" that focuses on customizing value creation to fit the individual customer or problem at hand. Its success rests on the availability or combination of the correct capacities.

Thompson's (1967) typology has previously been applied in a study by Stabell and Fjeldstad (1998), in which they use his technological activities to expand the, at the time, reigning notion of the value chain framework (Porter, 1985) to also include the value shop and network configurations. As business models are continually changing, Stabell and Fjeldstad (1998) sealed the idea of organizations fundamentally differing in their approaches to create value and paved the way for additional studies into the inner workings of the different types of organizations. With this study, we focus on the IPM

practices of the knowledge-intensive organization and seek an answer to the following research questions: *What value creation logics are applied in the IPM practices of knowledge-intensive organizations?* And *how can IPM be configured to accommodate for different technological activities?*

3. Methodology

As we argue for the presence of differentiated value creation logics in organizations that deliver intangible products or a combination of products and services, we collected qualitative data from six Nordic organizations. In Figure 1, the six companies have been placed on a scale similar to the "product-service system" illustration propounded by Tukker (2004) wherein he distinguishes five different orientations for value creation. Company 6 has been placed furthest to the left, in the category of "product orientation", as they primarily deliver value through tangible products related to healthcare. Nonetheless, they offer a variety of services related to their product lines and provide clients with unique advisory services as a supplement. While Companies 3 and 4 are widely recognized for the products they produce and have delivered to the market for decades, they also develop and apply a range of use-oriented services enabled by recent technological advancements that constitute a large (and growing) part of their overall value creation. Companies 1 and 2 provide a combination of services (e.g., network and risk management) and products (e.g., telecommunications infrastructure and security certifications), albeit with much higher reliance on services as their core components. Finally, as a consulting firm, Company 5 is arguably the only "pure service" organization and therefore put in the right-hand side of the illustration (Figure 1).

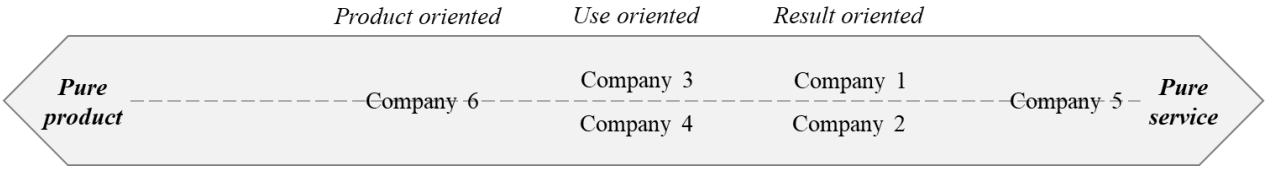

Figure 1 Companies on the "product-service system" scale.

We designed and used a semi-structured interview guide for the interviews that focused on IPM best practices from one of the more recent studies published by Menke (2013). We conducted interviews with a total of 16 informants in relevant roles ranging from VPs, SVPs, senior researchers, managers and directors across the six organizations.The conversations lasted between 45-60 minutes and were recorded using a dictaphone or third-party software for online interviews. We used NVivo to transcribe and code the interviews. For the analysis, we applied the "flexible pattern matching" technique (Bouncken et al., 2021), which allowed us to iteratively match the theoretical patterns proposed by Thompson (1967) with patterns that emerged from empirical data from the informant companies. We used this technique to explore the potential inconsistencies in the application of IPM practices across different types of value configurations. It is from this material and the abductive analytical process that our suggestions for an extension to the conceptualization of IPM emerge.

4. Findings

In the following sections we present the results from our flexible pattern matching process, in which we use the typology advocated by Thompson (1967) as a starting point for empirical curiosity across the knowledge-intensive organizations that were selected for this study. His typology comprises three different value creation technologies labelled the long-linked, mediating and intensive technologies. Within the technologies, we describe examples of specific IPM practices that are highlighted by the informants in the interviews.

