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Insights

Welcome to the July issue of the *Technology Innovation Management Review*. We welcome 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.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

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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

Chris McPhee, Editor-in-Chief

Welcome to the July 2019 issue of the *Technology Innovation Management Review*. The authors in this issue share insights on business incubators and accelerators, business model design, ecosystem knowledge management, and digital payment adoption in Africa.

The first two articles were developed from papers presented at ISPIM Connects Ottawa, a three-day event held in Ottawa, Canada, from April 7–10, 2019. ISPIM Connects Ottawa brought together world-renowned innovation managers, researchers, and business and thought leaders to share insights on specific local and global innovation challenges as well as general innovation management topics. The TIM Review and its associated academic program at Carleton University, the TIM Program (timprogram.ca), were proud to be the local hosts of the event in collaboration with the International Society for Professional Innovation Management (ISPIM; ispim-innovation.com) and local partners.

First, **Kristina Lukosiute** and **Søren Jensen** from the University of Southern Denmark in Odense and **Stoyan Tanev** from Carleton University in Ottawa, Canada, investigate possible negative outcomes entrepreneurs can experience when engaging with an incubator or accelerator. Based on a literature review and interviews with entrepreneurs from Denmark, Canada, and Lithuania, the authors developed a set of recommendations that entrepreneurs should keep in mind when considering whether to join a business incubator or accelerator.

Second, **Ron Beckett** and **John Dalrymple** from Swinburne University of Technology in Melbourne, Australia, adopt a system design perspective to examine that tools are available to facilitate the design of enterprise-specific business models. Drawing on the information systems literature, the authors identify a toolkit facilitating the design of activity system architecture to draw out the underlying complexity of a business model.

Next, **Behrooz Khademi** from the Royal Melbourne Institute of Technology (RMIT) in Melbourne, Australia, introduces a conceptual tool – the Ecosystem Knowledge (EK) Explorer – to help actors in a business ecosystem systematically discover external knowledge. In this article, the author uses bibliometric analysis, social network analysis, and text mining to conceptualize 39 constructs and measurable variables of the EK Explorer. The tool is designed to turn codified technical knowledge within knowledge-based ecosystems into practical insights for collaboration, competition, technology management, investment, or policymaking purposes.

In the last article, **Leigh Soutter**, **Kenzie Ferguson**, and **Michael Neubert** from the International School of Management (ISM) in Paris, France, explore impact factors that affect the adoption of digital payment systems in sub-Saharan Africa. The authors compare findings from the literature with their results from three case studies of mobile money adoption in Kenya, South Africa, and Nigeria that include semi-structured interviews with subject-matter experts, archival data in the form of industry and regulatory reports, and observational field notes. The study is intended to help FinTech innovators, academics, and policymakers to understand how technology and framework conditions impact payment business models in Africa.

Note also that we have recently issued a call for papers for an upcoming special issue on **Innovation and Entrepreneurship in Nigeria** (tinyurl.com/NIS-TIM) to be published in early 2020. Featuring Guest Editor **Okechukwu Lawrence Emeagwali** from Girne American University in Cyprus and Associate Guest Editor **Abayomi Baiyere** from Copenhagen Business School in Denmark, this special issue will be developed in collaboration with the Nigeria Innovation Summit (innovationsummit.ng), which will be held from August 20–21, 2019.

For other future issues, we are accepting general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions, and proposals for future special issues.

Chris McPhee
Editor-in-Chief

Editorial: Insights

Chris McPhee

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. Chris holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. He has 20 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

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Is Joining a Business Incubator or Accelerator Always a Good Thing?

Kristina Lukosiute, Søren Jensen, and Stoyan Tanev

> *"It is a good thing to learn caution from the misfortunes of others."*
>
> Publilius Syrus (85–43 BC)
> Writer

Business incubators and accelerators are often hailed as essential tools for fostering growth in startups. However, not only do entrepreneurs often face the question of which incubator or accelerator to join, we suggest that they should also question whether or not to join one at all. Is joining a business incubator or accelerator always a good thing? In this article, we investigate some of the negative outcomes entrepreneurs can experience when engaging with an incubator or accelerator. We apply a cross-case analysis of empirical observations from qualitative interviews with Danish and Canadian entrepreneurs to arrive at a set of recommendations that entrepreneurs should keep in mind when considering such an engagement. These points are further qualified based on informal interviews with four serial entrepreneurs.

Introduction

The concept of business incubation remains topical and yet it is now more than fifty years old (Al-Mubaraki & Busler, 2010). The spread of business incubation practices across the world has opened a new dimension in management theory and practice. Indeed, over time, the need to manage incubation programs in a way that helps the formation and growth of startups has become increasingly important (ECA, 2014).

Today's typical entrepreneurial ecosystems accommodate multiple incubators, which usually complement each other in terms of the services they offer. Such multiplicity provides an opportunity for early-stage startups to maximize their chances for success by shaping specific incubation strategies that combine multiple complementary incubation environments (Jakobsen et al., 2017). According to Al-Mubaraki & Busler (2010), the most frequently provided services are marketing assistance, help with everyday business operations, linkages to strategic partners, networking activities, Internet access, help with accounting, and linkages to angel or venture capital investors.

