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Insights

Welcome to the December issue of the Technology Innovation Management Review. We invite your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview
The Technology Innovation Management Review (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints —from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others —to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

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About TIM

The TIM Review has international contributors and readers, and it is published in association with the Technology Innovation Management program (TIM; timprogram.ca), an international graduate program at Carleton University in Ottawa, Canada.

Editorial: Insights

Stoyan Tanev, Editor-in-Chief, Gregory Sandstrom, Managing Editor

Welcome to the December issue of the Technology Innovation Management Review. This issue consists of a mixture of "Insights".

The first paper is **Sara Moqaddamerad's** "Visioning Business Model Innovation for Emerging 5G Mobile Communications Networks". Her paper targets the intersection between strategic foresight and business model innovation, using 5G networks as a case study. It attempts to synthesize evidence of business model innovation (BMI) by emerging disruptive technologies as examples of how to use future-oriented "foresight" techniques. The research sought to uncover how to strategically integrate foresight into BMI processes in the context of the telecommunications industry, through a series of participant interviews and 2 company workshops. While speculative in orientation, the paper offers helpful advice in "visioning" business futures, especially for companies facing competition, when technology-driven innovation is available that could impact their business models.

Jahja Rrustemi and **Nils S. Tuchschmid** follow with "Facebook's Digital Currency Venture "Diem": the new Frontier ... or a Galaxy far, far away?" Their paper looks at the brief history of Facebook's new digital currency or token "Diem" and "Novi" wallet. The paper addresses how they are using distributed ledger (blockchain) technology to enable a permissioned network of users who may benefit from digital transactions with accessible products and services worldwide. The paper's main focus on the financial industry, local currencies, economic inclusion, and generally on tokenization, offers a suitable background for one of the first scholarly papers published on Diem. The authors note with caution and concern Facebook's history with the monetization of personal information, and that "[s]everal issues with Diem remain problematic that we believe have not yet been satisfactorily tackled" (pg. 27). At the same time, they "foresee profitability from using Diem tokens that can be investigated and developed" (pg. 28. The paper raises several difficult questions about this financial experiment, which may provoke tech entrepreneurs globally.

The next paper by **Pınar Buyukbalci, Esin Ertemsir, and Zayneb Boukari** looks at "Embracing Product Innovativeness in Technology Firms: The Impact of Management Model Principles". After first defining both "management model" and "product innovativeness" from the existing literature, the authors add to it by exploring the impact of management models on product innovativeness. They create and report on a questionnaire with 55 questions, focusing on the above defined terms. Their questionnaire targeted 723 companies located in science parks hosted by technical universities. The authors "assume that management model principles are manifested in product innovation processes and practices" (pg. 35) in coming up with three hypotheses that they develop in the paper. Overall, the paper aims "to help companies develop a better understanding of the role of management models in fostering product innovativeness" (pg. 42).

Finally, **Rui Nuno Castro** and **João José Pinto Ferreira** present "Project Portfolio Management in the Front-End of Innovation of Research Centers". Their study is based on an in-depth literature review of 170 papers in SCOPUS focussing on project portfolio management (PPM) and front-end of innovation (FEI), from which they identified 25 discussion threads based on 12 distinct concept groups. The authors used a theoretical tool by Pereira et al., 2020 called "Front-End of Innovation Integrative Ontology (FEI2O)" to assist in framing the discussion. Their inquiry aims to help research centers prioritize research project ideas, measure FEI success, and manage collaborative projects with industry.

The TIM Review currently has a Call for Papers on the website for Upcoming Themes with a special edition on *"Aligning Multiple Stakeholder Value Propositions"* (April 2021). For future issues, we invite general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and scaling technology companies, and for solving practical business problems in emerging domains such as artificial intelligence and blockchain applications in business. Please contact us with potential article ideas and submissions, or proposals for future special issues.

Stoyan Tanev
Editor-in-Chief
Gregory Sandstrom
Managing Editor

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Visioning Business Model Innovation for Emerging 5G Mobile Communications Networks

Sara Moqaddamerad

> "In a world of uncertainty, our guiding philosophy is: Take charge. If nobody knows what the future will hold, your vision of how to navigate it is as good as anyone's. The future may as well belong to you."
>
> Rita Gunther McGrath
> Professor of Management
> Columbia Business School

The purpose of this research is to introduce and apply a novel approach for developing business model innovation. It shows step-by-step how to envision and create business model innovation activities. The data was collected through a case study of a European provider of technical services in the electricity and telecommunications network industry, which is coping with the uncertainty and complexity of emerging fifth generation mobile communications networks (5G) and subsequently the transformation of telecom markets. This paper contributes to the intersection of strategic foresight and business model innovation by synthesizing existing knowledge and in-depth case evidence to demonstrate how business model innovation is developed in the context of emerging disruptive technologies using future-oriented methods.

1. Introduction

With the emergence of the next generation of mobile communications technology, known as "5G", the telecommunications industry faces a major disruption and transformation. 5G technology aims to interconnect people globally and create real-world wireless and networked societies (Mitra & Agrawal, 2015). These disruptive signals of change are already creating a new level of uncertainty and turbulence that demands agility (Gibson, 2014) and business model innovation (BMI), so that enterprises can offer new products, services and revenue models, which can be created and captured by existing and new players (Chesbrough & Rosenbloom, 2002; Casadesus-Masanell & Zhu, 2013; Wieland et al., 2017).

Business models are important for commercializing and creating economic value from (new) technologies (Chesbrough, 2010). They are one of the foremost tools for innovation, involving both competition and describing the position of a firm within its value network (Chesbrough, 2010; Casadesus-Masanell & Ricart, 2010; Demil & Lecocq, 2010; Zott et al., 2011; Casadesus-Masanell & Zhu, 2013; Lanzolla & Markides, 2020). BMI extends the business model and is crucial in creating and capturing value from technology-driven changes (Casadesus-Masanell et al., 2010; Wieland et al., 2017). As a result, the strategic innovation of business models substantially impacts the long-term prospects of a firm in today's dynamic environment (Wirtz et al., 2010). BMI offers a way to cope with a new form of organizing a business in an efficient and effective way that can lead to sustainable competitive advantage (Wirtz & Daiser, 2018).

Even though, BMI is widely acknowledged as a potential response to disruption and changes in the sources of value creation, it remains one of the most challenging tasks for managers (Eppler & Hoffmann, 2012). This is due to environmental volatility, uncertainty, complexity, and ambiguity (VUCA), as well as shifts in competition, new regulations for markets and governments that have been increasing by fast-paced technological changes. These changes have compelled some firms to rethink and enhance their BMI continuously (Schaller & Vatananan-Thesenvitz, 2018). The other challenge is a lack of concrete guidance on how a company can innovate its business model (Bucherer et al., 2012; Schaller & Vatananan-Thesenvitz, 2018), along with few

possibilities for assessing BMI in abstract fashion, which means that BMI requires experimentation and stabilization time (Teece, 2010).

Moreover, academic work on BMI to a great extent has been developed in silos (Zott et al., 2011), conceptual and empirical studies on BMI are few (Gibson, 2014), and the wide application of BMI in various fields makes it highly diversified (Massa et al., 2017). Schneider and Spieth (2013) argued that existing studies point towards continued exploration of BMI in further contexts to enhance our understanding of how to support firms (in terms of tools and methods) throughout the BMI process. Moreover, established processes related to BMI, apparently are not common in practice (Cortimiglia, et al. 2015), since BMI is often seen as an ad hoc (rather than systematic) process, without a clear framework for exploring opportunities (Girotra & Netessine, 2014). Although, Wirtz and Daiser (2018) detected seven generic BMI process steps (analysis, ideation, feasibility, prototyping, decision-making, implementation, and sustainability), they underscored the still heterogeneous (in content and scope) structure of BMI process knowledge within the literature.

Little theoretical understanding exists concerning how business model tools work and enable BMI. The term "BMI tool" is still rather ambiguous in the literature and has taken numerous forms, understood broadly as techniques, methods, approaches, and frameworks built to support various tasks in different stages of BMI. They are mostly created conceptually and have not yet been applied and evaluated systematically (Schwarz & Legner, 2020). The existing frameworks that integrate tools and methods are still quite generic, which makes decision-making during innovation processes rather difficult (Girotra & Netessine, 2014; Tesch & Brillinger, 2017).

These difficulties indicate that we still have a limited and disparate understanding of BMI (processes and methods). With this in mind, I was motivated to study BMI in a new context to help create a new way for developing BMI. Thus, I began to integrate elements from an activity system perspective on BMI (Amit & Zott, 2012) together with a BMI process model developed by Wirtz and Daiser (2018). This suggested a new approach was needed involving strategic foresight, a way of creating high-quality functional forward-thinking views to make informed decisions in the present (Karp, 2004). This was believed could support firms wishing to explore BMI in environments characterized by VUCA. The research, therefore, also answers the call for further research about "the process and elements of BMI as well as its enablers and effects in anticipation and response to increasing environmental volatility", made by Foss and Saebi (2017).

The application of strategic foresight for developing BMI in the context of innovative technologies is not yet prevailing in the literature. This paper contributes to this gap both in theory and practice, by providing insights from utilizing two strategic foresight methods, that is, "horizon scanning" and "visioning" during the process of creating new business models in the context of 5G networks. Herein the main research question driving this study is:

How can future-oriented business model innovation be developed for emerging disruptive technologies?

The structure of the paper is as follows. First, a review of existing literature on the concepts of business model and BMI from a strategic perspective. Following this, a discussion about strategic foresight to provide the background for practicing a new approach of BMI. After that, the research design and method present an overview of the empirical research context and strategic foresight methods employed in the process of BMI. Next, a discussion of the research findings, and finally, conclusions and implications for management theory and practice.

2. Summary of Key Insights from the Literature

2.1 Understanding business models and business model innovation

Business model and strategy

The origin of business modelling goes back to value creation and capture within the internet business in the mid-1990s. It has been gaining momentum since then and has become a key concept for technology, innovation, management, and strategy fields (Afuah & Tucci, 2001; Amit & Zott, 2001; Zott et. al., 2011). The definition of 'business model' has been prolific since its birth. For instance, Osterwalder et al. (2005) defines a business model as a conceptual tool that consists of a set of concepts and their relationships that reflects the business logic of a specific firm, describes the value provided for customers, and how that value is created and monetized. Business models have also been studied

on an intuitive and holistic level (as a unit of analysis), describing how firms do business or function to achieve their goals (profitability, growth, etc.) (Massa et al., 2017). Although, there is still no generally accepted definition for all business models due to various uses in the literature (Zott et. al., 2011; Massa et al., 2017), a field that researches business models has gradually developed (Wirtz et al., 2016).

In the "strategy" stream of research, a business model is conceptualized as a structured and analytical model that depicts a business' architecture and links the firm's strategy (how to compete) to its activities (execution of strategy). Accordingly, a business model bridges the formulation and implementation of strategy (Porter & Gibbs, 2001; Margretta, 2002; Richardson, 2005). Along the same lines, Casadesus-Masanell and Ricart (2010) viewed the business model as a direct result of strategy and means for (operative) implementation of market strategies.

Adopting the strategic view, a business model is important to enable a company's plans to create and capture value that spans the internal/external boundaries of the firm and its industry (Amit & Zott, 2001; Zott & Amit, 2010). Business model activities (for example, value-chain activities, customer segments, choice of products, services, and revenue mechanisms) involve human, physical and/or capital resources that link value creation with value capture to exploit business opportunities for the parties involved (Chesbrough & Rosenbloom, 2002; Zott & Amit, 2010).

Embedded in theoretical and empirical research, Amit and Zott (2001) and Zott and Amit (2010) further explored activity system design as consisting of two parameters: 1) design elements describing the architecture of an activity, including its content, structure, and governance, and 2) design themes describing the sources of the activity system's value creation. The latter includes the novelty that captures the degree of an activity system's innovativeness, the lock-in activities that cause "switching costs" or increased motivation for business model participants to stay within the activity system and transact, complementarities wherein the business model's interdependent activities have value-enhancing effect, and efficiency where the aim is to reduce/save costs through activity system interlinkages. Moreover, these value drivers are often mutually reinforcing, that is, the existence of each value driver can strengthen the effectiveness of any other one (Amit & Zott, 2001). For instance, collaboration between value drivers provides more effectiveness or complementarities that bring benefit when supported by novel design (Amit & Zott, 2010).

Interestingly, strategies are also looked at as a system of interrelated activities, as brought to the fore by Porter (1996), who contended that coordinated activities can drive competitive advantage. Thus, a firm's strategy integrates its business model activities, which form the business' value logic (Osterwalder et al., 2005; Zott & Amit, 2010; Wirtz et al., 2016).

Business model innovation and strategy

Afuah (2014) defined BMI as a framework for creating and capturing value by doing things differently from the norm (Afuah, 2014). Amit and Zott (2010) suggested BMI means developing a right business model for a specific situation, that is, BMI can occur through value drivers in business models that entail new activities (content), linking activities in a novel way (structure), or altering the activity performed by a particular party in a way that leads to novel forms of cooperation (governance). Changing one or more of these design elements leads to changing the whole model. Thus, BMI denotes designing and implementing an enterprise activity system that is either new to the focal firm, target market, industry, or generally to the world (Amit & Zott, 2012).

An innovative business model can generate a new market or enable a company to create and exploit new opportunities in an established market (Amit & Zott, 2010). In a rapidly changing technology market, product innovations without BMI may not always create sufficient competitive advantage (Amit & Zott, 2010). As a result, BMI designs a process through which a firm may adjust its business model to suit a new competitive landscape (Kindström & kowalkowski, 2015). Efficient and continuous BMI thus becomes vitally important for maintaining sustainable competitive advantage (Teece, 2010; Cortimiglia et al., 2015).

BMI can be driven by new customer demands, such as the emergence of new value propositions or technology obsolescence (see Casadesus-Masanell & Ricart, 2010), and also derive from strategic activities, as strategy defines the pattern of BMI (Cortimiglia et al., 2015). Furthermore, BMI can have a positive effect on a firm's strategic flexibility (Schneider & Spieth, 2013). It requires managers to constantly monitor and identify

uncertainties that impact the current business model, anticipate possible consequences of internal and external changes to the firm, and proactively move towards innovating the business model to respond to external changes (Schneider & Spieth, 2013; Cortimiglia et al., 2015).

Methods like scenario planning and making roadmaps can be used to draw up an innovated business model's specificities. This can lead to identifying a range of new market opportunities based on available key activities, resources, and market attributes. However, there is no specific business model development that need be practiced at that point (Cortimiglia et al., 2015). There have been a couple of notable exceptions: 1) a study done by Tesch (2016), which applied scenario planning to evaluate BMI in the context of digitalization and IoT, and 2) a study done by Moqaddamerad and colleagues (2017) that focused on applying scenario planning to create novel business models in the context of 5G networks. The following section discusses further the value and importance of such forward-looking methods for BMI.

2.2 Strategic foresight: a novel approach for the development of business model innovation

The concept of 'foresight' means to have "an accurate view of the future" (Courtney, 2001). Foresight prepares decision-makers to fulfil future requirements and grasp opportunities, leading them to make more informed decision in the present (Karp, 2004). Strategic foresight enables future competitive advantage and involves "identifying, observing and interpreting factors that induce change, determining possible organization-specific implications, and triggering appropriate organizational responses (Rohrbeck et al., 2015).

Most strategy tools (such as SWOT analysis, and the Five Forces framework) do not encapsulate the dynamic model of reality. This is because they were designed for yesterday's more stable environments, thus adding little foresight on the strategies to win in a tumultuous marketplace (Courtney, 2001; Teece, 2007). Foresight does not emerge from meticulous market analysis or by examining perfect forecasting tools (if they ever existed) (Courtney, 2001). To develop foresight, organizations need to understand and explore the uncertainties they are facing (Karp, 2004) in order to help them find methods and procedures for gaining insight and making informed speculations about the path ahead (Teece, 2007).

Strategic foresight can thus guide the renewal of business models and help cope with the increasing uncertainty and ambiguity of technological and market disruption in two ways. First, it can enable decision-makers to recognize environmental discontinuities as well as developing ideas to work on emerging technologies, and second, it can provide a set of methods and techniques for selecting the external drivers of change, anticipating their possible development trajectory, detecting their consequences on the organization, and finally formulating the most proper response (Rasmussen et al., 2010; Vecchiato, 2012a & 2012b). Hence, such a business tool can generate anticipatory and actionable knowledge to be used by decision-makers.

Finally, strategic foresight is important not only to the survival of the firm, but to whole industry. It plays a significant role in strategic planning and innovation, gaining or losing competitive advantage, foreseeing and missing new markets, and making new strategic choices in turbulent circumstances (Lemos & Porto, 1998). Strategic foresight has arguably the strongest effect when embedded in companies as an ongoing daily practice, and should not be limited only to top management or a specialized R&D division, but rather also include bottom-up ideation perspectives (Verganti & Shani, 2016; Sarpong & Maclean, 2016). The next section presents a systematic way of developing business model innovation using strategic foresight methods.

3. Research Design and Method

Research context

5G telecommunications networks currently constitute a foundation for future digitalized societies based on the timely availability of high-quality wireless connectivity. This suggests changes to the industry's structure such that the traditional mobile telecommunications business dominated by mobile network operators (MNOs) has had to start transforming and becoming more open to new entrants known as local service providers. This transformation has sped up digitalization for local service delivery as well as boosting local businesses into new growth areas. Small operators have promised to provide: 1) hosted local connectivity for MNOs in specific locations, 2) locally tailored content and services, and 3) secure network operation (Matinmikko

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et al., 2017). However, local operators still need viable business models to achieve innovation, advantage and growth in a high-velocity business environment. Given the paucity of existing research on future 5G business models, this research aimed to conduct an explorative qualitative single case study to study a contemporary phenomenon within its real-life context (Yin, 2018: 50).

Description of the case company

The company under study is a leading northern European supplier of technical services for power and communication networks. Founded in 2001, the company operates in Nordic countries as well as Germany, Poland, and Lithuania, with headquarters in Sweden. The company delivers a comprehensive range of solutions that includes designing, planning, building, installing, and securing or maintaining the operation of electrical networks (smart grids, fibre) and (mobile and fixed) telecommunications networks. It also designs and installs charging points for electric cars and internal networks for mobile phone coverage. The company has 6,200 employees out of which 1,500 are based in Finland and its net sales were EUR 1.1 billion in 2019.

Data collection process

Data was collected from a national project in the telecommunications industry with 5G technology, where the case company was part of the project consortium. The data was collected through: 1) the company's website and professional media (secondary data), 2) ten interviews for selecting and ensuring the diversity of workshop participants, understanding the company's current challenges, as well as scoping and framing strategic foresight activities (Table 1), 3) two consecutive workshops that were designed and facilitated based on the results of the interviews. The first workshop aimed at scoping and opening the context of 5G technological development (for example, opportunities, challenges, possible solutions), analysing the company's current business model, and scanning trends in the telecommunications industry. The second workshop aimed to develop alternative visionary and innovative business models for three years ahead specifically to address the participating company's challenges. Figure 1 shows the process of data collection.

Applying strategic foresight methods: horizon scanning and visioning

"Horizon scanning", also known as environmental scanning, is usually conducted at the beginning of any strategic foresight activity. Horizon scanning helps to achieve a broad forward-looking view to prepare an organization for change. It entails sensemaking and prioritizing activities and serves as an early warning system to detect emerging indications of important future developments. Additionally, it aids a company in taking timely action well before imminent changes can become problems (Day & Schoemaker, 2005).