Long-linked technology

Activities related to the long-linked technology are highlighted by informants in all the organizations, as they reflect on the more structural and procedural aspects of their IPM practices. Particularly the practices in Company 6 that works with healthcare products are dominated by a long-linked technology logic, as the informants describe their stage-gate method:

> *"When it comes to the portfolio and product development we have two development processes. The one is a scoping process that takes a maximum of five months. In this we have two gates – running a little double diamond, design thinking." (J)*

> *"It is a fairly commercially driven organization, so there is a sharp focus on the cash register at all times. I like that quite a lot. And I do not know if it is not, I mean, "R&D-ish", but at least it provides some direction and a clear set of goals." (M)*

Informants representing the majority of companies (1-4) highlight delimited or differentiated practices associated with the long-linked logic of value creation, as illustrated by the following quotes:

> *"We operate with proxies that have a logical rationale for how value is created. And so we have a set of proxies that go, for example, on number of peer reviewed publications. We use this as a proxy to check research quality." (B)*

> *"We use a stage-gate waterfall project model that is sequential. (…) Every month there are, what to say, steering committee meetings with the leadership where we choose the projects that are up for presentation. Sometimes they give us updates, sometimes it is a gate meeting where we say "have you met the targets required to move on from gate 1 to the next phase of the project?", and then on an ongoing basis we also assess the resource consumption of the projects" (N)*

Only Company 5, which operates in the consulting industry and therefore is characterized as a pure service organization, shows vague signs of long-linked technological activities.

Mediating technology

As the organizations leveraging mediating technologies are faced with great degrees of uncertainty, several informants describe how managers ultimately must trust the individual researcher to help select the right projects for the portfolio. Consequently, IPM tasks are instead shaped to support and bridge connections between projects and stakeholders:

> *"You must trust that what they do is valuable. And then occasionally you help with, e.g., communicating the link to other areas in order to prove the value." (C)*

> *"we put a lot of trust in our colleagues that they will come with the projects that add value on the rest of the organization. They're also experts. It's not just me and my team, they're also experts. And you hear that we wait for them to bring the ideas." (F)*

In addition, informants highlight the importance of social skills among researchers and of individual projects assuming a holistic perspective. To accommodate for these requirements, managers focus on the hiring procedures and incentive structures related to the projects of the portfolio.

> *"successful research is a function of personal networks. It is so. And in [the organization], which is so huge and so complex and so, you know, heavily changing, the ability for us to*

influence decision makers is through socialization. Decision makers, or those who actually take our input to action. It's through building, nurturing personal networks." (G)

"when you have 50 applicants it is easy to find those with the right professional competences. But they are actually hired based on "fit". It is their social competences and "fit" within the group, and this is so important to make teams work properly." (O)

"it is a prerequisite to make the dynamics operate in this professional work, meaning in the professional development, to make a bottom-up process operate, to create commitment and enthusiasm in such a process. A prerequisite for this is that you function socially (…) This is often correlates with such things as compensation plans, right? In [the organization] we only have collective models. We have no individual bonus component" (P)

Intensive technology

Portfolio practices that are associated with the intensive technological activities are highlighted by almost all the informants. As innovation projects are ultimately intended to create value for clients, informants stress the need to combine and match internal competences with environmental needs through a dynamic reciprocal process.

"Portfolio management at a project level happens through a dynamic process with the researchers themselves coming up with a set of ideas. And then there is a set of external drivers from the company and from society. And in that meeting spot with the competences from the individual and these driving forces, that is where a project is created." (B)

"what's important is for everyone who works in [the organization] to be associated with a subject group, and in that subject group a lot of competence development takes place. Research and development, experimentation, play, sandbox, bottom-up. And then what becomes marketable competence, what becomes innovative services, we do not know until it surfaces" (P)

In several cases, managers must be able to provide the right team for the task at hand and therefore have resources, for example people with specific competences, linked to multiple projects. Consequently, resource flexibility is factored into portfolio processes:

"So, but the way to handle it also as a portfolio of projects is to have a reasonable degree of integration between projects, meaning resources between projects, that you can move around. So that people from one project also know somewhat what is moving in another project." (O)

However, in addition to substantial activities related to the long-linked technology, informants from Company 6 only highlighted peripheral links to the intensive value creation technology (and none to the mediating). These links involved an inherent user perspective when it comes to defining and scoping new developments, as the goal is to solve user problems, albeit with a "price premium" (J).