Understandably, existing research focusing on business incubation emphasizes the potential benefits for startups, the characteristics of successful incubators, and the factors that could enhance the chances for success of both startups and incubation environments. There is, however, another side of the coin because, "while generally beneficial to new entrepreneurial start-ups, there are some disadvantages associated with incubator units but these are rarely recognized or discussed within the extant literature" (Barrow, 2001: 362; Mcadam & Marlow, 2007). Unfortunately, there is little research focusing on some of the potential drawbacks or disadvantages of participating in incubation programs. The objective of the present article is to suggest an alternative exploratory perspective by summarizing the results of a preliminary empirical study focusing on identifying some of the potential disadvantages of joining and completing incubation or acceleration programs.

The content of the article is organized as follows. The next section summarizes the key insights from the literature. It reviews some of the definitions of incubators and accelerators and discusses the sometimes-confusing overlaps between them. In addition, some of the key

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risks of joining an incubator are discussed. The Research methodology section describes the research steps, the sources of empirical data, and the type of data analysis to be performed. The Results section summarizes some of the negative experiences of entrepreneurs who have been part of business incubation programs and provides some reflections about the differences in these experiences in incubator-like and accelerator-like environments. Finally, the Conclusion provides some final reflections and summarizes some of the most typical downsides of being part of an incubator or accelerator.

Key Insights from the Literature

According to Gunter (2012), startups tend to be the most rapid job creators. Either startups move up by rapidly expanding their innovation to become economically successful, or they rapidly go out of business. Very often, startups develop radically innovative products and, eventually, disrupt existing markets. However, startups who seek to do things differently face several challenges and uncertainties associated with the shaping of a viable business model, reaching out to early buyers, setting up durable partnerships and sustainable operations, etc. To deal with these challenges and uncertainties, startups usually benefit from all available resources including existing regional and national business incubation programs.

Incubation vs accelerators

In order to establish a successful business, entrepreneurs are often looking for business programs that could help the growth of their business. In fact, incubators and accelerators are meant to boost the successful development of newly created firms by increasing the likelihood of their survival and growth. Incubators and accelerators should enable a smooth start and future growth for startups. However, many concepts of incubators and accelerators have been put forward, which sometimes confuses both scholars and practitioners.

The original concept of an incubator has changed since the first private incubator was established in New York in 1959 (Hausberg & Korreck, 2018). Since then, many different forms of entrepreneurship support have emerged, one of which is the accelerator. The first seed accelerator was Y Combinator in 2005, which was followed by TechStars in 2006. Many others have followed their lead, but Y Combinator and TechStars remain two of the top accelerators in the world today.

Such programs are now commonplace, but there is still confusion regarding the terms incubator and accelerator. For example, many startup programs that describe themselves using the same term do not share common characteristics (Dee et al., 2015).

Thus, in order to make a distinction between these two terms, it is necessary to answer the following questions:

- What does an incubator or accelerator offer?
- Who is an incubator or accelerator targeting?

Characteristics of an incubator

The goal of incubators can differ depending on the type. Hausberg and Korreck (2018) define business incubators as "organizations that support the establishment and growth of new businesses with tangible (e.g. space, shared equipment and administrative services) and intangible (e.g. knowledge, network access) resources during a flexible period and are funded by a sponsor (e.g. government or corporation) and/or fund themselves taking rent (or less frequently equity) from incubatees." Certainly, the most typical goal of an incubator is to foster entrepreneurship and develop new firms, but different incubators can have different priorities. They target ventures that are in their early development stages, so the term incubator should not be used interchangeably with the terms science park or technology park, which are generally designed to support more mature firms (Hausberg & Korreck, 2018). According to Irshad (2014), incubators can be classified based on objectives, formation, types, industry, source of finance, location, and the specific combination of all of these. For instance, the objective of a non-profit incubator is to create new jobs and increase tax bases. Typically, non-profit incubators are operated by government institutions. For-profit incubators are focusing on return on investment and profitability. University-based incubators can be situated somewhere between non-profit and for-profit (Hausberg & Korreck, 2018).

Characteristics of an accelerator

As described above, in 2005, a new institutional form of business incubation emerged: the accelerator. Accelerators incorporate some of the characteristics of incubators and business angels (Bueren, 2016). They adopt a distinctive incubation model with a unique way of structuring incubation, growth, and investment initiatives. Interestingly, the founder of the Y Combinator, Paul Graham, called the organization a "seed-stage investment firm" instead of accelerator (Bliemel et al., 2016).

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There is, therefore, a distinction between the classic business incubator and a typical accelerator. "Accelerators usually are fixed-term, cohort-based programs providing education, monitoring, and mentoring to start-up teams (usually not single entrepreneurs) and connecting them with experienced entrepreneurs, venture capitalists, angel investors and corporate executives and preparing them for public pitch events in which graduates pitch to potential investors" (Hausberg & Korreck, 2018).