To frame the scope of horizon scanning activities, the author conducted a focused scan to identify new

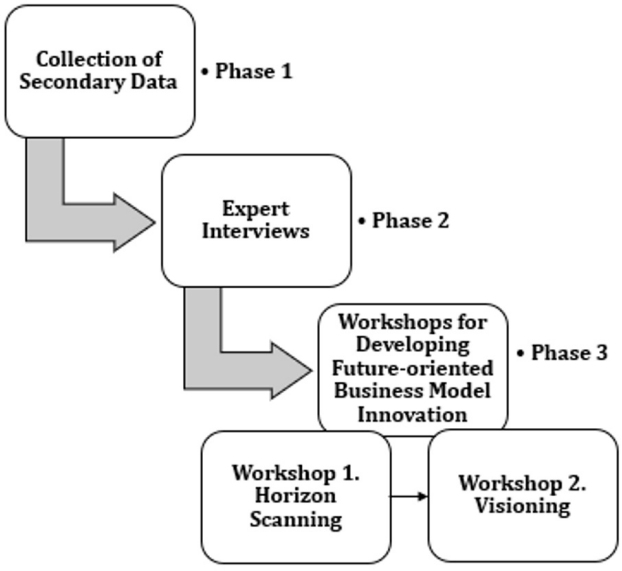

Figure 1. The process of data collection

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Table 1. Workshop participants and company's challenges

Participants	Company's challenges and uncertainties
1. Head of digital transformation 2. Product manager 3. Mobile communications engineer 4. Solution manager 5. Area business unit director 6. Sales and business development director 7. Mergers and acquisitions manager 8. Electrical and telecommunications engineer 9. Marketing and sales manager 10. Radio access network engineer	• Profitability and growth • Short-, medium- and long-term visions on 5G • Changing revenue model and service offerings • Company position in the new value chain. • Strengthening sales and marketing activities • Identifying new customers and partners. • Investments in new areas and technologies • Market fragmentation and uncertainty caused by 5G • Creating new businesses with current assets • Role of content in service • Changes in 5G technology • Increasing operational efficiency

developments that signal potential future change (emerging issues) in regulatory, technology, and business domains, given they are the most relevant domains to 5G market changes (Ahokangas et al., 2013). The time horizon was defined by the participants and is context-based. Selecting the viable time horizon is an important factor in applying foresight. It is based on the type of future under study, as well as the type of business, market, target group, and investment (Duin, 2006). Since the telecommunications industry is rapidly changing, three years ahead was considered feasible and logical to envision and plan.

"Visioning" as a strategic foresight method entails setting goals and creating a direction to the future to which the firm can commit. Visioning helps with strategic planning for the future by ensuring that goals are driven by the organisation's values and that stakeholders are participating (Bezold, 2009). Visions created during the 'visioning' process are products of stakeholder dialogues, for instance, when analysing and understanding problems and possible solutions to respond to potentially undesirable contextual changes. Visioning helps to successfully converge actions in a desired direction (van der Helm, 2009).

The author applied visioning to activate workshop participants' futures thinking, to help define clear objectives and a well-organized strategy, and to craft and deliver a shared actionable vision of innovative and future-oriented business models for 5G networks. Hence, visioning helped to reduce the uncertainty of the BMI process and thereby sought to improve company performance and competitive advantage.

4. Summary of Analysis and Results

Shaping a future-oriented BMI process by applying horizon scanning and visioning

This section presents the results of integrating BMI process and strategic foresight methods. For the BMI process, I adopted the framework suggested by Wirtz and Daiser (2018) made of analysis, ideation, feasibility, and prototyping. The case company took over implementing the business models separately, which was beyond the scope of the workshops. For business model representation (Figure 3), I applied the magic triangle model developed by Gassmann et al. (2014). The framework addresses four major areas including, 1) the target customer, 2) the customer value proposition, 3) the value chain behind the creation of the value, and 4) the revenue model that captures value. Figure 2 exhibits the business model innovation process and activities that were performed throughout the process.

Step 1: Assessing the current business model

The analysis phase of the BMI process addresses the current business model from a content perspective through scanning and scoping the current situation, as

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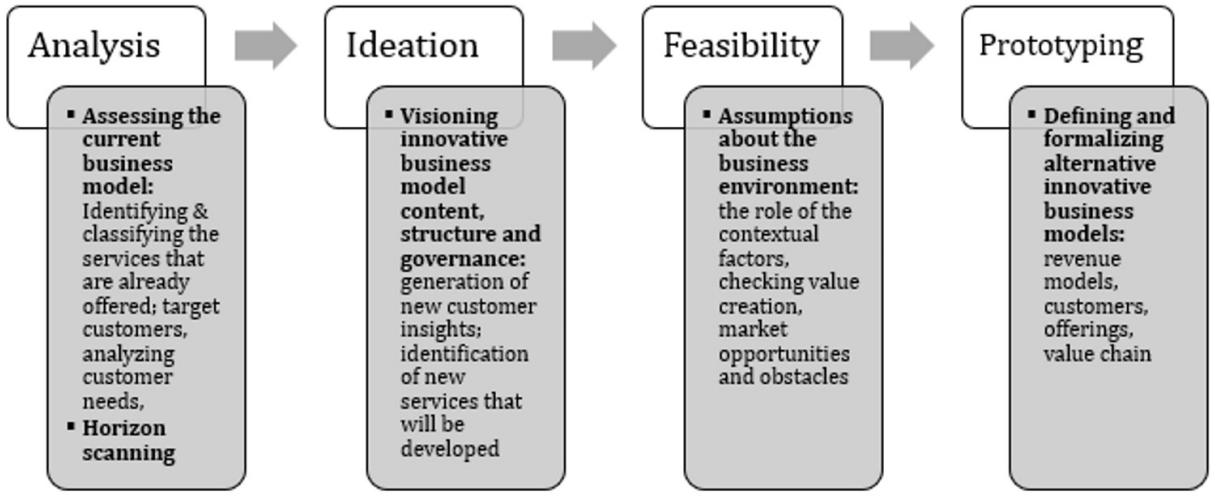

Figure 2. Business model innovation process and related activities combined with strategic foresight methods. Adopted and modified from Wirtz and Daiser (2018)

well as understanding the current business model weaknesses, strengths, opportunities and threats. As illustrated in Figure 3, currently MNOs form the main and the most important customers for the case company. MNOs generate 95% of the company's revenue through annual agreements and account for traditional daily services related to the company's core competencies in communication and infrastructure

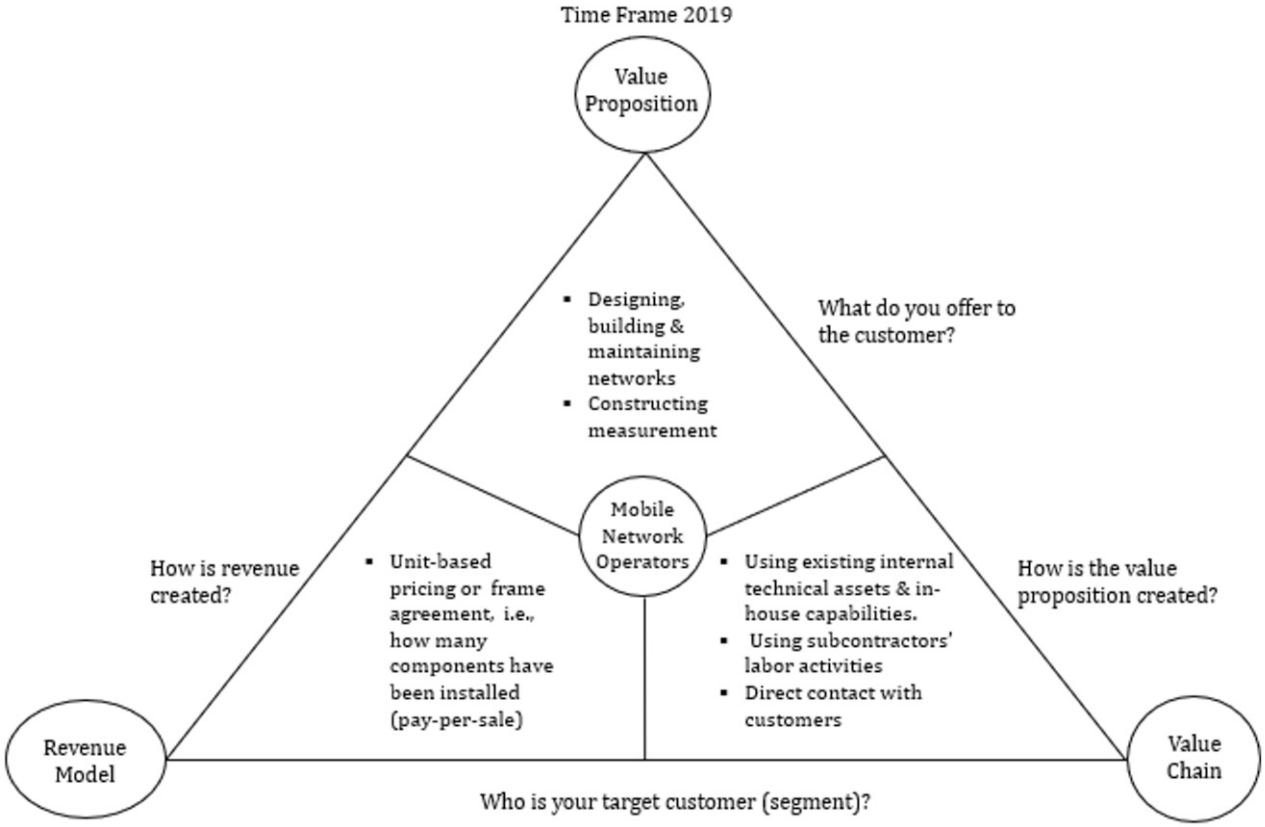

Figure 3. Current business model (2019)

Table 2. Horizon scanning

Trends in the Telecommunications Industry		
Technology	Business	Regulatory
1. Change in network deployment from outdoor local cell to indoor local small cell networks. 2. Softwarization and virtualization of mobile networks. 3. Increasing use of AI in network management and optimization. 4. Increasing use of higher frequency bands for indoors coverage.	1. The growth of local service demand in the digitalization of different verticals (factories, campuses, etc.) especially indoors. 2. Growing need for local indoor small cell networks and spectrum licenses. 3. Cost-efficient network scaling according to demand through sharing, i.e. *"Network-as-a-Service".* 4. Change in network deployment from owning infrastructure to buying required infrastructure as a service. 5. Entrance of new stakeholders to mobile communications market.	1. Change in network deployment from a small number of nation-wide long-term spectrum licenses to a larger number of sharing-based local spectrum licenses. 2. Change in network deployment from a small number of dominant MNOs to the emergence of a larger number of local operators. 3. Defining new regulations for spectrum sharing, e.g. local licensing.

management (designing, planning, building, and maintaining networks). The revenue model is task/activity-based or time/unit-based, with the highest revenue achieved through pure installation work. The company's strengths revolve around its strong expertise and skills in this field that can pave the way for finding new opportunities (new customer segments and offerings).

The emergence of 5G technology has especially created a lot of uncertainty and turbulence in the market as new local operators enter the market. Thus, it has become important to understand this new technology and grasp how it might influence the company's operational effectiveness and performance. For that, they need to monitor trends in the industry to effectively renew their business models. The next activity in the process addresses this issue through horizon scanning.

Horizon scanning

New business models are often based on early signals of change, for instance, new technologies, new customer requirements, or new regulations (Gassmann et al., 2014). Horizon scanning (Table 2) as a creative activity helps participants to think differently, both by identifying trends that will form the most likely future and by pinpointing threats and opportunities. This activity enables anticipating and accommodating opportunities. In this study, the questions asked were, "what are the most influential trends in the telecommunications industry? And how will they affect the case company?"

An analysis of insights from these trends indicates that the company's environment is substantially changing. For instance, spectrum bands (from 3.5 GHz and higher) will soon be available for different service provisioning, which require radio access permission from regulators for operating services. The company now faces uncertainty from various technologies (for example, LTE, 5G, WLAN) being developed in their desired direction. Additionally, the current way of offering services and generating revenue will likely no longer be profitable with the advent of 5G networks, since mobile operators have started moving towards easier installation of hardware and software in a way that everything can be installed remotely, controlled, and operated through cloud-based services.

Telecommunications services will be mostly offered for indoor purposes, while many new entrants are now entering the market and could impact the value chain

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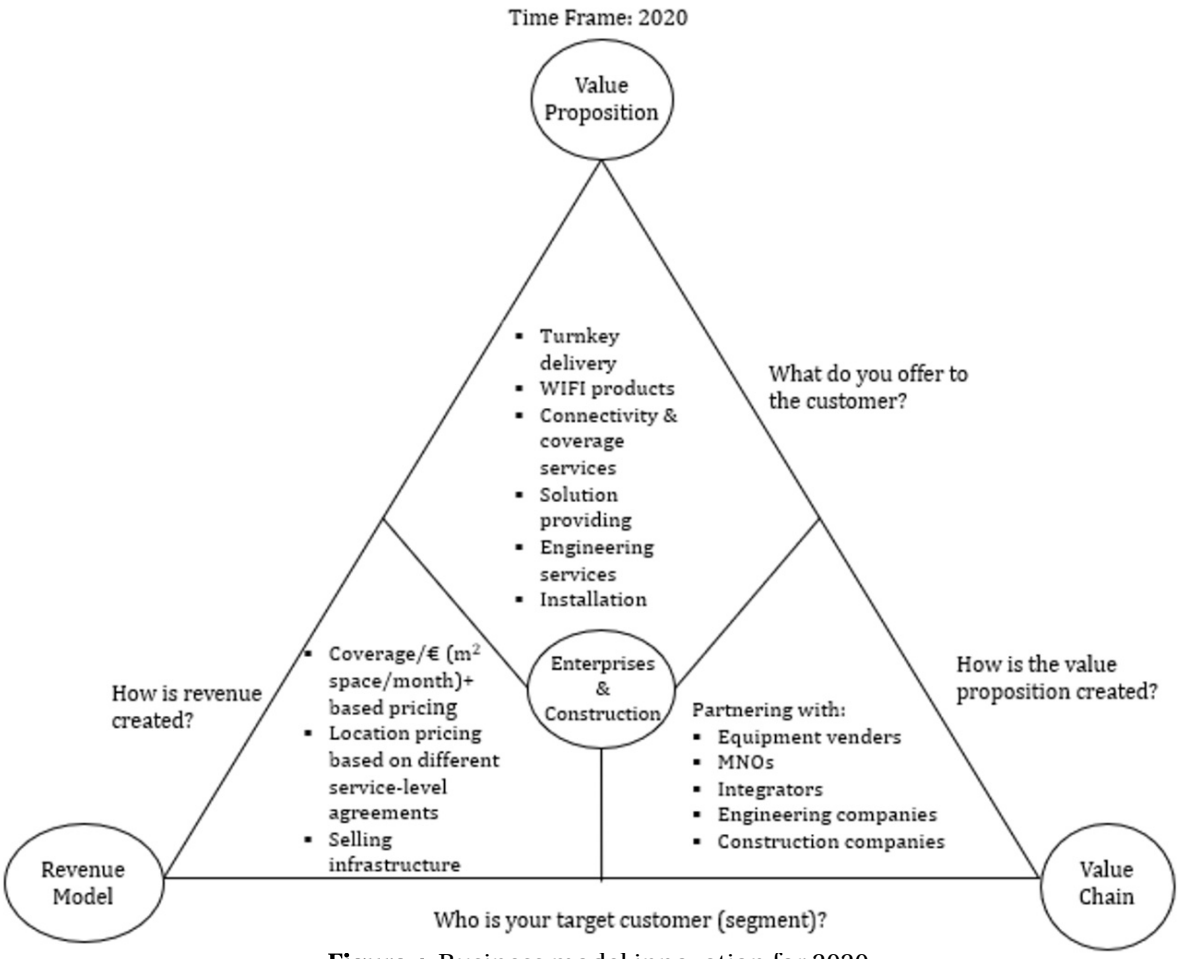

Figure 4. Business model innovation for 2020

and value network activities. These changes necessitate the case company to acquire new skills and enhance its competency in service and data provisioning, as well as operational excellence, renew its organizational structure and respond to end customer needs, and change the governance of its external resources and relationships. Achieving growth requires offering high quality indoor services (for example, connectivity and coverage) and in that sense, the company must compete with operators who have 90% share of indoor services. The case company has a major advantage over the operators in having built an existing high-quality network infrastructure. All in all, the case company needs to move fast, act proactively, learn from good practices, take more risks, and find its position within the value chain of high margin business. The next steps address possible solutions in the form of alternative innovative business models.

Step 2: Ideation

The ideation phase generates clear BMI ideas and concepts, as well as establishing the rationale, scope and key objectives of the new business model. While horizon scanning can be a key input to the visioning process, visioning activities can uncover the company's goals and aspirations, bringing consideration of the future back to the present, thereby creating the basis for BMI. As a researcher working with the case company, I began the visioning process by asking "where would the company like to be in 2022?" And "what are the areas for business model renewal until 2022?" The participants had to identify and prioritize areas of common grounds built on positive change in the company's current business model, as well as thinking about preferable future business models.

Step 3: Feasibility

Participants should be able to better sense the feasibility

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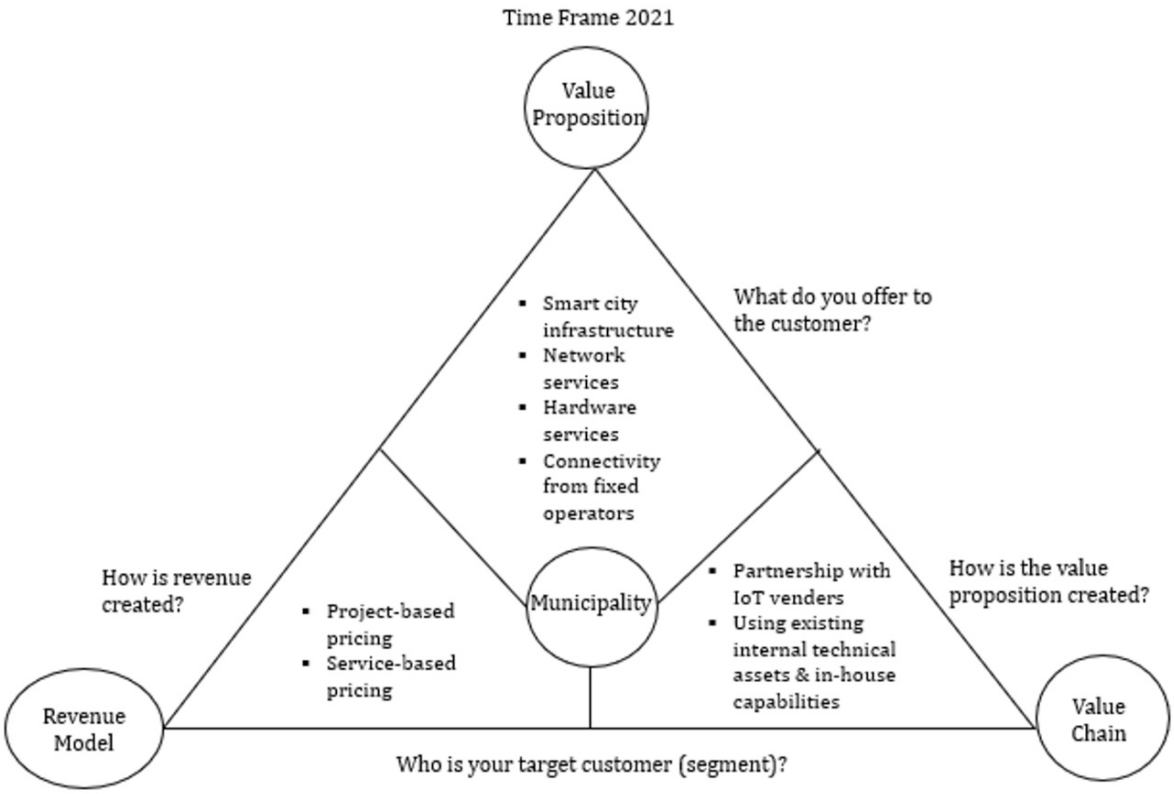

Figure 5. Business model innovation for 2021

of new business models (that is, evaluating the practicality and impact of the conceptual draft of BMI) by scanning the environment, finding technology requirements, analysing the market, industry and competition.

Step 4: Prototyping
After confirming the feasibility of a BMI, the content of an alternative business model is prototyped, evaluated, refined, and optimized. In practice, these three steps happened together through questioning and extensive discussions between the participants during the workshops. Based on this activity, three different innovative business models were developed looking ahead to 2022 (see Figures 4, 5, & 6).

Business model innovation on the horizon
The participants created three innovative business models based on value creation and capture ideas and opportunities, as well as targeting customers that they had identified through previous steps. Figure 4 displays the business model innovation for 2020.