Mixing technologies

Across the interviews it quickly becomes clear that multiple technological activities, or logics, are present in the IPM practices of the individual organizations. This point of mixing technologies related to IPM practices within the individual organization is not just the result of our analysis. Informants from two different organizations highlight the concurrent presence of what can be interpreted as long-linked and intensive or mediating technologies in different development phases:

"Here it is more qualitative and perhaps a bit more agile as we can quickly pick up new tasks. When it comes to the rest of the company it is a lot of spreadsheets with KPIs (…) it is a quite strong portfolio management culture in the rest of [the organization]." (D)

"my colleagues working with the product projects, they have a much more complex flow and you can track the whole flow through here [the IT system, red.], and then you could export all the projects coming up for the next decision points, and then there's checklists. (…) We are not quite restrictive to that same extent." (F)

"from the beginning it is more supporting and at the end it is more demanding. Yeah, so I think that is the big difference in how you treat it." (I)

Managers are expected to handle and balance multiple technologies when it comes to the IPM practices of the knowledge-intensive organization. Whereas some projects (e.g. explorative research projects (O)) call for the supportive and mediating function of IPM, other projects (e.g. commercial or collaborative EU projects) call for the strict and effective management of progress.

5. Concluding discussion

This article draws theory and inspiration from Thompson's (1967) seminal study and uses his notion of different technological activities and accompanying characteristics to examine the IPM practices of knowledge-intensive organizations. In Thompson's (1967) terminology, IPM in the case organizations can be considered an "input component" that seeks to buffer the technical core of the organization from environmental influences and fluctuations and the uncertainties that stem from it.

When the organizations deal with long-linked technologies, buffering can take place by defining KPIs, collecting data and making decisions related to project selection and prioritization on behalf of the organization. These buffering practices are recognized in large parts of the extant literature on IPM (Cooper, 2008; Cooper et al., 1998). In organizations dealing with intensive technologies, IPM buffers the technical core by ensuring the presence and combination of the right competences across projects to allow innovation to happen. Accordingly, parts of the IPM literature focuses on dynamic capabilities as a way for organizations to re-allocate resources to accommodate for uncertainties (Kopmann et al., 2017; Petit, 2012). The "right competences" are often defined in close collaboration with the environment, which is only natural according to Thompson (1967, 12), as he argues that the two (technical and institutional) level are naturally linked and interdependent. And finally, when it comes to mediating technologies, IPM can work as a buffer to support and create links between individual projects and relevant parts of the environment as is emphasized by informants in section 4.3. These mediating practices speak to an emerging part of the IPM literature that highlights the role of management as a "knowledge broker" across the network (Pemsel and Wiewiora, 2013).

Based on the findings, it becomes clear that there is grounds for the development of an IPM typology inspired by the theoretical developments of Thompson (1967). The purpose of such a typology will be to extend the original IPM theories of Cooper et al. (1998) and thereby bridge two well-established fields by, first, creating an overview of the different theoretical IPM configurations that are present in the knowledge-intensive organization, and second, by providing managers with a framework consisting of practices related to each configuration.

The Product Portfolio

Building on Thompson's (1967) long-linked value creation technology, the "product portfolio" is widely recognized as a valuable configuration for inherently product-oriented firms (Stabell and Fjeldstad, 1998; Tukker, 2004), primarily due to the effectiveness of splitting the organization into distinct activities that add value to a tangible product and ultimately create competitive advantage (Porter, 1985). For the same reason, within this configuration the product constitutes the primary medium for transferring value, as it is developed and matured through the organizational chain (Stabell and Fjeldstad, 1998).

As the organizations who work with IPM wish to create value beyond individual projects, there is an ingrained, or anticipated, interdependence between activities. All three configurations can be assumed to have some degree of pooled interdependence due to sharing common resources and relying on the success of the same organization (Thompson, 1967). However, interdependence in the product portfolio also has a sequential form, as the output generated "upstream" serves as the input further down in the organization. The same value logic is applied in the study by Menke (2013), which was used as our starting point for designing the interview guide, as he notes how R&D only creates value in the form of assets and capabilities in downstream parts of the organization such as manufacturing, marketing or customer service.

IPM, then, can essentially be considered a control function, as projects are selected and prioritized based on a "control and predict" logic (Archer and Ghasemzadeh, 1999), which is symptomatic of the technical portfolio knowledge perspective that uses the natural sciences as its ideal and promotes universal IPM practices (Hansen and Svejvig, 2023). This logic is described by several informants in section 4.1., as they highlight how exploratory projects are moved through the steps of a development process that often includes rigorous stage-gate procedures and measurements to indicate quality and progress.