The risks associated with selecting and joining an incubator or accelerator

A critical assessment of the effectiveness of an incubator or accelerator can guide entrepreneurs to make the right decisions about engaging with specific business support programs. Many entrepreneurs are novices who lack competencies, working capital, and potential for funding. Entrepreneurs make decisions based on what they perceive, and startups often want to be accepted into a well-established program without considering if it is the right program to be in. According to Bliemel and co-authors (2016), entrepreneurs usually apply to join an accelerator because they need seed funding, incubation services, and partnership networks. They emphasized that, for example, when entrepreneurs are only seeking mentorship, an accelerator program could be detrimental to them since there are many risks associated with an accelerator. Miller & Bound (2011) articulated several criticisms of accelerator models:

- After graduating an accelerator, startups are still fragile and in need of support.
- The equity taken by accelerators becomes problematic for further funding. Startups fear "Rich guys launching 'startup accelerators' so they can rip off new start-up founders" (Miller & Bound, 2011).
- Because of the increasing number of accelerators and their tendency to invest in early-stage firms, B-grade companies will not receive investment.
- "If accelerators continue to grow and start producing thousands of small companies, we can expect to see a bottleneck developing and in the event of a crash in confidence in the sector" (Miller & Bound, 2011).
- Accelerators will become "startup schools" who will encourage learning through educational returns rather than building real businesses.
- Accelerators build small companies that do not have quite global ambitions. These are companies that are building something that will become a feature of a larger service, rather than aiming to become a large company in its own right.
- Accelerators are making entrepreneurship so accessible that they start draining talent from larger technology firms.

Yu (2015) argues that founders with promising ideas avoid joining accelerators and instead choose different ways of progressing. For most of them, an accelerator without a well-established value ecosystem and network is worthless. On the other hand, the best startup exit for an accelerator or for-profit incubator comes when the startup is acquired. In this sense, an accelerator is just another type of incubator, whose goal is to increase the startups' survival chances (Hausberg & Korreck, 2018). But there remains a lot of definitional uncertainty. As Mian and co-authors (2016) emphasized, the definition of accelerators cannot be generalized due to idiosyncrasies in their relations to political, economic, social, and geographic conditions.

The summary of the risks associated with the possibility of startups joining business incubation programs demonstrates the need for more systematic studies focusing on the potential downsides of business incubation practices. The next section describes the methodology adopted to answer our initial research question, starting with the hypothesis that it is not always beneficial for new ventures to join business incubation programs.

Research Methodology

For this study, we adopted an explorative qualitative research approach using multiple semi-structured interviews with startup founders, complemented by informal discussions with serial entrepreneurs. We designed the questions around issues related to some of the negative experiences of going through specific incubation/acceleration programs and how such experiences affected the future of specific ventures. The interviewees were the founders of eight startups: four in Denmark (two active and two partly active) and four in Canada (three active and one inactive). We believe that the mixture of active (still operating), partly active (still operating but with declining activities) and inactive (non-operating) companies would provide a broader spectrum of opinions and experiences relevant to our

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study. Table 1 provides an overview of the eight startups featured in the in-depth interviews with their founders. Each interview was recorded, transcribed, and coded to help identify key observations. The observations were then cross-analyzed to identify and prioritize the emerging common issues that could be used as a basis for the formulation of practical insights.

The in-depth interviews with the startups' founders were complemented with insights from informal discussions with additional four *serial* entrepreneurs (SE1, SE2, SE3, and SE4). SE1, SE2, and SE3 are Canadian serial entrepreneurs working within the digital marketing/cryptocurrency, SaaS, and computer science industries, respectively. SE4 is a Lithuanian serial entrepreneur working within the IT sector.

Results

As Eisenhardt (1989) has emphasized, there are many divergent ways to look at qualitative data. In this study, we chose to examine the similarities between codified key insights. Then similar codified key insights were assigned to a single coding category. The codes were created by using both pre-set codes and emergent codes. Pre-set codes derived from existing research articles focusing on various aspects of business incubation programs and were incorporated into the interview guides, while emergent codes emerged from analyzing the data. The analysis identified seven categories, and based on insights from the interviews, a cross-case analysis was performed. The categories and key insights of the cross-case analysis can be found in Table 2, and they are discussed in greater detail in the subsections that follow.

In our analysis, we do not explicitly distinguish between incubators and accelerators and used the more general term "business incubation program". We did this for two main reasons. First, the existing definitions sometimes overlap in some of the characteristics of the incubation programs, which makes it difficult to apply the terms in practice in a clear-cut fashion. Second, the incubation program managers themselves sometimes use the terms incubator and accelerator in a relatively loose sense based on personal preferences, previous experience, and the established language in their communities. We will focus therefore on the negative experiences of entrepreneurs who have been part of business incubation programs and provide some reflections at the end about the differences between incubator-like and accelerator-like environments.