In the 2020 business model, the target customers were enterprises and construction companies (building houses, shopping malls, factories, industrial automation) and their customers included real estate companies, property management organizations, renovation companies, and end users. Construction companies are the channels for reaching enterprises. Construction companies, however, are not specialized in managing operations inside buildings and therefore cannot maintain continuous services. This creates a new opportunity for the case company to create and capture value.

In this situation, 5G networks have not yet been commercialized. The case company can therefore offer high quality WIFI services apart from infrastructure services and quality management services, both for MNOs and enterprises. These services can be offered through subcontractors and may lead to additional projects. The case company may also act as an integrator and distribute or sell big vendors' equipment. Nevertheless, moving towards offering engineering solutions appears to be more promising now as we approach the onset of 5G networks. The company believes that partnering with vendors will create more

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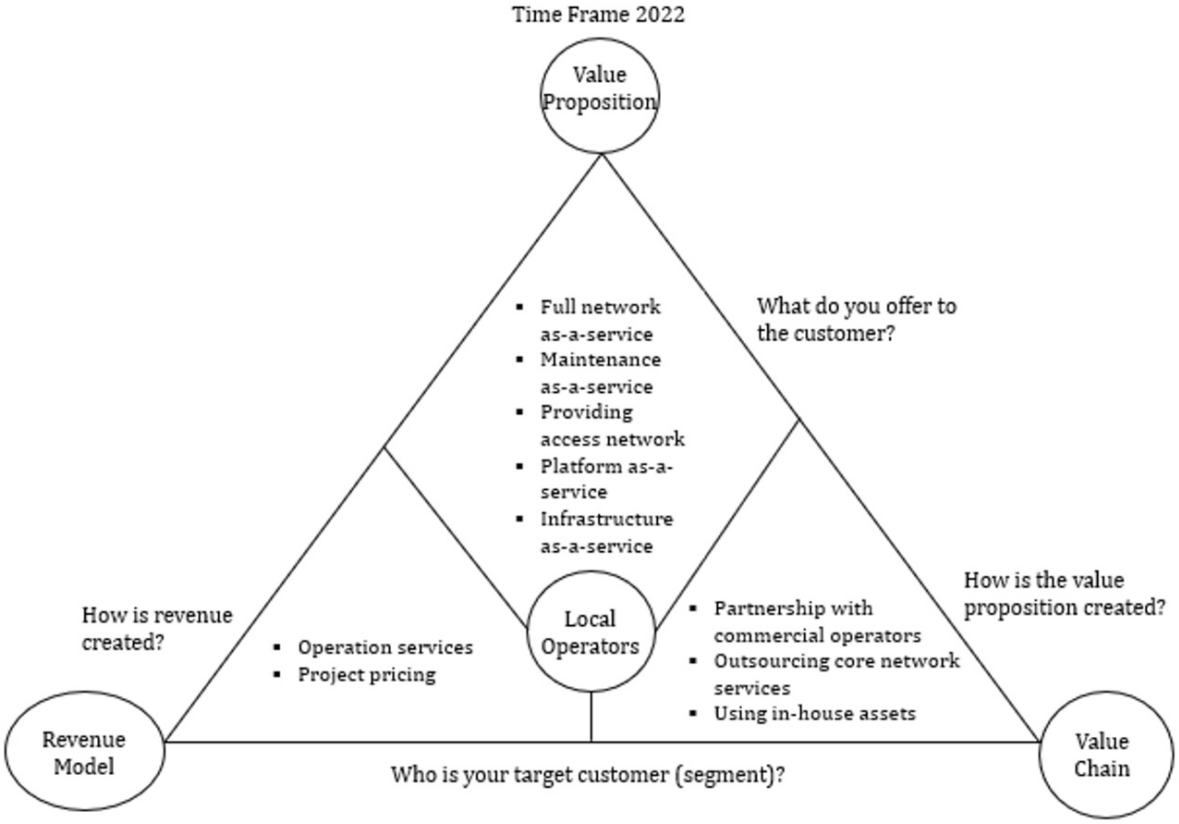

Figure 6. Business model innovation for 2022

opportunities for offering their network-as-a-service indoors. In this regard, MNOs become strategic partners to the case company because of their network of customers and the services needed from the case company (that is, building infrastructure). Revenue will be mainly generated through leasing, monetizing coverage, connectivity (based on existing locations), and site acquisition, as well as selling infrastructure and installation payments.

The next year's business model (2021), Figure 5, focuses on a new customer, that is, a municipality. In this situation, the company aims to enable "smart city" operation by offering services like the design and utilization of IoT, infrastructure, hardware, and improved connectivity. The company's value chain functions through partnering and integrating with IoT venders, while the revenue model is project- and service-based pricing.

As a result of the interviews and workshop, it is recommended that the company combine its experience and expertise in telecom and electricity to provide services to the municipality when constructing different areas and blocks. It should thus move towards partnering with IT companies to create more value for end customers and expand its market share.

The business model innovation for 2022, as shown in Figure 6, serves a new customer segment, i.e. local operators. In this situation, 5G networks are assumed to be ready for commercial purposes. Local operators can include hospitals, campuses, utilities, factories, shopping malls, sport arenas, and others, which may need to have a wide variety of infrastructure and network services, such as accessing the core network, connectivity, and maintaining the whole ICT infrastructure.

In this situation, the company can gain the advantage of offering a whole package for infrastructure and platform as-a-service, as well as securing connectivity service contracts for all customers. Acting as a local operator would require having cloud capabilities, a core network (hosted by Google), and an access network that MNOs and vendors sell to. The case company should therefore outsource its core network as-a-service. Getting into indoor services offering business requires cooperation

with commercial operators, since they have an existing network of customers. Hence, business models for the 5G era are shaped around local operators as customers and partnering with commercial operators to create value. Since the largest share of the company's market is within northern Europe, revenues there would be high while competition would be limited. Moreover, one novel opportunity could be starting with a "Wi-Fi network lighting" to get into the 5G market outside of traditional telco operators. The participants understood the importance of creating these visionary business models both for customizing and packetizing the service offerings and classifying customer approaches in practice.

5. Discussion

The innovative business models envisioned above with a strategic lens aim at creating new internal and external (interdependent) activities that can be governed in a way that creatively link value creation to value capture. This reflects a novel view of strategy development in which strategic choices are able to focus on designing effective interdependent activities (Lanzolla & Markides, 2020). Identifying existing trends and key uncertainties can significantly affect the industry and the company's future. This not only enables anticipating and accommodating opportunities, but also insight to provide inputs towards creating new visions and discovering their possible business outcomes. During the BMI process, the case company's strategies got built on a shared vision of the most important features of their future business models, which identified potential customers and gained understanding of their needs.

Factors like an industry's background and structure, a company's core capability, or the diverse strategic segments in which the company competes, together with considering uncertainties about the future (Schoemaker, 1992) are addressed during the visioning process. These factors are crucial for generating strategic visions. BMI in this way becomes key to the heart of a firm's strategic vision. The research findings highlight the company's core capabilities (engineering, product/service quality, quality of personnel) can be effective for multiple strategic market segments that they might be competing in (market segmentation, service groupings, technology), with the aid of future-oriented innovative business models. These core capabilities seemed to be durable and form the ground for the company's sustainable competitive advantage. However, the case company under study in this research paper also realized that it must develop further their sales, marketing, and R&D capabilities, along with its engineering capability and high-quality services.

By utilizing a process called "visioning" in a workshop setting, I intended to inspire and frame the participants' dialogue, open their mindset towards discussion about future developments incoming as a result of the emerging 5G market, and help evaluate potential actions. Visioning in this way helped understand the shape of the past and present, and enabled a productive map of the company's mental image of possible alternative strategy development (Van der Helm, 2009). This was done in a way that enacted collective sensemaking (perceiving, interpreting, and responding to change) and created "foresightful" knowledge (Sarpong & Maclean, 2012). Being engaged in a temporal process focused on innovation, the participants actively constructed dynamic images of future business models and concentrated their efforts on developing a broad and shared outline of the innovative business models. This resulted in enhancing the company's learning capability, as well as awareness of the diverse set of emerging possible business futures. Thus, it helped lead to improved decision-making and implementation of strategies, according to the feedback after the interviews and workshop.

The practice of "horizon scanning" enabled the company's participants in developing BMI to build mental models that enabled them to better understand their business environment. By linking both visioning and time horizons, this helped them construct mental models for setting goals. Creating two or three (BMI) visions sequenced along a time continuum, so the theory goes, can help structure a company's future goals in clear achievable steps (Hines & Bishop, 2013). The envisioned innovative business models enable the company to gain lead time for generating and/or directing change, along with greater flexibly to enact various activity systems, and allocate resources more efficiently. Moreover, in the face of exogenous shocks, old ways of thinking and ad hoc created business models cannot offer to provide sustained realistic growth into the future. In that case, innovations must emerge through revitalized ways of thinking and strategic foresight, which "visioning" in particular was designed to do. Indeed, if a company lacks strategic foresight, their business models often lack genuine novelty, agility and resilience, and consequently cannot adapt to and

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survive from exogenous shocks. Considering these benefits, the research from this study suggests it is worth integrating strategic foresight into a company's current processes of developing BMI.

6. Conclusion

This research attempted to apply strategic foresight approach for developing BMI in high velocity environments in order to help companies not to miss valuable uses of innovative technologies. The above report has shown that BMI can be an effective way for companies to manage the challenges of adopting disruptive technologies and increasing competition from the entry of disruptors. Innovative business models can generate substantial market value either by creating new markets or transforming existing ones. Moreover, innovative business models can become a crucial factor for a company's effectiveness in creating and capturing value in VUCA environments. Nevertheless, methods that can simplify and help business leaders understand such environments are scarce in the literature (Gibson, 2014). BMI regardless still requires both creativity and "structured guidance to frame and focus thought" (Eppler et al., 2011).

To address these issues, this study employed a qualitative single case study approach to integrate the concepts of BMI and strategic foresight (in terms of innovative future-oriented methods). This was done to capture the lived experiences of bottom-up ideation, as well to access and exploit the distributed expertise of business managers and engineers.

This study sought to contribute to our understanding on how strategic foresight methods can be systematically integrated in a BMI process in the context of the telecommunications industry, which is a dynamically changing complex of technologies and markets globally. The pragmatic value of "strategic foresight" has remained little understood by practicing managers, especially how it may help them to systematically innovate their business models. This study therefore tried to fill this gap by showing how strategic foresight can enable prospective and creative thinking, while improving the knowledge creation needed for solving problems. This approach to BMI can give managers a strong incentive to utilize strategic foresight methods regularly, as well as integrating them as ongoing daily practices for more effective BMI processes. The ability to demonstrate how future-oriented BMI can be managed in practice may lead to enhancing the development of BMI theories. Likewise, it may help move towards unifying the strategic foresight and BMI research streams, which empirical evidence has so far been unable to support.

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Facebook's Digital Currency Venture "Diem": the new Frontier … or a Galaxy far, far away?

Jahja Rrustemi and Nils S. Tuchschmid

> *"There will be an electronic currency, and it will be universal, and we must accept that fact."*
>
> John McAfee

This article focuses on Facebook's new digital currency, initially called "Libra" and renamed in December 2020 "Diem", that has been designed and proposed by the Diem Association (formerly the Libra Association). It briefly reflects on the historical meaning of money and currency, as well as "local currencies" viewed as precursors to the new "digital currencies" or "cryptocurrencies". The paper presents a general overview of the Diem project, particularly from the perspective of financial theory and practise. It looks specifically into Diem's business model and analyzes the project's planned and potential revenue streams, according to official documents published by the Diem Association. The research identifies potential obstacles and hurdles this digital currency would (since it has not happened yet) face on launch day and assesses whether the project is feasible in its current form. In the authors' view, although some early concerns were addressed in the Diem White Paper 2.0, the Diem project is only questionably ready for commercial launch in its current state. Speaking directly to the financial aspects of the Diem Association's project, the current regulatory hurdles and institutional pressures seem difficult to bypass without making some additional noticeable and meaningful changes to Diem.

1. Introduction

Thanks to technological advances, new forms of electronic currency are now possible and already available. In particular, distributed ledger-based digital "blockchain" technology now offers a secure transaction-oriented system free from censorship and control by central government powers. This technology, invented by a pseudonymous figure (or team) "Satoshi Nakamoto", has allowed so-called "cryptocurrencies", such as Bitcoin, Ethereum and Ripple, to create a new digital economy. Due to their "decentralized" character, these cryptocurrencies are poised to potentially disrupt national and central bank-backed "fiat currencies" (see note 1) around the world.

Riding the financial digitalization wave into a new frontier, and followed initially by 28 other companies of various business sectors, social media and networking giant Facebook announced in June 2019 its intention to launch a digital currency initially named "Libra", now called "Diem". The announcement came as a shockwave, though Facebook patents for this new currency had been filed in 2018 and registered in 2019 (cf. United States Patent and Trademark Office).

National governments and their central banks have traditionally enjoyed a kind of "monopoly" when it comes to deciding what counts as legal "currency". So long as paying taxes to the government and receiving paychecks in a national currency holds, that currency's legitimacy stands. Yet, if people could consume products or services using a new, widely available digital currency locally, in a way both simpler and cheaper than with the current economic system, then its impact on our daily lives might be far greater than many people have yet imagined. In other words, the launch of the Diem "token" could, if completed, have many and significant ramifications, and impact many spheres of daily activity in societies worldwide, including communications, business, and education, as well as the financial realm.

Facebook's Digital Currency Venture "Diem": the new Frontier ... or a Galaxy far, far away?

Jahja Rrustemi & Nils S. Tuchschmid

This paper focuses on Facebook's digital currency designs and plans to be built using "blockchain" distributed ledger technology (DLT). However, since digital currency cannot be disentangled from the broader concept of "money", we first briefly explore what money means. In section two, we discuss "local" currencies and the "decentralized" (see also, "distributed" or "P2P sharing") financial system that stems from these currencies. The next section presents Diem's network architecture and business model, relying on various documents, including Diem Association white papers, transcripts from U.S Congress hearings, and several other articles, in both "yellow" and academic literatures. The following section considers the business motivations behind Facebook's initial intention to launch a digital currency, its potential risks, and the limitations that led to a revised version, now called "Diem" (Libra Association, 2020). The final section presents concluding remarks and several open questions for future exploration, framed as an invitation to further discovery as this broad social experiment develops.

2. Money and Currency

What is money? At first sight, the answer appears obvious. A few years ago, people would have seized their wallet and taken out their national central bank's notes. Others would have searched deep in their pocket and extracted coins. But all would have agreed that, whether notes or coins, it was money! Nowadays, people might show their "plastic" debit cards or their credit cards or even their smart phones. Money has become digitalized. But is it still money? Not really. Of course, it helps to explain what money could or should be, but only partially. Following William Stanley Jevons, economists have argued that money should fulfill three economic functions: it has to be a medium of exchange, a unit of account and a store of value (Jevons 1875).

By "medium of exchange", we mean that it has to be easily exchangeable and accepted as such between two counterparties in a deal. The examples of people showing bank notes, coins, debit, or credit cards and even their smart phones, were just illustrations of this first function (see note 2). As far as the "unit of account" is concerned, this refers to a standard unit of monetary measurement that can express the market value of a good, service, asset, or any transaction. Expressing values using a common benchmark speeds up the decision-making process and eliminates the conversion risk when both the unit of account and the medium of exchange are the same. Finally, "store of value" relates to the possibility of deferring payment for a set time by preserving the value of an asset and exchanging it later for the same value. Of course, for such a function to be acceptable, what is defined as money needs stability through time, which is a challenging task as, among other threats, it might be subject to inflation and deflation risks or, more prosaically, devaluation risk. Stated otherwise at its most basic level, the "value of money" and its purchasing power may change over time.

"Money" can be compared with the "currency" of a nation-state. Currencies like the Swiss franc (CHF) or the US dollar (USD) are widely perceived as both a medium of exchange and unit of account. But one might question whether they still count as a legitimate store of value. Who nowadays will physically pocket CHFs or USDs for retirement? Yet, the distinction is rather subtle. Currencies should be viewed as a form of money that is available and that circulates within a specific economic zone, be it the euro in Europe or dollar in the United States of America. Of course, some currencies might not display all the necessary characteristics to be called "money", and the less they do, the less attractive they are to potential users, and the more people will look for alternative monetary solutions (Wray, 2012). One can find enough examples of countries where the domestic currency was simply disregarded by its population, which instead adopted something else more reliable during a turbulent period.

Nowadays governments serve to "back" the medium of exchange for their national citizens through "fiat currencies". Yet fiat currencies are no longer backed by anything tangible or concrete. A $20 USD bill is just an IOU issued by the US central bank (the "Federal Reserve") whose "value" is based on what is written on the note. Somehow, governments and central banks must guarantee that the value of their money as a reflection of the strength and vibrancy of their national economy will not decline to the point of disappearing, and will remain roughly stable over time. Nor can a government succumb to "default" on its financial obligations in people's minds. From trusting our neighbors or family members in the past for financing, now people trust governments and central banks to take out their "money" or get it back.

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This point is crucial in understanding how the Diem project differs from previous "digital currencies". Digital currencies based on blockchain and other distributed ledger technologies (DLTs) are usually called "cryptocurrencies" because they use cryptographic functions or hash functions for transactions. Bitcoin and its current competitors all suffer from what has been perceived by many as a major flaw: lack of backing and unstable currency behavior (Kristoufek, 2015; Hayes, 2017; Kasper, 2017). The high volatility that has characterized the cryptocurrencies market so far suggests greater risk, along with the possibility of difficulties in properly transferring digital wealth through time. One possible solution suggests that the backing of powerful global corporations could help guarantee the persistence and existence of a mainstream digital currency, enabling a service like what governments do with fiat currencies. Diem aims to offer such a solution.

3. Local Currencies and Decentralized Finance

Economies at the local level can use what are called "local currencies" to promote their regional products and services. These currencies share some common features both with Diem and cryptocurrencies in general. Local currencies have existed for decades, yet with the advent of blockchain technologies and the possibility of "tokenization" (making a token), along with exchange value that doesn't require issuing promissory notes, new radical change may soon be upon us.

Local currencies rose in popularity during the 1990s due to a demand for locally produced goods and services (Jayaraman and Oak, 2001). Local businesses began to aim at preserving the specific characteristic of a town or region more than transregional businesses, while protecting and fostering the creation of local wealth (Schuman, 1998). Local currencies have also been developed with the intention of bypassing the limitation of a single currency system that sometimes constrains communities from local economic development (Grover, 2006).

The principal beneficiaries of local currencies are for the most part the economically excluded (Williams, 1996). Unfortunately, the prevailing flaw found by the local currency studies lies in the relatively low circulation and adoption rates of local currencies. This diminishes the significance of the research results. The "general public" has not yet widely adopted these currencies for use in everyday transactions. The reasons for this can be traced back to the three main functions of money referred to above. To summarize, local currencies do help in improving communities in some cases, yet the effect is somehow limited or minimal due to their low public adoption rate.

If local currencies were to develop, it would undoubtedly be in the form of cryptocurrencies and tokens, even though the ideals involved with the advent of decentralized finance (DeFi) through Bitcoin and Ethereum are different from local currencies (that is, borderless versus local economy). Yet, the technology behind the cryptocurrencies and the solutions it can provide are also applicable to local currencies. Although it can be argued that local currencies address very specific local conditions not well served by a national government currency, both cryptocurrencies and alternative currencies strive to diverge from the common and imposed government currency by creating new channels of exchange. Blockchain DLTs look set to answer those needs.

It is also crucial to understand that the way of thinking behind cryptocurrencies is drastically different from what currently exists in transaction cost economics (TCEs), which includes the presence of intermediaries or third parties. First, TCEs is driven by supply and demand, which invites arbitrage opportunities. DeFi built using blockchain technologies instead is established based on distributed trust (Seidel, 2018). Following Botsman (2017), distributed trust "flows laterally between individuals" without prior trust required. This new type of digital trust comes, of course, with its own deficiencies, in the form of various frauds and scams. Due to limited or non-existent regulatory and executive governance, the financial system is vulnerable to the emergence of unregulated innovations, which people with malicious intent can use to their advantage. Promises of delivering services that will never be fulfilled in exchange for e-money have been a recurring major concern expressed by investors, which is an issue for both cryptocurrencies and DeFi.