The Platform Portfolio

At the center of figure 3, we find the "platform portfolio" configuration that builds on the mediating technology. Thompson (1967) highlights activities within the mediating value creation logic as bringing actors that are or wish to be interdependent together. Organizations that rely on a mediating logic can be considered providers of a networking service in both a literal (such as the telecom company) or figurative form (an insurance company) (Stabell and Fjeldstad, 1998). This can be translated to an IPM context, as value is thus generated through the facilitation of exchange, for example knowledge, across the network.

In addition to the pooled form, the platform portfolio relies, first, on strong reciprocal interdependence due to the need for synchronization across activities that can rely on each other's output despite taking place simultaneously in different parts of the organization (Thompson, 1967). In addition, both the platform and problem configurations have sequential interdependence as projects sometimes move beyond the exploratory phase to be included in the commercial parts of the organization. However, these configurations do not carry the intentionality of the product portfolio when it comes to the more serial interdependence.

Both the reciprocal and sequential interdependence appear in the findings of the study in section 4.2., as informants highlight IPM as a knowledge broker across the network of projects and external

stakeholders as well as the sequential role of projects that serve as input in the commercial parts of the organization. Factors such as "trust" in the individual researcher is emphasized in several interviews, which speaks to the emancipatory perspective that is in place to guide the portfolio approach of the organization according to the latest research from the field (Hansen and Svejvig, 2023), as organizations seek to build new forms of robustness when faced with uncertain circumstances. An example is provided by Sweetman and Conboy (2018), as they argue for viewing certain portfolios as "complex adaptive systems" in which individual projects are considered autonomous agents. In these complex types of portfolios, Sweetman and Conboy (2018) highlight unique practices such as the use of holistic reward systems, collective decision making and a flat peer-to-peer structure, compared to the "plan-driven" approach that is often found in the product portfolio configuration.

The Problem Portfolio

As value creation becomes more intangible, this call for alternative configurations that instead focus on dealing with complexities within and around the organization (Aas et al., 2017). This relates to Thompson's (1967) intensive technology, as the "problem portfolio" configuration often exclusively deals with the development of intangible services that contribute to solving customer problems (Stabell and Fjeldstad, 1998). Value is defined as the ability of the organization to understand and help solve client problems that are often complex, why the configuration has strong natural ties to its surrounding environment.

When it comes to the unique interdependencies of the problem portfolio, Stabell and Fjeldstad (1998, 422) put it eloquently as they note that "The iterative and cyclical nature of problem-solving in shops results in a high degree of both sequential and reciprocal interdependence between activities." In this context, the "shop" is likened to an organization that would apply the problem portfolio configuration.

In this case, the task of IPM instead becomes one of connecting the right competences and capabilities with the problems to be solved (Band and Scanlan, 1995; Gutjahr et al., 2008). This issue is highlighted by multiple informants in section 4.3., as they are required to be innovative in terms of competences instead of value being captured by tangible products. We draw parallels to the understanding portfolio knowledge perspective, as stakeholder involvement becomes key to ensuring project success (Hansen and Svejvig, 2023). In the problem portfolio configuration, IPM acts as a dynamic capability, as the organization must be able to sense and respond to relevant change in the environment (Killen et al., 2015).

To sum up the discussion, Aas et al. (2017) put it well, as they highlight the inherent conceptual complexity of IPM in organizations that lean increasingly towards the creation of intangible products. They argue that *"NSD [New Service Development, red.] often involve parallel changes in the service concept, technology, organization and processes (den Hertog, 2002). Such complexity also implies that the heterogeneity of NSD projects is larger than that of NPD projects. Therefore, it may be more difficult to design a stage-gate process that would fit for all NSD projects in a portfolio. Thus, each NSD project in the portfolio may have to be followed up in a more individual and flexible manner, than the projects in a NPD portfolio."* (Aas et al., 2017, 24). In the quote, Aas et al. (2017) hint at the idea of, what could be coined as, portfolio hybridity as several different approaches to the management of service portfolios can be necessary. This point also speaks to a growing field of literature on servitization, as organizations undergoing servitization often find themselves in contestation with existing ways of doing business (Palo et al., 2019). Accordingly, the purpose of this study has been to

extend the classic stage-gate model by examining how IPM can be configured to accommodate for the different value creation logics and technological activities that are often present simultaneously in the knowledge-intensive organization.

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