Admission criteria: *Incubation programs did not perform due diligence and assessment to ensure startup quality*
Business incubation programs have different approaches to the selection of startup clients. The success or failure of a startup in a business incubation program depends on how qualified the program managers are in selecting the right startups at the right stage. Four out

Table 1. Overview of the eight startups selected for in-depth interviews with their founders

Case	Description of Startup / Key Product	Status	Country
A	Student-founded startup focusing on designing furniture	Active	Denmark
B	Premium-priced product to reduce stress and anxiety	Partly active	Denmark
C	Business consultancy in creativity and innovation	Active	Denmark
D	Product to make automated production line more efficient	Partly active	Denmark
E	A platform for students to find and apply for scholarships	Active	Canada
F	Synthetic cannabidiols for the treatment of pediatric epilepsy	Active	Canada
G	Engineering service provider working towards building a portfolio of intellectual property related to the control and operation of robotic assets in space	Active	Canada
H	Online booking platform that simplifies access to workspace and recreation facilities	Inactive	Canada

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Table 2. Summary of insights from the cross-case analysis related to the negative aspects of incubation/acceleration, as perceived by the founders of startups interviewed in this study

Category	Insight	Code	Frequency
Admission criteria	Incubation programs did not perform due diligence and assessment to ensure startup quality	A, B, C, D	4/8
Services and offerings	General workshops, courses, and lectures about entrepreneurship were not found to be valuable	B	1/8
	Startups received low commitment from program mentors and advisors	D, E, F, H	4/8
	The incubation program did not meet the company's initial expectations	B, D	2/8
	Tangible services such as access to manufacturing capabilities were not provided or were limited	A, C, F, G	4/8
Network	Startups did not efficiently use the office space provided by the incubation program	B, E, H	3/8
	The incubation program's network was not aligned to the startup's product	A, D, F	3/8
	Startups were unaware of the business incubation program's ecosystem	E, F	2/8
Financial resources	Business incubation programs did not provide direct or indirect access to investment	B, D	2/8
Equity	Equity taken by the business incubation program made startups unattractive to potential investors	D	1/8
IP protection	Participation in a business incubation program put intellectual property at risk	F	1/8
Post-incubation	Following incubation, startups looked to join another business incubation program or sought business angels	A, B, E	3/8

of the eight startups mentioned that their business incubation programs did not perform formal due diligence because of two main reasons: 1) they were newly established or 2) the program managers simply believed that the product was in line with the program's focus and competencies. None of those four startups received feedback or were evaluated by the program. It could be assumed, therefore, that incubation programs acted in their own self-interest when attracting new tenants and raising public awareness of their programs. This is especially applicable to university-based business incubation programs, which are more supportive and more inclusive in nature. SE4, who was co-founder of an incubation program, pointed out that demo days are only for community, to show that the program is still operating. Overall, entrepreneurs should be conscious that incubation programs are not always necessarily acting in the best interest of startups. Moreover, an incubation program's admission process should be seen as an indicator of how seriously managers are taking a startup into consideration. Without due diligence on by both the programs and the startups, startups are at risk of becoming part of a program that is not necessarily valuable to them.

Services and offerings: *General workshops, courses, and lectures about entrepreneurship were not found to be valuable*

One out of the eight startups mentioned that general workshops and lectures about entrepreneurship were

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not found to be valuable. Startup B emphasized that it was a waste of time to participate in general workshops when the company needed financial resources to develop a minimum viable product (MVP). Without a functional prototype, startup B was unable to demonstrate their proof-of-concept. Despite spending one year in a university-based incubation program, startup B has not succeeded in developing a functional prototype. Thus, startups who are involved in the program can spend a lot of time working on secondary tasks, instead of focusing on primary ones. According to SE3, business incubation programs "keep startups busy with stuff which they don't really need to do like presentations, instead of helping them with securing first customers."

Services and offerings: *Startups received low commitment from program mentors and advisors*
Four out of the eight startups emphasized that they received low commitment from program mentors and advisors. Startup F gave an example in which the lawyer of their incubation program suggested not to file a patent application in China despite the company's plans to expand globally and build a pilot plant in Hong Kong. Startup E has not received any support from mentors and advisors and wished there was someone to keep them accountable. Startup D, as with start-up E, has been left on its own. Startup H failed to leverage a sound marketing strategy and expected advisors to help them earlier in the process. SE2, who has also passed through a university-based business incubation program, indicated that some of the mentors were professors and a variety of mentors would have been more appropriate. SE4 mentioned that some entrepreneurs do not get appropriate help from incubation programs because that help is untargeted, as service providers are not interested in startup results.

Services and offerings: *The incubation program did not meet the company's initial expectations*
Business incubation programs promise startups a variety of services. However, according to SE1, the quality of these services, and even their availability, might be in doubt. Such a situation happened to startup D and startup B. Startup D complained that the program managers promised to help with further product development, but their company never subsequently received such help. Startup B was totally disappointed with their program, as it provided only physical space and general workshops while the company expected to get help with acceleration, mentoring, legal advice, investors, and networking. Startup B was even willing to pay for services if the program was able to provide what they needed. Accordingly, startups should make sure in advance that business incubation programs will provide what they promised and what was expected from them based on the initial formal or informal agreements.