So far most blockchain-based projects have not yet gained mainstream users, likely due to their complex technological framework. To combat this weakness, decentralized financial services are striving to become increasingly user-friendly. However, it remains to be seen when non-tech-savvy people will be able to easily

access and use DLTs. Additionally, and perhaps paradoxically, a crucial need remains for a clear and standardized regulatory framework for DeFi around the world.

Current regulatory environments for cryptocurrencies are still uncertain and unsettled globally (Chen & Bellavitis, 2019). Laws and regulations regarding the finance industry and financial services change frequently nowadays, a fact that can prove costly for business and investment. The uncertainty and volatility cause many companies to adjust their business model, change locations, or eventually go bankrupt. Laws pertaining to financial innovations in the digital economy are so far extremely varied country-to-country, and certainty is lacking in regard to future government policies on this matter. While cryptocurrencies have so far been highly volatile, this particular issue can be solved by "stable coins", with values that are usually pegged to fiat currencies. Diem is to be introduced as a "stable coin" that is pegged to multiple fiat currencies.

4. The First Venture: Facebook's Libra version 1.0

Facebook has been trying to get into the online payment market through the WhatsApp pay application after seeing the success of their Chinese counterpart, WeChat. Roughly 90% of payments by Chinese living in big cities use either WeChat's mobile payment method or Alipay (Mansoor, 2020). Yet, the WhatsApp application did not take off as expected and the use of mobile payments in many "western countries" still lags behind China, and other Asian and African countries.

The online payment market remains massive economically, which suggests enormous profit opportunities for early actors on the playing field. Although the WhatsApp pay attempt did not meet with the expected success, Facebook came back in 2019 with Libra, now called Diem, a new project that shares similarities with the previous idea. At the same time, they made it clear that they do not intend to stop at the initial 28 members, which included Paypal, Uber, eBay, and Vodafone. They were instead planning to expand the Association to over hundred members in the upcoming years.

Following the 1st white paper published in 2019, the Association's main objective was stated as providing access to financial services and cheap capital worldwide, with a particular focus on underdeveloped countries. Through their platform, they aimed to reduce the costs of money movement throughout the world and presented their digital currency as a public good that would create "immense economic opportunities" (Libra Association, 2019a). The 1st white paper appeared mainly altruistic and consumer-friendly. Meanwhile, the private global companies that compose the Association have clear economic interests for being in the project.

Initially Libra, now Diem, is being built on blockchain technology. As an electronic currency, it was inspired by how blockchain is now being used in other digital currencies to "decentralize" finance. The Diem Association plans to include additional features for their electronic currency according to their business model, which we address below. The DLT behind Diem is designed to allow for scalability, meaning that they expect multiple billions of potential users simply due to the global outreach of the companies backing the project.

Diem also needs to be secure and flexible, which is only made possible by solving the so-called "trilemma" of blockchain technology between scalability, security and decentralization presented by Vitalik Buterin. Like most available cryptocurrencies, Diem is to be rolled out as a "decentralized network". Many DLTs rely on a "permissionless" system to verify the transactions in the blockchain network. "Permissionless" (in contrast with "permissioned") means that network members can join freely with the only restrictions imposed on them being what they have agreed to in the Genesis Block by joining that particular blockchain network. Overall, DLTs allow for greater transparency in business and personal transactions, as well as rendering it almost impossible to "hack" data (Haber & Stornetta, 1991, 1997; Bayer et al., 1993; Massias et al., 1999). The question is whether Diem can solve this trilemma, and if its users will be convinced of the safety and privacy of their everyday personal financial transaction data.

It remains a key challenge to achieve both scale and speed of transactions. Transactions with DLTs take longer to execute the more users are active in the network, which is why the speed of transactions is so important. In Diem's case, network users would have to validate and "reach consensus" for transactions of

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potentially more than a billion customers, which could prove unfeasible when Diem eventually gets rolled out (Catalini & Gans, 2016; Catalini et al., 2019).

To address this, validation authority is granted to a restrained and trustable group of people, who, in this case, are members of the Diem Association. This feature of the project distinguishes the Diem digital currency as operating within a "permissioned" DLT-based system, designed to make it easier to scale, and which likewise fits with the Diem Association's ambitions. This move serves to give the Diem Association more control over Diem tokens and meanwhile lessens the financial power of network users.

A basic diagram explaining the overall architecture of the Diem ecosystem is provided in Figure 1. It is important to note that the validators must be understood as an integral part of the Diem Blockchain, and to the overall ecosystem process.

Notably, Diem will not use "mining", but will create demand by exchange for fiat currencies. In the 1st white paper (Libra Association, 2019a), Facebook's digital currency was then to be pegged to a basket of low volatility assets, composed of bank deposits and short-term government securities. This type of digital currency is commonly called a "stable coin", as it avoids the high volatility risk by pegging its value to an already existing fiat currency.

The Diem Association's members will purchase the low-volatility assets that go into the Diem reserve and provide potential owners or users the virtual equivalent of Diem at the existing exchange rate. These assets are to be selected from "stable countries" and for the most part, denominated in US dollars, euros, British pounds,

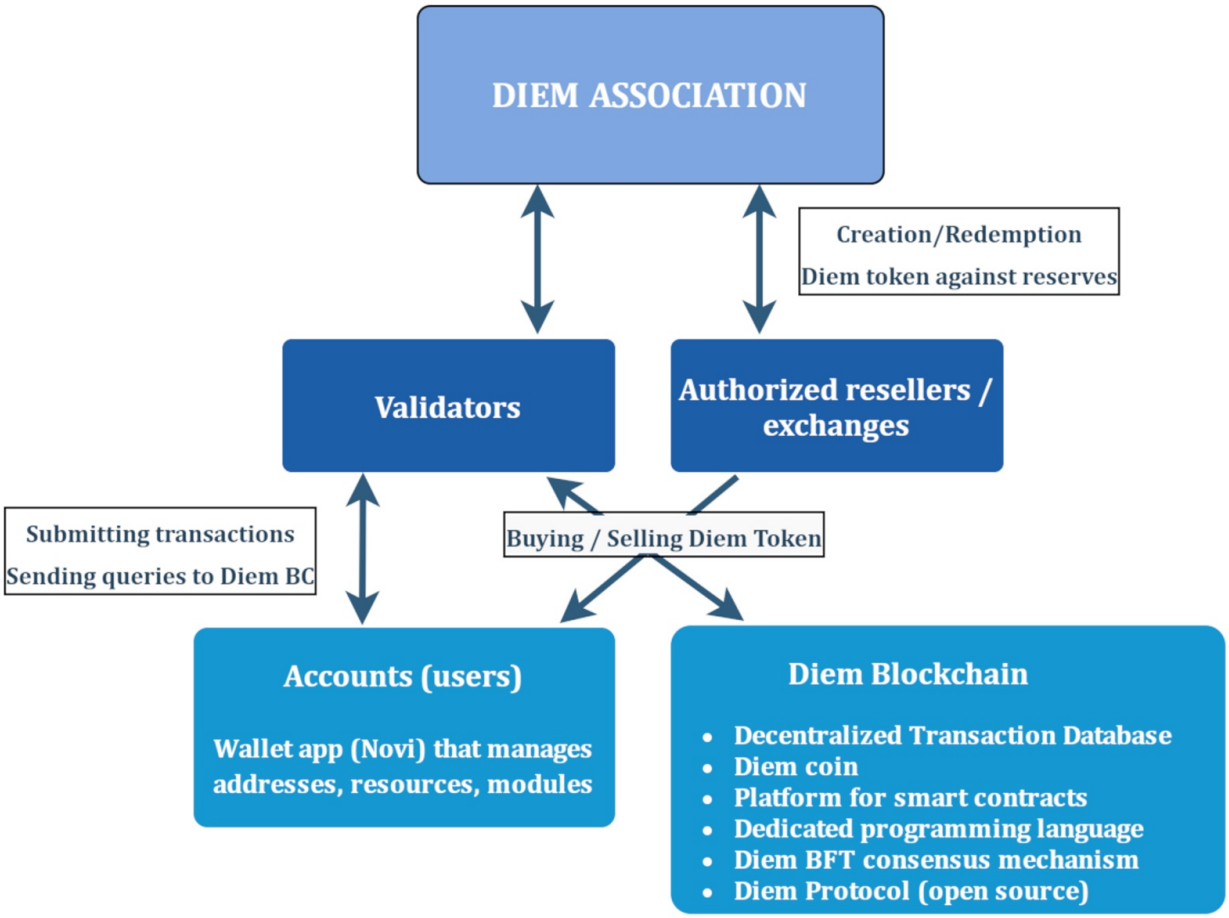

Figure 1. Diem ecosystem architecture
BC = blockchain, app = application, BFT = Byzantine Fault Tolerant
Source: modified from Bruhl, 2020

or yen (Adrian & Mancini-Griffoli, 2019). Facebook announced in September 2019 that the reserve would be composed of 50% USD, 18% EUR, 14% JPY, 11% GBP, and 7% SGD. Hence, the Diem token's value would behave like an Exchange Traded Fund (ETF), by tracking a basket of short-term and high-quality securities, with strong exposure to USD. By operating this way, Facebook and the co-founders expect their digital currency's value to stay relatively stable, at least in a fashion similar to well-known fiat currencies.

Of course, "pegging" to fiat currencies is one thing, while trusting who manages and secures the digital currency is something else. In addition to Diem currency managed by the Association, comes a digital wallet, "Novi". It was initially called "Calibra", but the name was changed in May 2020. Thanks to Novi, the owners of Diem tokens will be able to save, send, and spend Diem. Novi wallets will connect with phones, tablets, computers, and are likely to integrate credit cards, following the statement of David Marcus, co-creator of Diem, during the U.S. Congress hearings (U.S. Senate. Committee on Banking, Housing and Urban Affairs, 2019). Novi is registered as a subsidiary of Facebook and is not under the direct influence of the Diem Association. David Marcus also declared that Novi would become completely autonomous from Facebook, and eventually a fully-fledged member of the Diem Association in the future, as an independent entity.

This topic is delicate for Facebook given Facebook's track record regarding private information, since the information stored in peoples' wallets is often most crucial and sensitive (Coombs, 2005; Cohen, 2013; Albright, 2018). The Novi wallet is designed to contain all recorded transactions of the individual Diem-user, including whatever private information they feed it. David Marcus made it clear during the hearings that they will not share account information with any third parties without consumers' consent, or use it to improve targeting ads on behalf of Facebook or any third parties. The Novi digital wallet will thus be essential to Diem's potential for success, as it is where the transactions and transfers of digital currency will take place.

5. Opportunities and Challenges: The new version or Diem 2.0

At first, Diem was said to be motivated by a desire to help emerging countries and the world. Thanks to cost reduction and easier accessibility, Diem would provide access to financial services and facilitate transactions between users worldwide (Libra Association, 2019a). Little was mentioned of other economic incentives behind undertaking this venture for Facebook and its business partners. Each member of the Association was required to invest at least 10 million US dollars to be part of the project. In return, each member would receive investment tokens granting them a share of the Diem reserve fund (Hochstein, 2019).

The costs of the project overall and how much Novi and Diem altogether have already cost Facebook are difficult to estimate. During the hearing in the U.S. Congress in July 2019, the Association representative at the time, David Marcus, continuously refused to mention the size of Facebook's investment. We can certainly speculate that the amount was quite substantial. A private company would require a defined business plan and clear return opportunities. Facebook is not a non-profit organization looking to better the world at their own expense, without expecting to recoup their investment. They were no clear-cut answers on how Facebook planned to turn a profit with the Diem token, if that was indeed its direct goal.

First, we imagine that costs or fees payable with Diem tokens would be attached to transactions to profit Facebook through Novi. Transaction fees currently exist in the competitive financial services market, even if many argue these fees are too high. Yet, Facebook promises that its fees will be lower than those charged by the banking industry (Libra Association, 2019a). Whether on Facebook or in banks, one must comply with national financial rules and regulations. Diem must go through anti-money laundering and terrorist financing procedures for all transactions to avoid liability. Diem Association members will also have to handle the exact same issues that financial actors have to deal with when operating worldwide payments, which represent the main bulk of costs. In short, one way or another it must be made sure that the money pouring into Novi wallets is not fraudulent or being used for illegal and nefarious purposes.

None of the identity and security procedures can be skipped. Blockchain brings no additional value in this regard, since the procedure is time-consuming and costly. Also, Facebook and its partners argue they will be able to provide financial services to people who are

currently left out and at a lower cost, especially in underdeveloped countries. First, among the vast number of people currently not using financial services, only those with access to mobile technology or internet could see Diem as a solution. According to GSMA Intelligence (2020), there are around 5.2 billion smart phone users worldwide, that is 67% of the world population, and 4.57 billion internet users, or 59% of the world population, according to the International Telecom Union (2019). Yet, following a report from the World Bank in 2018, around 1.1 billion of the "unbanked" adults have at least a mobile phone and nearly half of them have internet access, suggesting that Diem could be of use for them. Secondly, Facebook will have to set up some sort of system where people in those countries can exchange their national fiat currency from and to Diem. Be it through local banks, shops, phone companies, or any other third party, the exchange intermediaries create higher fees, which might be similar to current rates offered by the competition.

However, one can speculate that transaction fees will not be the main source of revenue, especially when the Diem Association's reserves constitute an important asset that can be used to generate profit if managed correctly. It is crucial to understand this topic, while many questions regarding it are in our view still left unanswered. The Diem Association will be the one managing the financial assets of the reserve acquired by selling (exchanging) Diem to (with) clients. The white paper 1.0 specified that any interests gained will "be used to cover the costs of the system, ensure low transaction fees, pay dividends to investors who provided capital to jumpstart the ecosystem" (Diem, 2019). It seems evident to us that Diem's idea of cutting costs is ambitious at best and that they will likely either operate without profits or will have to increase fees at some point.

To the above question regarding how Diem intends to initially finance the low transaction fees, it is likely that they expect to finance it thanks to investments from the reserve fund, which will be composed mainly of short-term government bonds. Unfortunately for Facebook and the Diem Association, the current economic environment is plagued by very low interest rates, and the future is uncertain in this respect. If Diem's economic ecosystem depends on returns from their reserve fund, then the Diem project is much riskier financially than initially thought.

Diem tokens should then be looked at as shares in a managed fund that are also used as a medium of exchange. What would then happen in case the fund does not provide enough returns? Would the managers extend the duration of the financial instruments, pick different currencies, or invest in securities with lower creditworthiness? In other words, the reserve fund might have to revert to the initial promise of keeping a fixed proportion of low volatility currencies. The Diem Association addressed this in its 2.0 White Paper, which reads that the "activities of Libra Networks are governed and constrained by a Reserve Management Policy that can only be changed by a Member supermajority, subject to regulatory approval" (Libra Association, 2020). The goal here is to be licensed and regulated by a national authority, in this case the Swiss financial regulator FINMA.

Still, the argument above is valid only if the Diem Association has no other sources of profit available, should they be unable to cover operating costs. During the US congress hearing, David Marcus very briefly mentioned that in the upcoming years they intended to make loans available to users, which they expected would also become a source of profit. In other words, in addition to creating a digital currency as a means of payment, Facebook intends to offer typical banking services soon as well. Facebook has insisted that they will maintain a one-to-one ratio in their reserve requirements, which is surprising considering the fact that to provide loans, they would need to make use of assets sitting in their reserve, and thus bypass that ratio. Mr. Marcus was further questioned on this specific matter, saying the Diem Association would simply trust the word of private companies that they would not change the reserve. This is not saying much and his answers remained evasive. Legislators suspected a change would occur with the reserve requirements at some point, as the profitability seems too good to look past. Banks work this same way, except that the traditional central bank's role in the new economic ecosystem will be replaced by the Diem Association, which would have to put up additional funding from its founding members in case things turn for the worse. If lowering the reserve requirements is not an option, the Diem Association will have to turn to external parties or future members that could provide the necessary financial services the project requires. In case Facebook decided to provide loans through Novi, the Diem Association would truly compete with the banking sector and potentially national central banks,

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in both providing currencies and exchanging money for clients.

If Diem's launch and subsequent network growth manages to create a strong enough ecosystem, where the currency becomes a vital part of a country's economy, then it could heavily undermine the power of that country's central bank to conduct its policies. Many governments were thus understandably quite reluctant initially about DeFi through digital currencies. Even if Diem agreed not to adjust the reserve requirements or change the reserve's investment policy for five years, ten years or even twenty years, what would happen afterwards? A mere change of board members or a majority vote would enable transforming the Diem Association's policies. Simple promises that reserve changes will not happen were definitely not enough, considering the magnitude of the matter at hand, that is, a potential conglomerate with billions of customers that can possibly print money and implement their own monetary policies.

Aside from using the Diem Association reserves as a tool to raise profits, revenue is expected to also come from the ecosystem Diem creates. By the sheer increase of traffic in their platform, Facebook expects to increase revenue from ads. If Diem and Novi become essential to peoples' lives as much as Facebook has for some people, it is safe to say that revenue will increase if advertisements are also part of the project.

To summarize, the Diem venture has raised many concerns and faces strong headwinds for its near-future launch. Only a few months after getting started, the project had to deal with a set of significant blows: the departure of five members of the Diem Association and negative comments from government representatives and politicians. In an interview published in December 2019, then Swiss President, Ueli Maurer, for example, stated that "The Libra project has failed in its current form and needs reworking to be approved" (Hughes, 2019). Worse, the French government declared that they intended to block Diem from developing on European soil, although it is doubtful on what legal ground such a restriction would be implementable. All in all, the latter were not reassuring signs concerning the future of Diem in its initial form.

To answer concerns raised by politicians, regulators, and central bankers, the Diem Association announced in their April 2020 Diem 2.0 white paper that they plan also to offer single currency stable coins, in addition to the standard Diem token composed of multiple currencies. This means that Diem USD, Diem EUR, Diem GBP, for example, will each be available to customers, backed by securities denominated in these specific currencies, so as not to interfere with the monetary sovereignty of those countries. Stated otherwise, *the new Diem is more becoming a global value platform where multiple single currencies can be "plugged" in* (see Sandner, 2020).

To this set of "single-currency" stable coins or "programmable currencies", Diem will be backed by a basket of currencies (see figure 2 below). Diem will thus act as a kind of "substitution currency" only for places where stable currencies are lacking. The final goal for Diem tokens is to "integrate smoothly with local monetary and macroprudential policies and complement existing currencies by enabling new functionality, drastically reducing costs and fostering financial inclusion" (Libra Association, 2020). Regarding initial concerns about the possibility of the Diem Association offering loans, they responded in the 2020 white paper that they will not be providing loans from their reserves (Libra Association, 2020). Instead, they will be potentially turning to third parties to offer these services through the Diem network, thus reducing risks the Diem association could pose to central banks.

The rebranding of the project from Libra to Diem in December 2020 and the reinforcement of the management team by bringing in new senior executives seems to aim at showing organizational independence and increasing the likelihood of regulatory approvals. Indeed, Diem was designed not only for Facebook alone. One may thus wonder what the other Diem Association founding members expect? The private companies that joined hands in this project came from different backgrounds. Hence, they complemented each other in a way that would allow future consumers to gain access to a range of products and services using Diem tokens. The products and services offered by the Diem founding members aimed to fulfill most of a consumer's needs.

Altogether, the Diem Association initially included companies in industries, ranging from telecommunications to online shopping and traveling.

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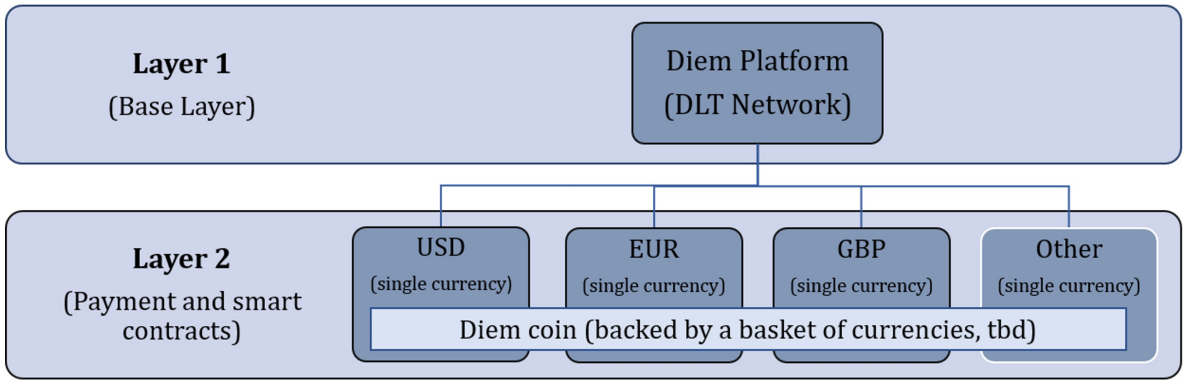

Figure 2. The Diem 2.0 architecture
Tbd = to be determined

At the time of founding, the Diem Association was composed of 28 members. Currently, there are 26 members; 8 have left and 6 new members have joined. Most of the big financial companies departed, like Ebay, Mastercard, Paypal and Visa. Among the newer entrants, one finds a payment system company, an e-commerce company, a cryptocurrency brokerage firm, and a few venture capitalists.