Services and offerings: *Tangible services such as access to manufacturing capabilities were not provided or were limited*
One of the reasons why startups join a business incubation program is access to office space. However, other tangible services such as manufacturing and prototyping capabilities are no less important. Startup F joined a program because of the potential access to prototyping labs. They emphasized that renting a lab can cost a fortune. Startup F developed a kit to test marijuana oils, but because they did not have access to a workshop, it became impossible to produce the kits. Startup A emphasized that existing manufacturing firms require a continuous production supply and are not interested in signing contracts with startups. In addition, startup A was not allowed to use the resources of the university incubation program for commercial purposes. Thus, it could not achieve a competitive advantage based on early prototyping. Startup C also noticed that startups who have physical products face difficulties in getting into contact with potential manufacturers. Startup G wished that the program facilities had a workshop, where they could test their product.

Network: *Startups did not efficiently use the office space provided by the incubation program*
The purpose of startups sharing the same office space is the opportunity to build relationships with peers. Startup H emphasized that sharing an environment with people who are going through the same challenges is very valuable. In fact, startup H established a partnership with another startup that was part of their incubation space – something that would not have been possible if they were not using the same physical space. In addition, startup H mentioned that, at a certain moment of time, the attendance of startup teams in the office space dropped down significantly, which reduced opportunities for collaboration. Startup B felt frustrated that only 2 or 3 startups out of 15 used the office space on a regular basis. Startup E also noticed that attendance of the startup teams diminished over time. After all, the entrepreneurs themselves started to question if there was a difference between using the incubation office space and working at home.

Network: *The incubation program's network was not aligned to the startup's product*
As was emphasized in the literature review, incubation programs provide more generic network resources and

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offer less idiosyncratic network resources, because it is not practical for a program to even try to address each potential startup's every need. Accordingly, three out of the eight startups who joined a more general incubation program (i.e., with no specific sector of focus) stated that the program cannot help them with connections to strategic partners. Startup F needed access to pharmaceutical and chemical manufacturing industries in order to secure access to a valuable supply chain. Since the program network was not in line with their product, the startup had to build its own network. Startup A needed access to manufacturers and distributors in order to start commercial production. Since the incubation program did not provide the necessary connections, startup A considered finding a business angel with the right competencies and knowledge in the field. Startup D needed access to the automation industry in order to test a product and meet potential customers. However, the incubation program was more focused on the healthcare industry than automation. Startup D spent 10 months in an incubation space without any luck establishing the necessary partnerships in order to commercialize the product or even test it at a customer's site. According to Mas-Verdú and co-authors (2015), business incubation environments are insufficient on their own and have to be aligned with other businesses characteristics such as technology, size (number of employees), and sector. In general, generic network resources are valuable only for those startups that do not know how to pursue their business idea. Startups who are looking for strategic partners in order to commercialize their product should join sector-based incubation programs.

Network: *Startups were unaware of the business incubation program's ecosystem*
Sa and co-authors (2012) stressed that entrepreneurs cannot fully benefit from an incubator's resources when those resources are not well coordinated. Two out of the eight startups mentioned that they were unaware of the ecosystem of the business incubation program. Both startups were part of a university-based program. Startup F found out about some of the existing resources, but only by accident. Meanwhile, startup E mentioned that the services provided by the program were not very well advertised. Startups who were unaware of the existing program resources started looking for resources outside of the incubation environment, which is a time-consuming process. Therefore, business incubation programs must make sure that their startups are informed about available resources.

Financial resources: *Business incubation programs did not provide direct or indirect access to investment*
To cross the valley of death, startups can use the resources of the business incubation environment to secure initial funding. Startup D had a proof-of-concept and was ready for investors. However, none of the investors from the incubation program's network were willing to invest in it. After a few unsuccessful attempts to find investors, the incubation program stopped trying to help with investment search despite earlier assurances from the incubation program managers that startup D would receive funding from their investor network. Startup B was not ready for initial funding but needed seed money in order to finalize their prototype. The rest of the interviewed startups either were not ready for investors or they succeeded in attracting investors by themselves. According to Rijnsoever and co-authors (2016), non-incubated startups who have access to the same investors raise as much funding as incubated startups. Accordingly, being part of a business incubation space does not necessarily mean that a startup will receive funding or be connected to potential investors.

Equity: *Equity taken by the business incubation program made startups unattractive to potential investors*
Different business incubation spaces operate under different business models. Most of them are looking to promote regional growth, while others are focusing on generating financial returns from equity. Startup D joined an incubation space with high hopes of securing investors, potential customers, and product development in exchange for 38% equity. The incubation program did not help with product development and customers, but it was ready to charge the startup for other services. Startup D did not use any of the services, because the services were not good enough and were not worth paying for. As it appears, the incubation program adopted a for-profit property development model to charge a fee for services offered. However, the startup did not receive any investment through the program. The program only provided office space and connections to investors. In fact, most of the startups in this program received an investment from other institutions operating in the region and the program managers only advised startup D to approach them directly. On the other hand, the funding institutions were running government-initiated incubation programs that filled the gap of financing when nobody wants to invest in early-stage startups. Those government-initiated programs seemed to provide better, free, or much cheaper, mentoring and consultancy for startups.

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On the other hand, SE3, who was involved in a government-led incubation program, mentioned that the program focused on taking startups at the point where they are ready for investment. SE3's company never needed an investment because they used bootstrapping. According to SE3, the best exit strategy for incubation programs is when their client startups are acquired.

IP Protection: *Participation in a business incubation program puts intellectual property at risk*
Participating in an incubation program can put a startup's intellectual property (IP) at risk because multiple entrepreneurs share office space, workshops, laboratories, and mentors. Startup F emphasized that their product and IP can be very easily exposed to third parties as everyone can access the incubation program lab and office facility. Since most incubation programs do not provide legal services and obtaining a patent is expensive, startups bear the risk of IP exposure. On the other hand, it is typically not the responsibility of the incubation program to protect their startup's intellectual property.

Post-incubation: *Following incubation, startups looked to join another business incubation program or sought business angels*
Usually, startups go through several incubation programs to build or acquire necessary resources for their businesses. After spending some time at a university-based early stage incubation program in Ontario, Canada, startup E applied to join another one, because they were looking for more dedicated hands-on mentoring and business support focusing on growth. Startup B, in Denmark, applied to join a university-based incubator but the application was rejected because the program was for students only. As a result, startup B applied to a regional investment agency in order to receive funding. Startup A is considering finding a business angel who will help with distributors and manufacturers. Accordingly, when an incubation program provides idiosyncratic resources or limits access to complementary assets, startups start to look for those resources in other programs or try to find business angels. Therefore, startups should understand that graduation from an incubation program does not necessarily mean that they will be ready for the market or able to grow and scale-up.

Conclusion

This section summarizes the key insights gathered from our research and analysis. In addition, it focuses on results that can be used to improve an entrepreneur's understanding of incubation programs. The analysis of the empirical observations resulted in the articulation of the following downsides of being part of a specific incubation program.

- Equity dilution can lead a startup to bankruptcy. Startups who have diluted too much equity to an incubator or accelerator will struggle to convince investors to invest in them later. Every time a startup issues new shares, the existing shareholder's equity decreases.

- Startups can face low commitment from incubation program stakeholders such as business mentors, advisors, and external partners. External service providers are usually not interested in startups' results.

- Putting IP at risk. Startups who join an incubation program are risking exposing their product or idea to third parties that have similar access to the incubation facilities. Half of the interviewed incubation programs do not provide legal advice nor IP consultancy.

- Young and inexperienced incubation programs do not do enough due diligence since, most often, their main goal is to fill spots and enhance their regional reputation.

- Startups can be unaware of the business and innovation ecosystem of the incubation program. Some programs do not do a good job in advertising the expertise and knowledge of their networks.

- General workshops, lectures, and courses provided by incubation programs are time-consuming and not necessarily useful. Startups spend a lot of time working on secondary tasks instead of focusing on primary ones. For instance, an interviewed startup spent 12 months in an incubator and was not been able to build a functional prototype during that time period.

- Incubation program networks may not align with a startup's product. The majority of the incubation programs provided only general network resources.

- Incubation programs do not usually provide seed money, investment, or connections to investors. In fact, being part of an incubation program does not guarantee any investment.

- The collaboration opportunities significantly decrease when an incubation space is underutilized and only a few startups use the office facility.

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- Prior to joining an incubator or accelerator, startups should consider whether or not they would need specialized facilities/equipment. Most of the interviewed founders participated in incubation programs that did not have specialized facilities/equipment.

- Startups may go through multiple incubation programs to acquire or build necessary resources. Therefore, startups who have not received necessary help or resources in a specific incubation program consider joining other programs or finding business angels with the right competencies for the startup's context.

Finally, consider the differences between incubator-like and accelerator-like programs in the way they refer to startups that have used multiple incubation programs. The general tendency for startups using multiple incubation programs is to move from early-stage incubation to more dedicated acceleration programs. As a rule, university-based programs are focusing on early incubation offering young entrepreneurs the opportunity the experience of being an entrepreneur. In this sense, we should be careful when comparing the performance of incubators because their missions could be quite different. On the other hand, acceleration programs tend to focus on growth objectives and stronger investment exposure and opportunities. Even though early-stage incubators also claim to offer funding-related networking opportunities, their focus seems to be on the quality of the entrepreneurial experience and the validation of the viability of the emerging business opportunities.