If a broad range of consumers can access most of their necessities from the Diem network and become accustomed to using Diem, the "network effect" will also increase volume for member companies in the Diem Association. They would be able to segment a large piece of the market for themselves, assuming the overall network can convince people to adopt Diem. In simple words, future customers would be enticed to use Diem exclusively and, by consequence, to buy products solely from Diem members (Reitman, 2019). Clearly, legislators have reason to worry about the possibility for the Diem Association proposing preferential rates and prices to Diem token users. This raises concerns of unfair competition that drives away opposition. Worse, barriers to entry would increase for new participants. Competitors may be forced to either join the Diem Association or suffer from market loss. Executive repercussions would be quite important, and we could expect a similar grouping of competitors to counteract the Diem Association, perhaps with an alternative DLT-based digital currency.

6. Future Challenges, Questions and Final Remarks

What we can see at play in Facebook's Diem venture goes much deeper than simply offering financial services to people around the world who currently lack basic access to them. The arguments raised in this paper lead finally to the ethical elephant in the room: Facebook's past actions and what they entail in this instance. Diem - and Facebook in particular - keep reiterating that they are aware of the former scandal (see Facebook-Cambridge Analytica data scandal) concerning the monetization of personal account information. They insist they will make their best effort to ensure that such a breach will not happen again.

Can Facebook and the Diem Foundation be believed and trusted? Is what they have said and guaranteed about security and privacy sufficient? Or should they be held to account and opposed by legislators and regulators? Just as with Central Bank and other currency-creating matters, actions speak louder than words in business execution and network building. Several issues with Diem remain problematic that we believe have not yet been satisfactorily tackled in the white paper and additional Diem documentation.

The rebranding and reorganizing of the Association was one step in the right direction, but more is needed. According to German finance minister Olaf Scholz regarding Facebook's digital currency plans, "a wolf in sheep's clothing is still a wolf" (Schalal and Kraemer, 2020). Facebook's reports and updates suggest humanitarian motivation behind the creation of Diem: billions of people are left behind and, thanks to the Diem network, a solution may be available. Yet, believing that Facebook, together with its mega-corporate global partners, are motivated mainly by altruistic reasons, we believe would be simply naïve.

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While we have noted that the Diem project faces many obstacles, we also foresee profitability from using Diem tokens that can be investigated and developed. The biggest earning potential in the Diem project definitely comes from the information that its Diem token and Novi wallet users will provide while using the Facebook-Diem financial system, with its market reach through advertising, online "stores", merchandising, and service offerings. The potential to target not only advertisements, but also provide financial services and products to boost consumer demand through Diem transactions makes an obvious source of revenue for a consortium-network with "user currency" that can be organized with an aim to capturing profits.

Although Facebook promises its users that security breaches of their personal data will not happen again, it may be a promise they truly mean, but simply cannot keep. Information is and has always been a key component of Facebook's recipe for high tech success, just as it will continue to be with the addition of Diem tokens. A kind of new craze with what is called "big data" can now be seen with Diem as a quest for a far, far away galaxy still to be conquered. The Diem Association will be sitting on a gigantic goldmine of information ready for the taking and harvesting for massive profits. Who will blame them that they took advantage of the moment it was ripe to do so?

Acknowledgments

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Notes

1) "Fiat currency" is to be understood as a "legal tender" backed by a government, but which has no other use value without secure legal protection. Legal tender refers to the fact that the currency is a medium of payment recognized by a national, territorial, or other jurisdictional legal system.

2) For many, money arose simply to avoid the limitations of barter that are assumed to have been prevalent in early human societies. A barter system is known to be greatly restrictive, with both parties having to agree on a value for the different goods and subsequently finding a common ground to match the offers of both sides (Goodhart, 1998). Some, however, have disagreed with this view, as it might sound a bit too "simplistic" and not confirmed by historical observations (Graeber 2011).

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Facebook's Digital Currency Venture "Diem": the new Frontier ... or a Galaxy far, far away?

Jahja Rrustemi & Nils S. Tuchschmid

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Embracing Product Innovativeness in Technology Firms: The Impact of Management Model Principles

Pınar Büyükbalcı, Esin Ertemsir, Zayneb Boukari

> *"The most resilient companies foster a pervasive culture of innovation at all levels of the organization - one that values risk-taking, embraces experimentation, and considers failure an inevitable part of thinking boldly."*
>
> Lynne Doughtie
> Former Chairman and CEO of KPMG

Extending the debate on how to enable and manage innovation requires a discussion of the potential beneficial impact of management models and corresponding principles. In this paper, we draw on literature involving product innovativeness and management models to propose that product innovativeness is facilitated and influenced by practices and principles traceable in different management models. We test our hypotheses with data from a sample of high technology firms. Findings suggest that management models and principles have varying impacts on product innovativeness. Specifically, we found the principles of obliquity, emergence, and intrinsic motivation as significant enablers of product innovativeness, along with extrinsic motivation. Also, each management model differently impacted and fostered product innovativeness.

Introduction

A company's management model reflects its managers' choices, decisions, systems, procedures, people, and organizational structure (D'Amato, 2015). Companies nowadays are often faced with transforming their management models to cope with discontinuous change in the current hyper-competitive business landscape. Under turbulent conditions, organizations develop skills, structures, and principles that enable them to build an innovative organizational climate and thus achieve competitiveness (Cooper & Kleinschmidt, 2000).

Our focus in this paper is to reveal the impact of management models on product innovativeness. We will do this by trying to discover how specific principles in a company's management model affect product innovativeness. The study targets technology-oriented firms strongly relying upon innovativeness to stay competitive.

As far as we know, although certain principles in company management models have been central to recent discussion in literature, their impact on innovativeness has not been empirically studied from a management model perspective. This study offers a discussion of management models and their principles that addresses this gap, and attempts to extend the relevant theoretical debate by examining impact on product innovativeness. From a practical perspective, we suggest a guideline for tech-oriented companies to raise their awareness by highlighting various principles that foster product innovativeness.

Summary of Literature Insights

Definition of Management Model

Examining the history of management models in the last century and a half, Bodrozic and Adler (2018) highlighted that, "the concept of management model has not received much scholarly attention and terminology has been loose". They define a "management model" as "a distinct body of ideas that offers organizational managers precepts for how best to fulfill their technical and social tasks".

A management model is a managerial tool that focuses on the operational tasks of organizational procedures and acts as a guideline that unifies fundamental

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elements of a company: the practices, processes, and principles (Basile & Foraci, 2015). According to this definition, in this paper we attempt to discover the relationship between the practices & processes of product innovation, together with management model principles.

Despite being strongly related to each other, management models and business models are distinct concepts (Birkinshaw & Ansari, 2015). "Business models" reflect the ways a company earns money (Osterwalder, 2004) by describing the business process as a system of interdependent activities (Zott & Amit, 2010), which in the end leads to value creation. Although the nature and implications of these interdependent activities might differ across industries (Herting & Schmidt, 2020), in general, a business model specifically refers to a target customer or customers, key activities, key resources, partners, and other features, which altogether make up the value creation activities of a firm. On the other hand, "management models" are the framework that reflects upon the dominant "managerial logic of an organization" (Prahalad & Bettis, 1986), or simply, "the basic choices (a firm makes) about how work gets done" (Birkinshaw, 2010). In this regard, a management model describes "how activities are coordinated, how decisions are made, how objectives are set, and how employees are motivated" (Birkinshaw, 2012).

In this study, our conceptualization of a "management model" is based on the principles and framework of Birkinshaw (2012), described as, "the choices made by executives of a firm regarding how they define objectives, motivates effort, coordinate activities, and allocate resources– in other words, the definition of how work of management gets done". As underlined here, the management model of a firm focuses on making choices regarding four main pillars: defining objectives, motivating efforts, coordinating activities, and allocating resources (Birkinshaw & Goddard, 2009; Birkinshaw, 2012). Under each pillar, there are both traditional and alternative principles that represent aspects of the model's structure, as depicted in Figure 1. Traditional principles are those that firms have implicitly used for generations, while alternative principles are either "just beginning to be adopted", or which have not yet been widely used (Birkinshaw, 2012; Birkinshaw & Ansari, 2015).

In the Figure 1 model, "coordinating activities" (labeled as "managing across") are described on a continuum, with "bureaucracy" and "emergence" on two sides (Birkinshaw, 2012). Bureaucracy serves as a means of coordination through formal rules and procedures to ensure standardized behavior that will in turn lead to output consistency. As an alternative principle, emergence focuses on a spontaneous order where employees coordinate activities themselves, yet according to minimal pre-defined guiding structure.

The next dimension, "decision making", focus on how to allocate resources. These are traditionally managed through a principle of "hierarchy", a notion that

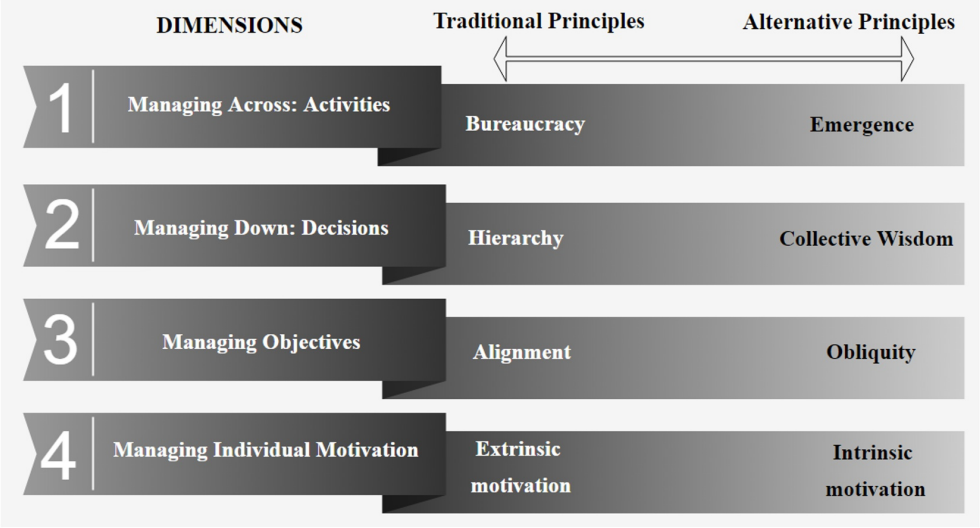

Figure 1. The four dimensions of a management model (adapted from Birkinshaw, 2012)

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managers have the legitimate workplace authority over their subordinates (Foss & Saebi, 2015). The alternative principle, "collective wisdom", suggests that under certain conditions the aggregated expertise of a large number of people can produce more accurate forecasts and better decisions than those of a small number of experts (Birkinshaw, 2012).

"Objective setting" is another critical dimension for a management model. In business contexts, the traditional principle of "alignment" means that all employees are working towards the same common objective in an aligned, step by step manner, while the "oblique" principle on the alternative side suggests that goals are best achieved when pursued indirectly. In other words, under "obliquity", a higher order general goal gets stated, while each unit is expected to design their own specific business objective to reach that higher order, generally defined goal (Birkinshaw, 2012).

The final dimension is "motivating employees", which can happen "intrinsically" or "extrinsically". If they are motivated intrinsically, which represents the alternative approach in this model, then the source of motivation is the inner interest or the satisfaction employees feel while doing their job. If they are motivated extrinsically, mostly observed in the traditional approach, then the source of motivation is often material rewards and external incentives (Casebourne, 2014).

Based on different combinations of management principles, four major types of management models have been put forth by Birkinshaw (2012) (see Figure 2).

As depicted in Figure 2, the "Discovery Model" bases on alternatives principles and is mostly adopted by small and medium sized ventures, or by designated units within special projects by large, established companies operating in an ambiguous, uncertain, and fast changing business environment. The "Planning Model" instead fully adopts traditional principles and when applied can be widely beneficial in mature industries where jobs are performed in a linear manner, and where there is a high degree of market predictability. The "Quest Model" and "Science Model" fall in between and employ various combinations of both alternative and traditional principles. In the "Quest Model", with a combination of collective wisdom and emergence as alternative principles, along with traditional extrinsic motivation and alignment, employees get told what to do, not how to do it. This model helps established and growing companies that operate in a competitive arena and thus need to try to differentiate themselves. The "Science Model" adopts the alternative principles of intrinsic motivation and obliquity, combined with traditional hierarchy and bureaucracy. This model is mostly practiced in special engineering project firms and other R&D-based business strategies. It suggests tight means and loose ends with formal rules and structures, as well

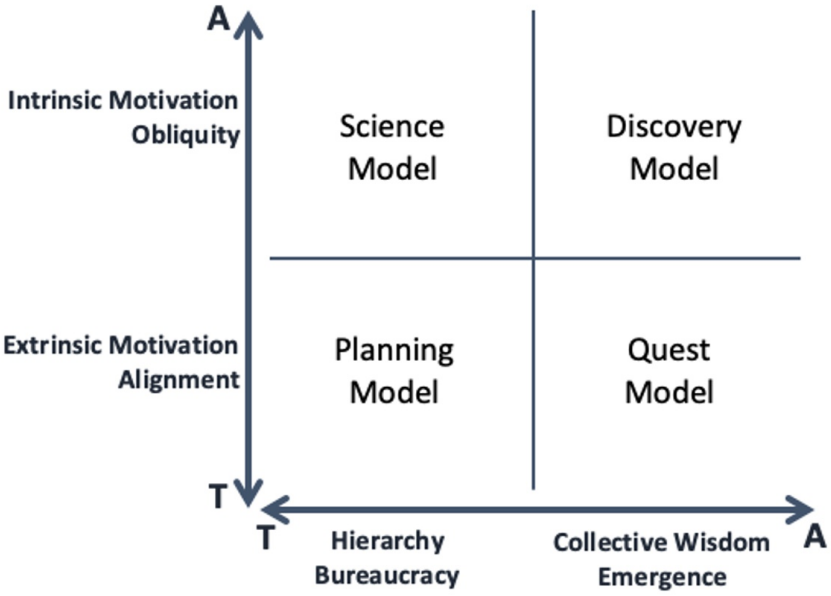

Figure 2. A framework on types of management models (Birkinshaw, 2012)
("T": Traditional management model principles / "A": Alternative management model principles)

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as authority in decision making based on scientific expertise, accompanied by intrinsic motivation to conduct science and sometimes necessary obliquity in achieving goals.

Product Innovativeness

Several definitions of "innovativeness" are available in related literature. Among them, a widely used one treats innovativeness as a company's propensity to introduce and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technology (Yusof, 2010). From a rather broad perspective, innovativeness has also been defined as a firm's capacity to engage in innovation; that is, introducing new processes, products, or ideas in an organization (Hult et al., 2004).

Product innovation involves understanding customer expectations, providing user convenience, and capture market demand. Damanpour (1991) defined "product innovation" as "new products or services introduced to meet an external and market need", while Conway and Steward (2009) described it as "a novel tangible artefact, including materials and components, those based on high as well as low technology, and those aimed at individuals or organizations". This study adopts Wang and Ahmed's (2004) framework of conceptualizing product innovativeness as, "the novelty and meaningfulness of new products introduced to the market in a timely fashion".

The impact of product innovation on a tech-oriented company's success is assumed to be related to the degree of novelty. In other words, a product new to a company but not to the market can be regarded as a minor innovation, some would even qualify it as an imitation, whereas a product new to the market represents a more drastic innovation (Mohnen & Hall, 2013).

Innovation types and firm innovativeness are both influenced by the interaction among resources, organizational structure, coordination, and motivational practices, which make a company's management model a critical factor either enabling or disabling innovation. Especially in tech-based enterprises, product innovation emerges as a proxy for agility and competitiveness, which prepares the ground to clearly differentiate the firm from its rivals and thus provide further growth and market expansion. The management model should also be well defined and flexible enough to anticipate and respond to abrupt changes in the business landscape, and thereby support innovative processes.

Methodology

This paper comes out of a research project that has been investigating the relationship between management models, principles, and innovativeness dimensions. The research's key steps were as follows: First, we identified the main research objective after a literature review conducted to better understand the gaps as well as unveil the main constructs and related variables. Following this, we discussed possible relations between variables and thus developed hypotheses. In the next step, we designed a questionnaire as the main measurement tool and decided the sample. After we collected data from the sample, we ran analyses and tested hypotheses to articulate the key findings. Further information is available below on the questionnaire, sample, and methodology.

We used a structured questionnaire for data collection. The questionnaire included 55 questions, 16 of which aimed to identify a company's type of management model, while 29 of them aimed to identify dominant dimensions in company innovativeness. The remaining 10 questions dealt with demographic indicators. Of these questions, 7 items directly aimed to measure product innovativeness. Questions measuring product innovativeness and the firm's tendency towards a specific management model pillar adopted a multiple-item six-point summated rating scale (1 = completely disagree, 6 = completely agree).

To identify each management model, items were derived from the specific definitions and brief test tools proposed by Birkinshaw (2012). To measure product innovativeness, we extracted related items from Wang and Ahmed (2004). Here are some example setup questions in this section: *"In new product and service introductions, our company is often first-to-market", "Our new products and services are often perceived as very novel by customers", "In comparison with our competitors, our company has introduced more innovative products and services during the past five years",* and *"New products and services in our company often take us up against new competitors".* Finally, the demographic questions were included to get information on variables such as age, size, and field of operation of companies in the sample.

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Since the study focuses on product innovativeness in technology ventures, the "science parks" at technical universities were selected as a target population, due their pioneering role in developing and commercializing technology. In our local environment, the 2 science parks in Istanbul established by technical universities host in total 723 companies. The sample in this study consists of firms operating at the science park of Yildiz Technical University, making it an acceptable and accessible population for the study. Yildiz Technical University Science Park was founded in 2003 and currently hosts 433 firms. The sample represents high-tech firms that compete in highly dynamic environments and whose survival is mainly due to their innovative capabilities.

In this research, we used convenience sampling on 90 questionnaires that were collected between the end of 2016 and the beginning of 2017. However, among these 90 questionnaires, 10 were incomplete and thus 80 firms were included in the final analyses.

Tabachnick and Fidell (1989) suggested that the minimum number of subjects for each predictor or independent variable in a regression analysis should be at least 5 times more than the number of independent variables. In other words, a minimum subject-to-predictor ratio as 5-to-1 is acceptable when not possible to have the recommended ratio of 20 times more cases than independent variables (Green, 1991). This study thus met the minimum number of subjects required to conduct multiple regression analyses with 80 firms, since six independent variables required at least 30 subjects.

This study used firm-level data. To reach responses highly reflective of a company's management model, data was collected mostly from founder-managers and other persons holding managerial positions. Respondents were invited to complete an anonymous survey questionnaire that took approximately 20 minutes to complete. While collecting data, we first used a self-administered survey method, with drop-off surveys and email deployment. However, the response rate was very low. Therefore, we switched to a household drop-off survey, and the questionnaires were handed to each participating firm one by one. Within a certain period, they were each directly picked up. The voluntary character of the participation was explained verbally as well as indicated in the questionnaire.

Hypotheses Development

This paper focuses on "product innovativeness", specifically "new to the market" products, and aims to study its relation with organizational management models, with specific focus on principles in management models. Current research assumes that certain principles in each management model have different impacts on product innovativeness. This is in line with the literature that emphasizes management models as traceable among a variety of management practices (Birkinshaw, 2010) and management model principles, which are manifested in organizations through certain processes (Birkinshaw and Ansari, 2015). Based on this, we assume that management model principles are manifested in product innovation processes and practices.