In conclusion, it is not always a good thing for a startup to join an incubator or accelerator. Or, rather, there are multiple aspects of business incubation practices that could affect negatively early-stage companies, and founders of new ventures should be very careful when selecting a specific incubation program. The answer, of course, cannot be considered in black and white terms since the focus of the selection process should be on the interference of the multiple factors that could potentially affect the future of a startup in terms of operations, market potential, external funding, etc.

We believe that the analysis provided here will enhance the awareness of both researchers and practitioners about the potential negative impact of improperly selected incubation programs. It should enable executive managers of existing incubation programs to refine their startup selection process and better articulate the value propositions of their programs. At the same time, we should point out that our study is based on a limited number of cases. Future studies should build a broader empirical base by selecting a larger number of startups and more sophisticated methodologies, taking into account the distinction between the incubation programs, the stage, and the strategic goals of the new ventures.

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> *"Architects in the past have tended to concentrate their attention on the building as a static object. I believe dynamics are more important: the dynamics of people, their interaction with spaces and environmental conditions."*
>
> John C. Portman Jr. (1924–2017)
> Award-Winning Architect and Real Estate Developer

In this article, we view business models as complex deal-making activity systems organized to create, deliver, and capture value. Unlike some other viewpoints, we emphasize both system components and their interconnection. Business activities are carried out by a network of actors drawing on a network of resources, and individual firms seek to configure these intersecting networks to enhance their competitive positioning. The business model literature refers to the significance of antecedent activities in providing context – opportunities the firm decides to pursue, the strategy adopted, and requisite capabilities. Drawing on this literature, we propose an approach to framing business model context. Drawing on the information systems literature, we identify a toolkit facilitating activity system architecture design. We suggest how this both draws out the underlying complexity of a business model and shows how a multiplicity of views makes sense.

Introduction

Chesbrough (2010) suggests that a great idea launched in conjunction with an inappropriate business model will be less successful than an average idea launched in conjunction with a great business model. Indeed, it has been observed that an innovative approach to conducting business can be a source of competitive advantage (e.g., Teece, 2010), resulting in an increasing emphasis on business model innovation (Foss & Saebi, 2017). Thus, questions around where to start, how to innovate, and what to innovate give rise to an ongoing research agenda. Sustainable businesses rely on the generation of income and other forms of support and may be represented as a complex activity system having a specific architecture (e.g., Amit & Zott, 2015; Zott & Amit, 2010), the development of which requires the rationalization of multiple viewpoints to be effective. What is the value proposition/deal and why does it make sense? Where and when are deals that provide mutual benefits negotiated? How is value delivered and by whom? How does a firm's business model relate to its strategy and accessible capabilities (e.g., DaSilva & Trkman, 2014; Teece, 2010)?

An enterprise business model does not exist in isolation; it is linked to a broader business ecosystem, and new concepts emerge from a parallel innovation ecosystem (e.g., Dougherty & Dunne, 2011). Reflecting on contextual and conceptual frameworks is seen to be an important practice in finding new ways to meet customer needs (e.g., Souto, 2015).

The literature provides some advice about designing a business model by drawing on established practice as a template (e.g., Gassmann et al., 2014), about adapting a current business model, and about mapping as-is and to-be situations (e.g., Osterwalder et al., 2014). However, as Osterwalder and Pigneur (2013) point out, "the core issue many organizations face today is the lack of a process that allows them to come up with entirely new and viable business model alternatives from which to choose."

This article addresses this perceived gap by adopting a system design perspective to consider the question: *What tools might help us design an enterprise-specific business model?* We draw together observations from three literature streams in framing system architecture

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design practice: some with a business model orientation, some with an enterprise architecture orientation, and some with a design thinking orientation. We then develop a toolkit that may be used to support business model architecture design and discuss its utility and consistency with observations from the extant literature. We start by considering matters of context, approaches to representing complex entities, and the design lifecycle.

Background

There are many articles cited in the business model, enterprise architecture, and system design literature streams. Here, in the interest of brevity, we generally limit our references to review articles and current viewpoints, as these also incorporate prior studies.

Business model context

Although there is general agreement that business models outline a firm's value creation, capture, and delivery mechanisms, there are a variety of definitions. One states that "a business model is the design of organizational structures to enact a commercial opportunity" (George & Bock, 2011); another indicates that, "whenever a business enterprise is established, it either explicitly or implicitly employs a particular business model that describes the design or architecture of the value creation, delivery, and capture mechanisms it employs" (Teece, 2010). Mitchell and Coles (2003) represented a practitioner perspective in stating that "a business model comprises the combined elements of 'who', 'what', 'when', 'why', 'where', 'how', and 'how much' involved in providing customers and end users with products and services".