Accordingly, our main research question addresses whether or not alternative management principles (emergence, collective wisdom, obliquity, and intrinsic motivation) have a different impact on a company's product innovativeness compared to the impact of traditional management principles (bureaucracy, hierarchy, alignment, and extrinsic motivation). If so, how does the impact of each principle change in terms of fostering and enabling product innovativeness, especially when taking into consideration their roles in relevant management models?

Today, managers tend to involve employees in decision making processes and decentralize planning to make them internalize goals and plan actions more easily. This is especially important for progress and improvement in organizational processes that require voluntary contribution of employees at each level. Clegg et al. (2002) put forth the view that people are more likely to make efforts to innovate when they feel trusted and empowered at work. Following this, Ellonen et al. (2008) suggested that different types of trust enhance innovativeness in organizations.

Involving multiple organizational members and stakeholders in a decision-making process pays tribute to the importance of collective wisdom, which can be traced in discovery and quest models. Like the term "collective wisdom", Lave and Wenger (1991) used the term "communities of practice (CoP)" and defined it as a connection among practitioners who share ideas and solve problems. Likewise, collective wisdom is seen as

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being valuable to organizations as it fosters the creation and sharing of "social capital", although, in the case of internal sourcing of employees, limitations are imposed by internal organizational sources, which sometimes demonstrate an "in crowd" perspective.

The results of related studies show that, especially in a complex and fast changing context, like that of technology-oriented companies, both centralization and formalization lead to restrictions on creativity and innovation (Ekvall, 1999). Similarly, individual level innovation capabilities and employee learning are limited when formal plans get dictated by top executives (Daft, 1978). McKnight and Chervany (2001) reveal that the positive impact of trust-related behavior and high inclusiveness can be traced in cases of strong cooperation, information sharing, informal agreements, and decreasing controls.

Thus, we hypothesize that:

H1: *Alternative principles of emergence and collective wisdom have a positive relationship with product innovativeness.*

Despite of the mainstream notion noting that centralization and formalization, both prominent indicators of bureaucracy (Damanpour, 1996), hinder innovation in most cases, more research is still needed to clarify the mixed relationship between bureaucracy and innovation by further exploring the impact of certain organizational features (Dougherty & Corse, 1995). In stable and predictable environments, some degree of centralization and formalization in decision making may enhance an organization's ability to implement innovation (Harold, 2000). In line with this view, Olson et al. (1995) found that, if efficiency is the issue, then product development processes can be associated with more bureaucratic approaches. Kessler and Chakrabati (1999) found that for radical innovation projects, assigning a project leader from higher hierarchical levels will speed up the process, while for incremental projects, lower-level project leaders might be assigned. On the other hand, Lahiri et al. (2019) put a focus on hierarchical relationships and found that there might be a strong negative impact of hierarchy on product innovation if a dispute occurs between founder-inventors and innovation teams in technology ventures.

Additionally, centralization of power correlates positively with innovation, especially in new ventures (Koberg et al., 1996), and when the business environment is rather stable. Offering international management insights, Wong (2002) noted that product managers have to both manage and coordinate new product development activities among headquarters and subsidiaries, in parallel with their company's centralization needs. In other words, a certain level of centralization and formalization makes it easier for firms to adopt and implement product innovation, especially when a technology is quite complex, or when the firm is rather young and has yet to describe the new product development procedures in their organizational framework.

The findings of this research picture a mixed relationship between hierarchy and product innovativeness, like what we observed with bureaucracy.

We observe bureaucracy and hierarchy among management principles in both planning and science models. As previously underlined, planning models are relevant to a more stable, predictable and measurable environment based on incremental innovation, In contrast, science models foster complex product development procedures by putting the implementation phase, beyond idea development, into a well-defined framework as shaped by bureaucratic and formal rules.

Accordingly, we hypothesize that:

H2: *Traditional principles of bureaucracy and hierarchy have a positive relationship with product innovativeness.*

Along with the bureaucratic and formal rules, the science model also includes oblique goals and intrinsic motivation. In other words, it uses tight and standardized procedures for applying ideas with complex technological procedures, but also encourages employees to seek new ways of delivering outputs, especially through idea generation processes.

Especially in creative and science-based works, where scientific progress, critical acclaim and peer review are as important as commercial ends, setting goals by following the principle of obliquity serves to make room for creativity (Birkinshaw, 2012). Highly-qualified employees in industries with science models are mostly motivated by intrinsic rewards and prefer creativity, the freedom to innovate, and recognition, compared with

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extrinsic gains such as financial instruments alone (Gumusoglu & Ilsev, 2009; Gupta, 2009). This is also in line with McGraw's (1978) proposal that simple and straightforward tasks can be enabled by extrinsic motivation, while for creative, open-ended, and complex tasks, where focused search and attention is required, such an approach may result in adverse performance outcomes.

Thus, obliquity and intrinsic motivation, both prevalent in the science and discovery models, are expected to foster product innovativeness as they create a setting for behavioral patterns to emerge and thus enable people think "out of the box".

Therefore, we hypothesize that:

H3: *Alternative principles of obliquity and intrinsic motivation have a positive relationship with product innovativeness.*

As mentioned above, we traced each management principle in various management models. Thus, as the following sections show, our analyses focused on the impact of management principles by taking pre-defined groupings with other principles in relevant models (as can be observed in Figure 2). Also, Figure 3 clarifies the type of management model in which we trace the hypothesized principles.

Data Analysis and Findings

Descriptive Statistics

The questionnaire sample consists of young firms, most of which were founded after 2004. The vast majority of participating companies (72%) operate in the software industry. The rest are distributed among telecommunication technologies (7%), pharmaceutical (8%), hardware manufacturing (5%), digital mobile media (5%), and in audio and video processing technology industries (3%).

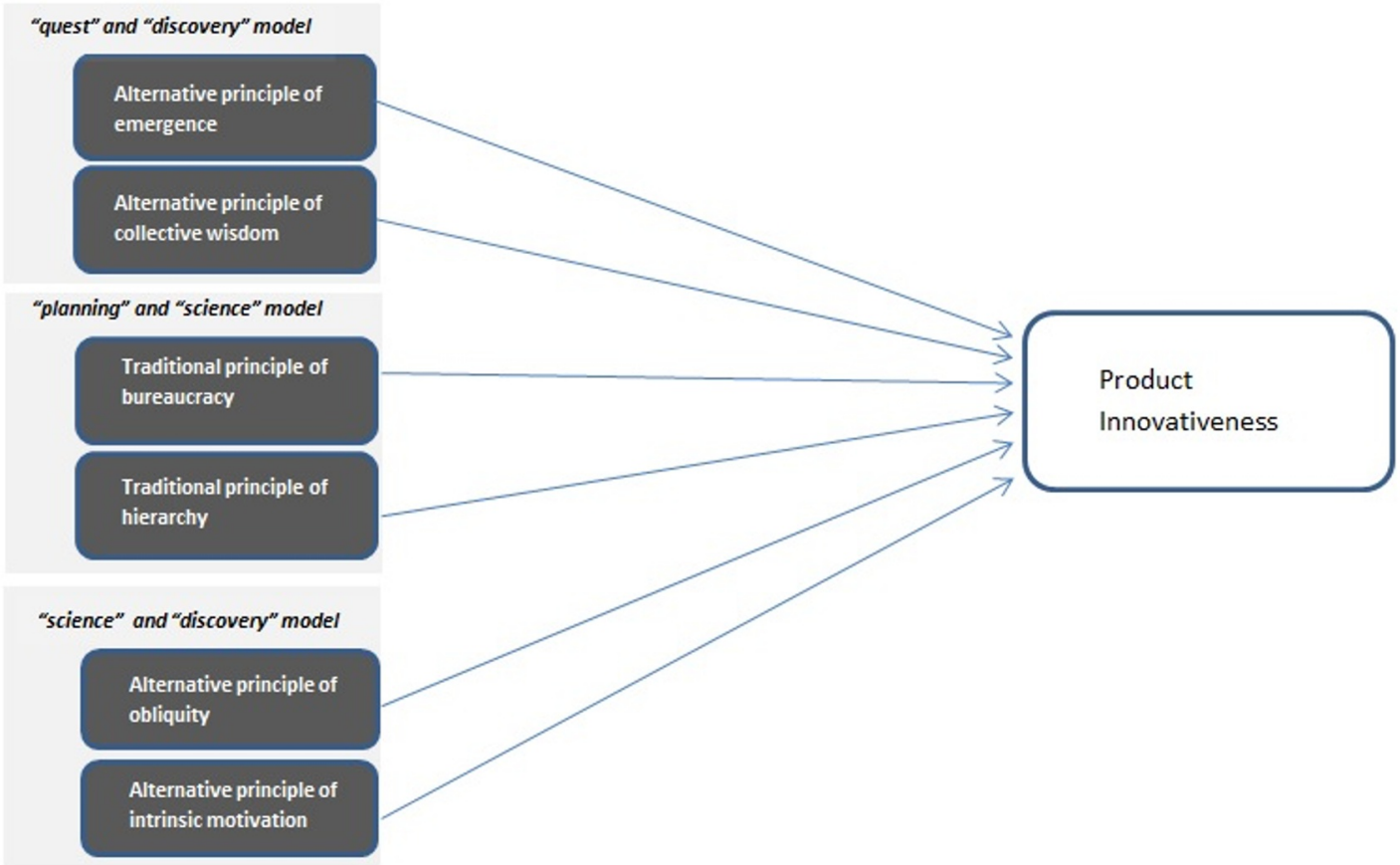

Figure 3. Theoretical Model

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Respondents were either founders or individuals holding managerial positions. Specifically, 15% of the respondents were founders, with 33% high level managers (C suite staff), and the rest middle and low-level managers who frequently interact with higher-level managers, and thus have knowledge and experience of the company's management model.

Finally of note, 38% of the total participating companies have less than 10 employees, while 31% have between10 and 20 employees, and the rest have more than 21 employees.

Analyses

First the relationship between management model principles and product innovativeness was calculated by Pearson's "correlation coefficient technique". The results (see Table 1), indicate a positive and significant relationship between product innovativeness and the principles of emergence, collective wisdom, obliquity, and both extrinsic and intrinsic motivation. These preliminary results provide support for the first and third hypotheses, with none revealed for the second hypothesis.

Along with the main purpose of this study, further analyses were needed to portray any underlying relationship between the variables. Thus, following correlation analysis, we further examined the impact of management models and principles on product innovativeness by linear regression analysis.

Prior to regression analysis, we tested the data set for normality, linearity, and multicollinearity assumptions, before proceeding with further multivariate analyses.

First, we calculated Mahalanobis distance values to see whether there were outliers in the data set (χ^2 (8) =26.13; p<.001). No outliers were identified. Next, we created scatter plot matrices, which showed that distributions are scattered close to the elliptic shape and that linear relations exist. These results indicate that the assumptions of normality and linearity are met.

Finally, we calculated correlations between independent variables to examine multicollinearity. No strong correlations were found between variables (-0.38< r <0.56).

Also, we acquired Cronbach's Alpha values for the product innovativeness measure (0.71) and for each group of items measuring different management models (Science Model: 0.69, Discovery Model: 0.79, Planning Model: 0.73, Quest Model: 0.67).

Table 1. The Correlations between Principles in Management Models and Organizational Innovativeness

	Variables	Mean	Std. Deviation	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13
V1	Bureaucracy	8.34	2.22	1												
V2	Emergence	6.61	1.73	0.14	1											
V3	Hierarchy	8.79	2.21	0.43**	0.00	1										
V4	Collective wisdom	7.70	2.28	0.04	0.38**	-0.03	1									
V5	Alignment	7.29	2.15	0.15	0.23*	0.13	0.07	1								
V6	Obliquity	6.80	2.25	0.12	0.30**	0.23*	0.28*	-0.38**	1							
V7	Extrinsic Motivation	6.08	2.00	0.04	0.13	0.11	0.22*	0.14	0.09	1						
V8	Intrinsic Motivation	7.98	2.07	0.03	0.16	0.05	0.36**	0.22*	0.05	0.27*	1					
V9	Behavioral innovativeness	18.23	3.03	0.13	0.23*	0.17	0.36**	0.19	0.06	0.12	0.40**	1				
V10	Product innovativeness	14.74	2.68	0.15	0.31**	0.18	0.28*	0.02	0.51**	0.28*	0.30**	0.27*	1			
V11	Process innovativeness	17.76	3.00	0.33**	0.11	0.31**	0.24*	-0.02	0.40**	0.20	0.23*	0.56**	0.45**	1		
V12	Market innovativeness	14.44	2.91	0.23*	0.10	0.21	0.10	0.05	0.14	0.26*	0.21	0.28*	0.26*	0.41**	1	
V13	Strategic innovativeness	13.06	2.52	0.01	0.16	0.01	0.25*	0.03	0.05	0.32**	0.13	0.07	0.12	0.09	0.37**	1

N=80, **p<0.01, *p<0.05

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Table 2. Impact of the Quest Model on Product Innovativeness

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	9.86	1.55		6.37	.00
Collective Wisdom	.17	.14	.14	1.24	.22
Emergence	.38	.18	.24	2.09	.04
Extrinsic	.30	.14	.23	2.08	.04
Alignment	-.10	.14	-.08	-.75	.45
R=0.42	R^2=0.18	f^2=0.22			
$F_{(4-75)}$=4.02	*p*=0.01				

Following tests for assumptions and reliability, we ran regression analyses. We used the method ($f^2 = R^2/ (1 — R^2)$) proposed by Cohen (1988) to calculate the effect sizes in the regression analysis ($0.02 \leq f^2 < 0.15$ small effect, $0.15 \leq f^2 < 0.35$ moderate effect and $0.35 \leq f^2$ large effect).

Data in Table 2 reveals the impact of the "quest model" on product innovativeness.

When the results were examined, we saw that only "emergence" and "extrinsic motivation" turned out to be significant predictors of product innovativeness.

According to our findings, the overall impact of the quest management model on product innovativeness is significant (p=.01), while the explanatory power of the model is moderate (R=.42, R^2=.18, f^2=.22). The quest management model accounts for 18% of the total variance in product innovativeness.

Data in Table 3 reveals the examined impact of the planning model on product innovativeness.

According to the results, the principles of bureaucracy, hierarchy, alignment, and extrinsic motivation show no significant combined impact on product innovativeness

Table 3. Impact of the Planning Model on Product Innovativeness

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	10.83	1.72		6.31	.00
Bureaucracy	.12	.15	.10	.81	.42
Hierarchy	.14	.15	.11	.93	.36
Alignment	-.06	.14	-.05	-.45	.65
Extrinsic	.36	.15	.27	2.42	.02
R=0.33	R^2=0.11	f^2=0.12			
$F_{(4-75)}$=2.27	*p*=0.07				

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(R=.33, R^2=.11, p>.05). In other words, the overall impact of the planning model on product innovativeness was not observed in this dataset. In terms of the impact of management principles, only extrinsic motivation significantly affected (p=.02) product innovativeness.

Following this, we analyzed the "science model's" impact on product innovativeness as revealed by the data in Table 4.

The combination of bureaucracy, hierarchy, obliquity, and intrinsic motivation altogether significantly and strongly affect product innovativeness (R=.59, R^2=.34, f^2=.52, p<.05). When we examined the results of the significance tests of the calculated coefficients, we saw that on an individual basis obliquity and intrinsic motivation were significant predictors of product innovativeness.

Finally, we obtained the results in Table 5 regarding the impact of the "discovery model" on product innovativeness.

The results indicate that emergence, collective wisdom, obliquity and intrinsic motivation together have significant and strong impact on product innovativeness (R=.59, R^2=.35, f^2=.54, p<.05), showing

Table 4. Impact of the Science Model on Product Innovativeness

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.06	1.57		4.50	.00
Bureaucracy	.09	.13	.07	.70	.48
Hierarchy	.03	.13	.02	.22	.83
Obliquity	.58	.11	.48	5.04	.00
Intrinsic	.35	.12	.27	2.85	.01
R=0.59	R^2=0.34	f^2=0.52			
$F_{(4,75)}$=9.77	*p*=0.00				

the important impact of discovery model on product innovativeness. At the same time, in terms of the impact of principles, we observed obliquity and intrinsic as significant predictors of product innovativeness.

In our findings, we note that some unexpected relations were revealed, along with expected ones. Below we address these relations with respect to the three hypotheses presented above.

Hypothesis 1, which stated that principles of emergence and collective wisdom have a positive relationship with product innovativeness, was only partially supported as the impact of collective wisdom was not observed singly. Rather, the collective wisdom principle enables product innovativeness only when it interacts with other principles in the "quest model" and "discovery model". The emergence principle, on the other hand, enables product innovativeness, both individually and with significant impact through the "quest model" and "discovery model".

Hypothesis 2, which focused on the relationship of bureaucracy and hierarchy with product innovativeness, was weakly supported as none of the principles significantly affected nor enabled product innovativeness. Their impact was observed only through their role in the "science model", where the overall impact of including other principles (obliquity and intrinsic motivation, along with bureaucracy and hierarchy) turned out to be significant.

Hypothesis 3, which discussed a positive relationship of obliquity and intrinsic motivation with product innovativeness, was fully supported, These principles affect and thus enable product innovativeness both individually and also through the overall significant impact of the "science model" and "discovery model".

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Table 5. Impact of the Discovery Model on Product Innovativeness

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.06	1.38		5.11	.00
Emergence	.19	.16	.12	1.21	.23
Collective Wisdom	.02	.13	.02	.14	.89
Obliquity	.55	.12	.46	4.61	.00
Intrinsic	.32	.13	.25	2.47	.02
R=0.59	R^2=0.35	f^2=0.54			
$F_{(4-75)}$=10.12	p=0.00				

Discussion

Our analyses put forth that the "discovery model" shows the strongest influence on product innovativeness, followed by the "science model" and the "quest model", respectively. Regarding the impact of management principles, our results show that the impact of obliquity and intrinsic motivation turned out to be especially strong, exerting significant impact both through management models and on an individual basis. Also, the emergence principle was found to be a significant predictor of product innovativeness.

The findings present mixed results regarding the alignment principle. Despite the non-significant individual impact on product innovativeness, alignment combined and interacting with other principles in the quest model was found to contribute to firm product innovativeness. This finding indicates that, rather than acting as an independent variable with direct impact on product innovativeness, goal alignment might portray an impact as an intervening variable. This is also in line with previous literature discussing that "context matters" for goal alignment to foster product innovativeness, specifically with regard to the varying impact of certain environmental factors on several forms of alignment (as put forth by Acur et al., 2012), and the possible impact of other variables such as visionary leadership and communication quality (Mascareno et al., 2020). Therefore, we recommend that future research should focus on the relationship of goal alignment with other organizational variables to clarify its impact on product innovativeness.

Our findings indicate that both intrinsic motivation and extrinsic motivation can be significant enablers of product innovativeness, making "motivation" the only management model pillar in our study that enabled product innovativeness both through alternative and traditional principles.

Intrinsic motivation thus bears a motivating role, especially for the high qualified employees (also known as, "golden collar workers") in technology firms. Recent literature also supports this by underlining the role of intrinsic motivating factors in fostering the stimuli to create something new, look for new opportunities, and continuously think on how to create new products or improve existing ones (Alvesson, 2000; Holland et al., 2012). In their study on micro- and small-sized software development companies in Turkey, Gumusoglu and Ilsev (2009) also found a strong influence from intrinsic motivation as a mediator variable on innovation and creativity.

Our findings also indicate a significant role from extrinsic motivation in enabling product innovativeness. Extrinsic motivation turned out to be influential in technology firms, just as with intrinsic motivation. In other words, intrinsic motivating factors are critical in initiating the new product development process, while people still expect visible rewards after they create new products that enhance or strengthen the competitive market position of their company.

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The obliquity principle's strong impact on product innovativeness shows the importance of sometimes setting only loosely defined boundaries while pursuing company goals. In other words, in order to harness creativity, following an oblique principle such as, "our company will beat our rivals by being the first to market", "we want to position ourselves as a company always offering novel products" will likely pay off more than always clearly defining and imposing from the top-down specific objectives.

In terms of coordinating new product development processes, the principle of emergence turns out to be an enabling factor. Emergence is closely relevant to coordinating activities and the execution phase of new product development, rather than the idea generation process. Specifically, it refers to deciding which rules and procedures to follow in developing new products and making them function. As Mintzberg and McHugh (1985) described with the term "adhocracy", it is crucial for the sake of creativity to give up or minimize bureaucracy and instead design a new form of coordination system with an innovative approach. A flexible, ad-hoc structure in this view expects to enable possible cooperation among employees, which in turn may foster product innovativeness (Pullen et al., 2009; Naranjo-Valencia et al., 2017) by liberating the coordination of their activities.

Another important finding from our study is that none of the decision-making principles, not collective wisdom nor bureaucracy is found to be a significant enabler of product innovativeness. Despite previous research that posed collective wisdom as an enabler of product innovativeness (Malhotra et al., 2017), our current study finds that controversial, and underlines what appears to be a non-significant role for collective wisdom. This is in line with a recent study by Zahay et al. (2018) that challenged the value and impact of internally crowdsourced ideas during NPD.

Despite the non-significant impact of "bureaucracy" on product innovativeness, our findings show that the "science model", including bureaucracy as a principle, portrays a statistically significant explanation. On the other hand, the "planning model" exerted no significant impact on product innovativeness. This finding supports Damanpour's (1996), which underlined that future research should identify specific conditions that unveil possibly varying impacts of bureaucracy on innovation. Also, the changing role of bureaucracy in this study put an emphasis on Dougherty and Corse (1995), who mentioned that "useful re-conceptions of bureaucracy's relationship with innovation … may help resolve persistent problems both in theory and in the real world".

Not all management models were applicable to this study's sample. For example, the planning model with its prescriptive nature was not expected be preferred in a dynamic entrepreneurial context. Still, we did not place such a limitation on the research and did not exclude it from our analyses in order not to restrict possible interactions among variables. However, as expected, 3 of the four models —the science model, quest model, and discovery model —were found to be supportive when the combined impact of all principles were checked. It is reasonable to observe the impact of these rather "proactive" models when the fast changing and highly complex character of technology-oriented companies.

Conclusion

The main purpose of this study was to investigate the impact of management model principles on product innovativeness. By unveiling several possible impacts, we aimed to open a new venue to discuss how product innovativeness is enabled by using specific management principles. Thus, we aimed to help companies develop a better understanding of the role of management models in fostering product innovativeness. The study in this respect contributes to the field of business management through an empirical examination of strategic factors that affect product innovativeness.

Future research might explore other variables to extend the discussion. For instance, the type of product developed might affect which management principles should be used to foster product innovativeness. As found by Saranga et al. (2018), when the nature of product development is rather "adaptation" and incremental modifications of existing products, a more structured process to develop products will be appropriate. Such differences might highlight special cases where certain principles become more (or less) affective in supporting product innovativeness. Due the sample firms we chose, the current study largely includes "new-to-the-market" products. Further studies should pay attention to products and include alternative modes of product development to address the impact of management principles more thoroughly.

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An unexpected finding of the study was the apparent insignificant impact of collective wisdom. In tech-oriented industries, the collaborative development processes in open-source software communities widely source from external parties. Online communities are also considered important sources of ideas for brand or line extensions, as well as product re-positioning (Ogawa & Piller, 2006; Christensen et al., 2017). Thus, to better analyze the impact of collective wisdom, we suggest that future studies examine comparisons among "in-crowd" sourcing vs. sourcing from external "crowds".

The limitations of our study also suggest promising opportunities for future research. One such limitation is its single country and single firm type (entrepreneurial high-tech firms) focus. To enrich the discussion here, future studies could therefore benefit from expanding research across different sectors and countries. Such comparisons will let researchers discuss additional relationships in a more comprehensive manner.

The main weakness of this study is the small sample size. With a small sample size, caution must be applied. To generalize the findings, future research should replicate similar research with broader samples. Nevertheless, an obvious strength of the current research design and activities lay in our access to "managers". Their responses helpfully reflected the essence of the company's management model. Thus, the findings of our research serve the purpose of raising awareness about the topic, while we strongly encourage that further research be undertaken with broader samples and additional methodologies.

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Project Portfolio Management in the Front-End of Innovation of Research Centers: a Literature Review

Rui Nuno Castro, João José Pinto Ferreira

> *"Effective portfolio management is vital to successful product innovation. Portfolio management is about making strategic choices. It is about resource allocation. It focuses on project selection. And it deals with balance."*
>
> Robert G. Cooper, Scott J. Edgett, and Elko J. Kleinschmidt

The beginning of an innovation process, also known as "front-end of innovation" (FEI), counts as an essential contributor to the successful development of new products and for their market appeal. Nevertheless, while helpful procedures and techniques for developing new products are well-known and widely applied, FEI is still an understudied area, and models for managing it are not yet commonly used in technology-oriented companies. FEI, also known as "fuzzy front end", can even be "fuzzier" in not-for-profit research centers. That is because the focus of these centers is advancing of scientific knowledge, rather than commercializing the results of those activities. This study summarizes the insights from a literature review on the topic of "project portfolio management" (PPM) in relation to innovation and, more specifically, with FEI and its components of ideation, innovation management, innovation strategy, foresight, and incremental or radical innovation. The authors selected and reviewed content from 170 papers published in SCOPUS prior to February 2019. The discussion uses a theoretical framework called "Front-End of Innovation Integrative Ontology (FEI2O)" to assist in framing the discussion.

Introduction

This study presents an integrative literature review on the processes, techniques, and capabilities of managing project portfolios, and on how they are discussed from the perspectives of innovation, ideation, and dynamic capabilities. The relationship among these topics is described in the scope of not-for-profit research centers. This study aims at addressing the problem of selecting and identifying the "best" opportunities in not-for-profit research centers that aim to impact society by transferring their R&D results to business enterprises. The purpose of not-for-profit research centers, as the name suggests, is different from that of for-profit companies. Companies target profit generation and thus innovation gets motivated by an expectation to increase sales and revenues. Not-for-profit research centers, on the other hand, are typically funded by public state budgets. They have a mission to advance knowledge, train researchers, and explore areas that may not be profitable in the short or even medium-term. However, most of these research entities seek to promote close relationships with companies, and thus enable knowledge and technology transfers.

The topic of "project portfolio management" (PPM) has been discussed and researched over the past 50 to 60 years (Zschocke et al., 2014). PPM is typically described as a process to attain four main objectives: maximize the value of a portfolio of projects, attain a balanced portfolio, make sure projects are strategically aligned, and develop the right number of projects to fit the existing resources (Cooper & Edgett, 2014). PPM targets the successful execution and development of active projects, while maintaining a balanced portfolio according to a suitable organizational strategy, with the right number of active projects and maximizing the value of the portfolio. PPM is well-established in the

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"new product development" (NPD) phase (Cooper et al., 2001) and already well understood in the scope of companies that develop radical or incremental products. It is less studied and applied by companies that develop new services (Aas et al., 2017), and research on the use of PPM by not-for-profit organizations still seems to be nonexistent (Barczak et al., 2006).

Not-for-profit research centers do not usually develop tangible commercial products. The "product" of a research center is commonly intangible and takes the "shape" of "intellectual property" (IP). Thus, new research projects may have several goals: to develop new IP for transferring/integrating into third party's commercial products in the future, to develop new technical and scientific competences and knowledge (thus contributing to the advancement of science and knowledge), or to develop new solutions, products, or services jointly with companies. Consequently, applying a PPM process in not-for-profit research centers may not be adequate. For example, many projects in this type of organization are publicly funded and cannot be canceled. These factors need to be considered, and research is required to find out how to adapt a PPM process to this reality. Also, the connection between the success of front-end activities and overall project success is not yet well understood (Kock et al., 2016).

Within the above context, this review article aims at understanding how to effectively manage a large number of ideas and opportunities that appear in the "front-end of innovation" (FEI) of not-for-profit R&D Centers. We present a literature review on the PPM topic that related organizational capability with the topic of "innovation". Specifically, we focus on FEI and its components of ideation, innovation management, innovation strategy, foresight, and incremental or radical new products. The paper's goals are: 1) to assess the available literature on both PPM and FEI, and identify insights that could be valuable to the specific context of not-for-profit research centers, 2) to discover the most relevant discussion threads relating to these topics, 3) to discover the existing gaps in the literature, 4) to unfold new research directions pointed by the authors of previous studies, and 5) to use an existing framework to organize all of the involved concepts.

This study is based on a selection and review of content in 170 publications concerning PPM and its relationship with FEI in the scope of not-for-profit research centers. The search included all available papers published in SCOPUS until February 2019. The discussion uses the so-called "Front-End of Innovation Integrative Ontology (FEI2O)" framework (Pereira et al., 2020) as a theoretical tool to assist in framing the problem. This paper writes through the use of reviews as proposed by Post, Sarala, Gatrell, and Prescott (2020), which involves looking at reviews as one possible "avenue" for advancing beneficial theory.

The paper contains five sections. The next section describes the research approach, followed by findings from the literature review in the subsequent section. Then a discussion of findings is presented, along with conclusions and ideas for further research to close to the paper.

Research Method

This study follows the "integrative literature review" approach defined by Torraco (2005). As a result, our review shows diversity and depth in the topics approached by this field. It intends to offer a novel and distinctive contribution to theory (Lepine & Wilcox-King, 2010) by relating the PPM process with FEI in not-for-profit research centers, thereby laying the ground for further development in this area.

Data collection process

Several methodologies may be used to collect data for a literature review (Crossan & Apaydin, 2010). We chose to search the Scopus database for keywords using queries shown in Table 1. Successive searches #1, #2, and #3 were done to cover different possible perspectives for paper selection. The whole process resulted in a total of 170 peer-reviewed articles, which are used in this review.

Data organization, classification, and results

We organized the articles in an electronic spreadsheet, ordered by number of citations, and categorized according to the contents of abstracts. The review was structured in a concept matrix as recommended by Webster and Watson (2002). The selected concepts were also used in the database queries. The concept of "innovation" was split as illustrated in the concept matrix outline in Figure 1. Several other words were also found to be associated with innovation. Their usage was less frequent, so we grouped them under the concept of "other innovation topics". The frequency table used in Figure 2, as suggested by Linnenluecke and Marrone (2019), shows the number of articles found per concept.

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We continued this analysis by uncovering relationships among concepts, as a way to find out if one concept appears in the literature more often related to another concept. Such relationships may indicate that certain concepts cannot be dissociated from other concepts, and thus that discussions of the PPM literature need to consider multiple concepts, an approach suggested by Tranfield, Denyer, and Smart (2003). We derived the results using an aggregative approach to try to identify emerging themes. Table 2 shows the number of articles that discuss PPM with two other concepts simultaneously.

The acronyms in Table 2 stand for: ID —ideation, MGMT — management, ST — strategy, NPD — new product development, FS — foresight, FEI — front-end of innovation, INC/RAD —incremental or radical, OIT — other innovation topics, DC —dynamic capabilities, RC — research center

Literature Review

We grouped the papers based on the concepts that are jointly discussed at least three times in the bibliographic database. The discussion follows the columns of Table 2. Below we identify the main threads of discussion in each group of related concepts that we found in the papers. Each group of concepts may have one or more threads of discussion.

Search	Query
1	***(KEY (portfolio management) AND TITLE-ABS-KEY ("front-end" or "innovation" OR "ideation" OR "research center" OR "nonprofit" OR "not-for-profit"))*** *AND DOCTYPE (ar) AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ENGI") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "COMP")) AND (LIMIT-TO (LANGUAGE, "English"))* *Results: 161 articles, most hits were related to the word "Innovation". Innovation is a very used and generic term, frequently associated with topics like "management", "strategy", "new product development", "foresight", "front-end", "incremental or radical", "IP management", among many others.*
2	***(KEY (portfolio AND management OR innovation) AND TITLE-ABS-KEY ("ideation" OR "research center" OR "nonprofit" OR "not-for-profit" OR "R&D organization"))*** *AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ENGI") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "COMP") OR LIMIT-TO (SUBJAREA, "DECI")) AND (LIMIT-TO (LANGUAGE, "English"))* *The word "front-end" was removed from Search #1 and "Innovation" was moved to just keywords. The term "R&D organization" was added to expand the search.* *Results: 16 articles, out of which 11 were already in the results of search #1. The remaining 5 were added to the initial list.*
3	***(KEY (portfolio management) AND TITLE-ABS-KEY ("front-end" or "innovation" OR "ideation" OR "research center" OR "nonprofit" OR "not-for-profit" OR "research institute" OR "university"))*** *AND DOCTYPE (ar) AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ENGI") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "COMP")) AND (LIMIT-TO (LANGUAGE, "English"))* *Search #1 was given another variation now including the terms "research institute" or "university".* *Results: 220 articles. After checking the abstracts, only four were added to the initial list.*

Table 1. Data collection queries performed in Scopus

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Figure 1. Sample Concept Matrix

Articles	PPM Concepts									
		innovation								
	ideation	management	strategy	product/NPD	foresight	front-end	incremental or radical	other innovation topics	dynamic capabilities	Research center / not-for-profit
Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2001). New Product Portfolio Management for New Product Development: Results of an Industry Practices Study. R&D Management, 31(4).				X						
Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2004). Benchmarking best NPD practices—II. Research-Technology Management, 47(3), 50-59.			X							
Mikkola, J. H. Portfolio management of R&D projects: implications for innovation management, Technovation 21 (2001) 423–435		X								
(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)

1. Relationship between the group of concepts PPM, Ideation, and Innovation Management

Farrington, Henson, and Crews (2012) related concepts with foresight methods and discussed how these methods influence the strategic research agenda of organizations. Khameneh, Sobhiyah, and Hosseini (2016) proposed a PPM capability model where idea and proposal management is a critical capability. In another paper, from an anonymous author (2003), it was mentioned that as much as 88% of initial screening

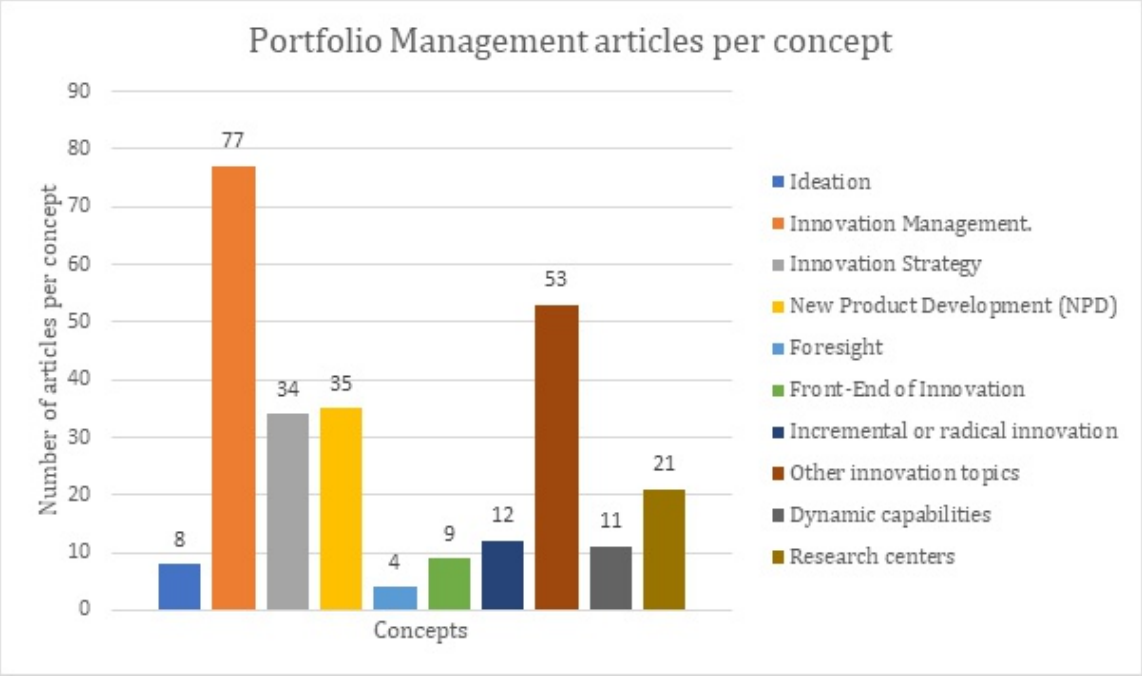

Figure 2. Project Portfolio Management articles per concept

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Table 2. Number of articles discussing PPM with two other concepts

	ID	MGMT	ST	NPD	FS	FEI	INC/RAD	OIT	DC	RC
ideation		3	1	2	1	3	1	0	1	0
management	3		19	19	2	1	7	9	6	8
strategy	1	19		6	1	2	4	2	4	5
product/NPD	2	19	6		0	3	3	2	2	0
foresight	1	2	1	0		0	1	0	0	1
front-end	3	1	2	3	0		0	0	1	1
incremental or radical	1	7	4	3	1	0		0	1	1
other inno-vation topics	0	9	2	2	0	0	0		6	2
dynamic capabilities	1	6	4	2	0	1	1	6		2
Research center/not-for-profit	0	8	5	0	1	1	1	2	2	

decisions made on new product projects are deficient and proposed that knowledge management solutions can enhance business performance. These findings suggest that ideation and knowledge management serve as critical capabilities of the PPM process and can have a positive influence on a company's strategic research agenda. This is the main thread of discussion found among this group of concepts.

2. Relationship between the group of concepts PPM, Ideation, and Front-End of Innovation

Three articles discussed this topic. The authors focused on the topic of ideation portfolio management, how it affects front end performance, and how it eventually impacts the PPM process. Heising (2012) proposed a framework that shows the relationship between ideation and PPM, while Kock, Heising, and Gemünden (2015) addressed an identified research gap ("how the management of ideation affects project performance") by performing an empirical cross-industry investigation. Kock, Heising, and Gemünden (2016) further discussed how researchers tend to explore the front-end from a single project perspective, instead of from a holistic perspective. The contribution of ideation portfolio management to the success of FEI activities marks a common thread of discussion found in the literature.

3. Relationship between the group of concepts PPM, Innovation Management, and Innovation Strategy

This relationship was addressed by nineteen articles. The coordination of collaborative projects and open innovation is a thread discussed by Katzy, Turgut, Holzmann, and Sailer (2013) and Brocke and Lippe (2015), which revealed that project managers tend to fail in satisfying the needs of collaborative projects. Several authors have discussed a thread on the alignment of projects with business strategy (Chao et al., 2009; de Moraes & Augusta Varela, 2013; Khameneh et al., 2016; Haghighi Rad & Rowzan, 2018). Other authors have argued, on another discussion thread, about how workshop-based road-mapping techniques may be used to address multiple management challenges, and integration in an organization's "innovation business plan" (Farrokhzad et al., 2008; Phaal et al., 2012).

4. Relationship between the group of concepts PPM, Innovation Management, and New Product Development (NPD)

Nineteen articles also addressed this theme. A first thread of discussion is on the efficiency of R&D investments. Chao and Kavadias (2013) discussed the trade-off between how much is invested and how a firm invests money (the firm's NPD portfolio strategy). Hughes and Chafin (1998) proposed a "value proposition life cycle" to improve the efficiency of multifunctional project teams. Schultz, Salomo, and Talke (2013) offered a scale to measure portfolio innovativeness, while Beaume, Maniak, and Midler (2009) put forward an innovation management life-cycle framework to measure the interplay between new features and new products. The topic of knowledge management is another discussion thread addressed by Cormican and O'Sullivan (2003), who focused on how to convert a company's knowledge base into IP and new products, and on the implications of a knowledge-intensive economy on networked organizations (Cormican & O'Sullivan, 2004).

The third thread within this group of concepts unfolds on the quality of decision making. Decision making in

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PPM and how it is influenced by the personalities and styles of the decision-makers was discussed by Kock and Gemünden (2016) while the same problem was addressed in family firms by Kraiczy, Hack, and Kellermanns (2015). Other authors studied the decision-making process in electronics companies (Jugend et al., 2015), and checked the role of incentives and collaborative tasks in decision making (Hutchison-Krupat & Kavadias, 2018).

The last thread presents PPM as a capability to reduce time-to-market and managing scope. Ferrarese and De Carvalho (2014) proposed a tool to maximize the effective time-to-market of a portfolio given the competitive monitoring activities, and Abrantes and Figueiredo (2014) identified the challenges to manage the scope of NPD projects within the dynamic contexts that organizations face today. Country-based PPM practices in developing countries were analyzed by authors bringing forward recommendations for establishing or improving PPM capabilities in those countries' organizations (Jugend et al., 2016; Khameneh et al., 2016).

5. Relationship between the group of concepts PPM, Innovation Management, and Incremental/Radical Innovation

Seven articles addressed this theme. The main thread of discussion in these papers was resource allocation to projects developing either radical new products or incremental new features. Similarly, the influence was shown of public incentives in the allocation of resources between projects that improve products (incremental innovation) and develop new products (radical innovation) (Chao et al., 2009). Another point of view compared how monopoly firms and their competing firms address the same problem (Zschocke et al., 2014). Other authors have offered a qualitative contribution to resource allocation based on multiple case studies (Lettice & Thomond, 2008). Finally, a discussion thread on the importance of continuous innovation as a method to battle against competitor's disruptive innovations was highlighted as another aspect under consideration (Hughes & Chafin, 1998; Denning, 2012).

6. Relationship between the group of concepts PPM, Innovation Management and Dynamic Capabilities

The management of collaborative projects and open innovation as strategic organizational capabilities was a thread discussed by Katzy et al. (2013) who identified a gap in coordinating open innovation. These authors state that such collaboration presents specific challenges that demand adaptations and adjustments to existing project management approaches. On another thread, PPM was considered as having a holistic capability to align projects with business strategy by Khameneh et al. (2016). These authors propose a PPM capability model that consists of eleven areas, with 81 capabilities. Other authors have treated "novelty" as a multidimensional construct (Rosenkopf & McGrath, 2011; Urhahn & Spieth, 2014; Sicotte et al., 2015). Building on the dynamic capabilities' theory, these authors discuss the implications of portfolio innovativeness.

7. Relationship between the group of concepts PPM, Innovation Management and Research Centers

This relationship was debated in eight articles. The first thread discussed the management of collaborative projects as expressions of academia-industry interaction (Katzy et al., 2013; Brocke & Lippe, 2015). One recommendation for future research on this topic suggested that effective mechanisms are needed for project collaboration between NRIs (National Research Institutes) and for-pro t organizations to maximize bene ts for both parties (Jeng & Huang, 2015). Another thread of discussion was resource allocation to projects as a trade-off between incremental and radical innovation (Hendriks et al., 1999; Chao et al., 2009). On a third thread within this group of concepts, some papers have presented portfolio-building processes for evaluating project portfolios at the early initiation stage in public and not-for-profit research organizations (Pereira & Veloso, 2009; Jeng & Huang, 2015). Finally, a systematic management method for interdisciplinary research at an academic research institution-level using a co-citation index was also proposed (Kodama et al., 2013).

8. Relationship between the group of concepts PPM, Innovation Strategy, and NPD

This relationship was discussed in six articles. The single thread of discussion was on the efficiency of R&D investments. On the efficiency of PPM processes, Cooper, Edgett, and Kleinschmidt (2002), and the same authors (2000) described the importance of a Stage-Gate model, and how its correct application increases a portfolio's value. Other authors contributed to this discussion through aligning R&D intensity with NPD portfolio efficiency, together with multifunctional project teams (Hughes & Chafin, 1998; Chao & Kavadias, 2013).

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9. Relationship between the group of concepts PPM, Innovation Strategy, and Incremental/Radical Innovation

Four articles addressed this relationship. The authors addressed ways for companies to battle disruptive innovation brought up by other companies and consider alternative strategies. Denning (2012) compared continuous innovation with "good" management and concluded that continuous innovation is the most reliable strategy. Chao and Kavadias (2008) discussed, on another thread, the definition of a portfolio strategy that balances projects between incremental and radical innovation. Weigel and Goffin (2015) argued about the

Table 3. List of discussion threads identified in the literature review

ID	Groups of concepts	Discussion thread	MCP	TtM	IP	BS	RA	RtC	QD
1	PPM, Ideation & Innovation Mgmt.	Ideation and knowledge management are critical capabilities of the PPM process			x				
2	PPM, Ideation & the FEI	The contribution of ideation portfolio management to the success of the activities in the Front-End of Innovation			x				
3	PPM, Innovation Mgmt. & Innovation Strategy	Coordination of collaborative projects and open innovation	x						
		Alignment of projects with the business strategy				x			
4	PPM, Innovation Mgmt. & NPD	The efficiency of investments in R&D		x					
		Knowledge management			x				
		Quality of decision making							x
		PPM as a capability to reduce time-to-market and managing scope		x					
5	PPM, Innovation Mgmt. & Incremental and Radical Innovation	Resource allocation to projects developing radical new products or developing incremental new features					x		
		Continuous innovation to battle against competitor's disruptive innovations.						x	
6	PPM, Innovation Mgmt. & Dynamic capabilities	Management of collaborative projects and open innovation	x						
		PPM as a holistic capability to align projects with business strategy				x			
7	PPM, Innovation Mgmt. & Research Centers	The management of collaborative projects	x						
		Resource allocation to projects					x		
		Evaluating a project portfolio at the early initiation stage in public and not-for-profit research organizations		x					
8	PPM, Innovation Strategy & NPD	The efficiency of the investments in R&D		x					
9	PPM, Innovation Strategy & Incremental and Radical Innovation	Alternatives to battle counter disruptive innovation						x	
		Portfolio strategy that balances the projects between incremental and radical innovation					x		
10	PPM, Innovation Strategy & Research Centers	Management of collaborative projects as forms of academia-industry interaction	x						
		Selection and prioritization of IT projects in universities		x					
11	PPM, NPD, and the FEI	Relate portfolio Management and new product development with the Front-End of Innovation			x				
12	PPM, NPD & Incremental and Radical Innovation	Balance between incremental and radical innovation projects					x		

The acronyms in Table 3 stand for: MCP – Management of collaborative projects and open innovation; TtM – Time-to-Market/Efficiency of the investments in R&D; IP - Convert the company's knowledge base and IP in new products; BS - Alignment with the business strategy; RA - Resource allocation to projects; RtC - Response to competition; QDM - Quality of decision making.

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importance that accessing customer insights assumes in creating radical new products, services, and business models.

10. Relationship between the group of concepts PPM, Innovation Strategy, and Research Centers

Five papers related these concepts. The management of collaborative projects as forms of academia-industry interaction is a thread discussed by Katzy et al. (2013) and by Brocke and Lippe (2015). Another thread of discussion was on approaches for selecting and prioritizing IT projects in universities (Kauffmann et al., 1999; Ahriz et al., 2018). According to these authors, such approaches need to be adapted to the university's strategy, vision, and culture because university managers face many uncertainties when prioritizing projects that make up their portfolio.

11. Relationship between the group of concepts PPM, NPD, and FEI

Three papers discussed this topic. The discussion stated that the relationship with the success of the FEI is not yet fully understood (Kock et al., 2016). Cooper (2006) had previously discussed the adoption of the Stage-Gate process by technology-development companies to support front-end activities. Oliveira & Rozenfeld (2010) presented a new method to support the development of front-end activities based on PPM together with technology road-mapping (TRM). Oh, Yang, and Lee (2012) proposed a decision-making framework that uses a fuzzy expert system in PPM to deal with the uncertainty of fuzzy front-end product development.

Discussion Thread	Management of collaborative projects and open innovation	Alignment with the business strategy	Time-to-market / Efficiency of the investments in R&D	Resource allocation to projects	Convert the company's knowledge base and IP in new products	Response to competition	Quality of decision making
Connections to FEI Agile New Concept Development sub-ontology	① ② ③ ④	⑤	⑥ ⑦	⑧ 10	⑨ ⑩ ⑪ ⑫ ⑬ ⑭	⑮ ⑯ ㉑	⑰ ⑱ ⑲

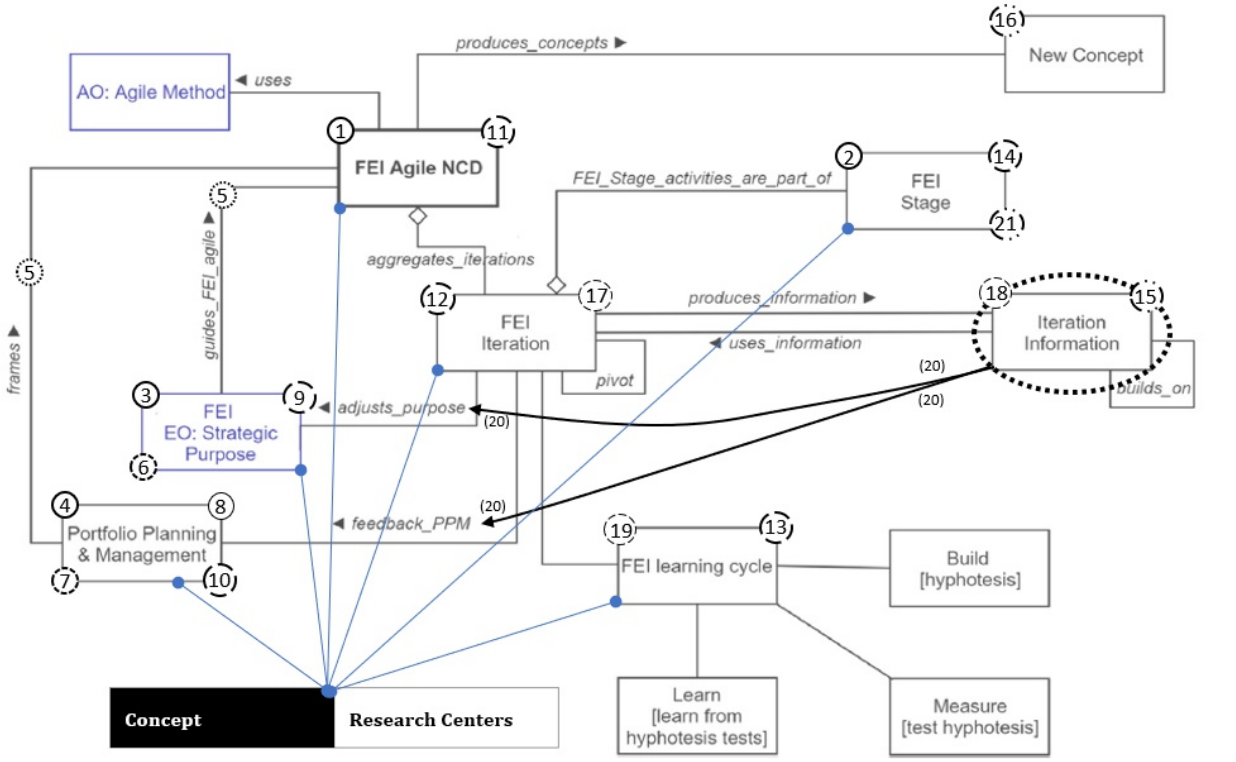

Figure 3. The connections between the PPM discussion threads projected into the FEI Agile New Concept Development sub-ontology —light grey as background (A.R. Pereira et al., 2020)

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12. Relationship between the group of concepts PPM, NPD, and Incremental/Radical Innovation
Three papers talked about this relation. The balance between incremental and radical innovation projects was the main thread discussed. This thread notes that companies face difficulties in fulfilling a balance of portfolio products, and that these difficulties possibly relate to a concentration of incremental innovation efforts in NPD (Jugend & Leoni, 2015). An innovation management life-cycle framework was proposed to measure the interplay between new features and new products (Beaume et al., 2009). The role played by PPM in decision-making to invest in high-risk projects and how companies choose to make investments in R&D was considered critically by Cooper (2013).

Discussion

We organized the main threads found in the literature review in Table 3. We identified a total of 25 discussion threads out of the 12 concept groups, though some threads appear repeatedly in the different concept groups. Thus, we grouped the 25 threads into an even number of main discussion lines. Together with this a total of seven distinct discussion threads were identifiable in Table 3.

Even though PPM is a well-known organizational capability that has been widely applied in the NPD phase, its relationship with FEI activities is not yet fully understood (Kock et al., 2016). To contribute to rationalizing this relationship, in this discussion we use the FEI Integrative Ontology (FEI2O) proposed by Pereira et al. (2020) to frame the above findings. The FEI2O consists of a set of six sub-ontologies: FEI Purpose, FEI Portfolio Planning & Management, FEI Agile New Concept Development, FEI Stage, FEI High-Level, and FEI Actors.

The following discussion will be built around FEI2O's sub-ontology FEI Agile New Concept Development (Figure 3) as the framework with which to overlay the above identified discussion threads. The agile nature of FEI emphasizes the need for flexibility with changing requirements and to adjust for developed concepts. It is described as an iterative process that unfolds along FEI Iterations, resulting in the development of new concepts (Pereira et al., 2020).

The connections between the identified discussion threads and the FEI Agile NCD sub-ontology are described next. The FEI Agile NCD sub-ontology produces the [NEW CONCEPT] that will enter NPD for further commercialization. The development of new concepts in FEI is guided by the [FEI EO: Strategic Purpose] (that represents the organization's strategy) and is framed by the [Portfolio Planning & Management] process that sets and monitors the constraints for developing new concepts. The [FEI Agile NCD] aggregates iterations [FEI Iteration] that are composed of several [BUILD], [MEASURE], and [LEARN] cycles (the [FEI learning cycle]). These cycles represent the process of building new hypotheses, testing the new hypothesis, and learning from the results of the tested hypothesis. Each iteration builds on previously existing information [Iteration information] and produces new information that will be used in subsequent iteration cycles. The [FEI STAGE] block represents activities executed in FEI (preliminary opportunity identification, product concept definition, feasibility, project planning and business model development). These activities are part of each [FEI Iteration] (each iteration contributes to improving the outcome of the activities performed in the FEI).

The following addresses the relationship between PPM issues and FEI in Figure 3:

- Discussing the management of collaborative projects and open innovation serves to address research gaps in coordinating open innovation projects and in the academy-industry relationship. The influence of industry in academic projects contributes to shaping the strategic purpose [FEI EO: Strategic Purpose] of research institutes (3) because they benefit from being aligned with industry interests. This influence must also be considered in the [Portfolio Planning & Management] process (4) to find proper balance with other non-industry projects (for example, by assigning them a higher priority when allocating resources). This interaction also influences [FEI STAGE] (2) activities, for example, through identifying new opportunities, and contributes to new research concepts [FEI Agile NCD] being developed by research centers (1).

- One of the PPM process objectives is to align the running projects with an organization's strategic purpose. Discussing the alignment of PPM processes with business strategy concerns the challenge of aligning what is being done in projects with business realities. In FEI, new ideas generated must also be

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aligned with a organization's overall business strategy before new concepts can be generated that will enter NPD. Therefore, aligning PPM processes with business strategy contributes to guiding the [FEI Agile NCD] (5) and to its framing by [Portfolio Planning & Management] (5).

- The efficiency of R&D investments factors in to influence the [FEI EO: Strategic Purpose] (6) and the [Portfolio Planning & Management] process (7). The new concepts being developed during FEI should contribute to boost sales, in case of companies, or cause an impact on society, by not-for-profit research centers. Researchers have been looking into how to reduce the time to market for innovation while balancing increasing technological complexity (A.R. Pereira et al., 2020). Trade-off thus is available between the innovativeness of each new concept produced during FEI (that might require a higher amount of iterations) and the time to introduce new products resulting from new concepts to market (7).

- Resource allocation to projects deals with finding appropriate distribution of human resources among projects, namely among projects developing radical new products, along with those developing incremental innovations that sustain the current business. While maintaining appropriate resources for incremental innovation projects, the [Portfolio Planning & Management] process (8) must leave "space" for disruptive projects too.

- Converting an organization's knowledge base and IP into new products is one of the main objectives of activities performed in the [FEI STAGE] (14). Connections (12) [FEI Iteration] and (13) the [FEI learning cycle] represent the relation between existing knowledge and new knowledge being acquired in each FEI iteration, as new knowledge is built upon existing knowledge. The new concepts [FEI Agile NCD] (11) being produced during FEI will aggregate knowledge gained from several iterations and result from a combination of new and previously existing knowledge. As the [FEI Agile NCD] is framed by the [Portfolio Planning & Management] process, a relation also forms between the existing knowledge base and this process (10). Finally, as each [FEI Iteration] adjusts the [FEI EO: Strategic purpose], the adjusted purpose also gets framed by the existing knowledge base and IP (9).

- The response to competition of a new product/service concept is greatly influenced by the value proposition and its positioning in the market. This gets developed in different FEI stages, including the definition of the business model used to offer the new concept in the market (21). This issue is further related to the balance between "continuous innovation" and "good management" (Denning, 2012). There is a set of internal management decisions that provide new information to each FEI cycle [Iteration information] (15). The response to competition is "materialized" by the new concepts that emerge as the result of the activities performed in the overall FEI process resulting in the [New concept] (16). Both [Portfolio Planning & Management] and [FEI EO: Strategic Purpose] get insights from the [Iteration information] (20). This feedback is key to adjusting strategy to the positioning of competing products and reacting to opportunities in emerging markets.

- On the quality of decision making, the papers discuss the influence of different personalities and styles on the quality of the decisions that are taken. The iterative process of the FEI and the involvement of multiple actors contributes to soften those influences on new concepts that are developed during FEI. Connections (17) [FEI Iteration], (18) [Iteration information] and (19) [FEI learning cycle] show how decision making is impacted by the information used at the start of each new FEI iteration, the result of each iteration, and the aggregated effect on the FEI Agile NCD. Higher quality decisions taken at this stage typically build on internal knowledge as well as on external primary and secondary sources (for example, FEI learning cycle), higher quality concepts (a.k.a. new knowledge, or new IP, or new prototypes) develop into products, and more likely innovations increase the portfolio's innovativeness. Adequate ideation of portfolio management may also help increase decision quality and reduce the time-to-market (Heising, 2012), a crucial feature in today's competitive world.

- In research centers, the [New Concept] module could be renamed as [New Research Concept] in order to focus on R&D efforts. FEI outcomes may be seen as new ideas/concepts whose feasibility still needs to be assessed before entering the [New Research Development] phase. The discussion of not-for-profit research centers appears mostly related to managing

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collaborative projects and open innovation, along with interaction between academia and industry. This interaction influences the research center's [FEI EO: Strategic Purpose] and its [Portfolio Planning & Management] process. The activities performed by research centers during FEI must address the challenges of collaborative projects and use the information provided by projects in the [BUILD], [MEASURE] and [LEARN] cycles performed at each [FEI ITERATION]. In the end, new research concepts that are investigated will benefit from close interaction with industry, which is represented in Figure 3 by connections between the "Research Institutes" block and the different components of the FEI Agile NCD sub-ontology.

Conclusion and Suggestions for Further Research

The discussion threads revealed by this study address all aspects considered in the FEI2O Agile NCD sub-ontology: PPM is an organizational capability that makes sure that both existing and new projects are aligned with business strategy. PPM also ensures that resources get allocated according to a defined strategy and that senior management involvement as an organizational factor drives PPM success.

Kock, Heising, and Gemünden (2016) showed that front-end success is highly essential for later project success. We support this conclusion that brings in the importance of ideation portfolio management. These authors underscore the importance of an effective and efficient FEI for project portfolio success in generating the right ideas.

The research also showed that PPM is widely discussed from the perspective of innovation management, innovation strategy, and NPD. PPM has been a research area for over 50 years (Zschocke et al., 2014) and has been one of the critical components of the Innovation Management field. Despite that, it has been a discipline used mostly by private companies (Pereira & Veloso, 2009) that focus on developing incremental or radical new products. As such, we conducted an integrative literature review to uncover the usage of PPM in research centers and universities because these entities are partnering more and more with companies to develop innovative new products and services.

As shown by Katzy et al. (2013) and Brocke and Lippe (2015), managing collaborative projects as a form of academy-industry interaction is still an understudied area of project management. Traditional project management methods have tended to fail when dealing with the specificities of these types of projects. The same authors point to the need for further research to generalize the findings and to chart the historical development of coordinating innovation processes. Based on the growing importance of open innovation and in cooperation with not-for-profit research centers and companies, we believe future research could be beneficial by promoting a more holistic understanding of how research centers manage their FEI. More specifically, we wish to inquire how research centers prioritize research project ideas, measure the success of front-end activities, and manage collaborative projects with industry.

Our analysis of the various PPM discussion threads framed together with the FEI Agile New Concept Development sub-ontology reveals that existing research does not highlight R&D as a critically relevant activity for FEI. This constitutes one of the study's main findings, a surprise considering that both the efficiency of R&D investments and resource allocation to projects were subjects of research. The relevance of R&D activities for the FEI and the organization of the FEI in research centers is left as a suggestion for further research.

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