Massa, Tucci, and Afuah (2017) undertook a critical assessment of prior business model research and identified three viewpoints on what constitutes a business model: 1) cognitive/linguistic schemas and mutual understandings describing what a business does; 2) formal representations/descriptions of generic components of a business model; and 3) as a focus on those particular attributes of real firms that give a competitive advantage and superior performance. They reflected on why there might be multiple perspectives and on the relationship between business models and strategy, noting that traditional theories of value creation and capture were biased towards the supply side. The notion of customer–provider value co-creation is a current demand-side topic of active discussion (e.g., Grönroos & Voima, 2013). Spieth and co-authors (2014) made similar observations in the context of business model innovation: firstly, explaining the business in support of strategy development; secondly, representing the running business using models and pursuing efficiency, and thirdly, developing the business through the exploration of new opportunities and sources of sustainable competitive advantage.

DaSilva and Trkman (2013) contend that business models represent a specific combination of resources (resource-based theory of the enterprise), which through transactions (transaction cost economic theory of the enterprise), generate value for both customers and the enterprise. They see a business model as an operational configuration of dynamic capabilities required to enact the enterprise strategy. Wirtz and co-authors (2016) assessed research focus areas, business model definitions, and components in more than 600 articles to offer a definition of the concept and characterize the components of an integrated framework in terms of strategic, customer and market, and value creation components. Unlike most business model representations, they added financing and capital models to revenue and cost factors in considering financial value generation and capture.

Allee (2000) noted that, although a traditional view of value creation considered a supply chain and its supporting infrastructure, in a knowledge economy, this is being superseded by thinking about value networks. Aversa and co-authors (2015) reflected this view, defining the modular components of a business model in terms of interacting value creation, capture, and delivery structures. And although traditional supply chains may focus on the flow of physical artefacts, both intangible artefacts (e.g., software) and intellectual capital may be important trading assets. Malone and co-authors (2006) adopted the business model as a unit of analysis in considering the relative financial performance of thousands of American businesses, as this gave more coherent outcomes than mapping using business sector filters. They characterized specific business models in terms of a combination of assets traded (financial, tangible, intangible, or intellectual; our adaptation) and the trading process (ownership transfer of assets created or of assets acquired, providing access to assets as a landlord or broker) (see Table 1) that represented strategic choices selected by a firm. It was noted that some firms had established different operating units having different business models, and we note that some firms combine these to offer a unique value proposition (e.g., jet engine manufacturers offering a lease/maintenance package). In practice, although a firm may choose a particular Table 1 model type, an associated set of decisions

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Table 1. What kind of business are we in? Sixteen core business model types (Adapted from Malone et al., 2006)

	Type of Asset Involved			
Trading Role	**Financial**	**Physical**	**Intangible**	**Intellectual**
Supplier	Entrepreneur	Manufacturer	Inventor	Educator
Distributor	Financial Trader	Wholesaler / Retailer	IP Trader	Collaborator
Landlord	Financial Landlord	Physical Landlord	Intellectual Landlord	Contractor
Broker	Financial Broker	Physical Broker	IP Broker	HR Broker

will be made about specific market segments to pursue that utilize the dynamic capabilities of the firm and make business sense: framing transaction, resource, and value structures (e.g., George & Bock, 2011). These structures may be elaborated in terms of generic subtier building blocks, for example using Osterwalder and Pigneur's (2009) Business Model Canvas. Later, we will discuss this level of analysis further.

Foss and Saebi (2017) reviewed 150 articles on business model innovation and suggested there were four research gaps. The first related to the construct: defining the unit of analysis plus the nature of innovation framed as the intersection of the scope of change (business model architecture level or module level change) and the degree of novelty (new to the firm or new to the industry). The second related to congruence: identifying antecedent activities such as strategy development and the nature of innovation outcomes sought. The third related to contingency and moderating variables including organizational capabilities and leadership, the role of learning and experimentation, cognition, and flexibility. The fourth related to boundary conditions: links with other viewpoints (entrepreneurship, sustainability, servitization) and the world external to the firm.

What we take from the foregoing is illustrated in Figure 1, which suggests firstly that the design of a suitable business model is influenced by five elements of context. We observe that these elements provide a bridge with the broader business ecosystem a firm is embedded in. Secondly, there are interactions between these elements independent of, but linked to the business model, for example, matching market opportunities and a firm's goals. And, finally, each of these elements may be a field of study in its own right. To Illustrate: what kind of business have we chosen to establish (see Table 1), and what are its goals? Is the value architecture associated with the delivery of economic, social, or environmental benefits, or with some combination of them (e.g., Dembek et al., 2018)?

Complex system representation and design

Our point of departure here draws on a review by Cilliers (2001) of approaches to understanding complex entities. Firstly, he points out that, in describing a particular complex system, one draws boundaries, implying that this system is embedded in a broader complex system. In the case of business model studies, the boundary is most commonly an individual firm, but in a cooperative, it may be a collection of semi-autonomous firms. Secondly, there is a natural tendency to form hierarchies (see Simon, 1962). This is reflected in most organizational structures and approaches to modelling complex systems. Finally, complex operations may be viewed as networks of interconnected nodes/modules, with a focus on the nature of the connections between them. Here, we note that the business model literature tends to focus on the nodes (components) with less attention given to the connections between them.

Taking a market engagement viewpoint, some researchers have characterized business ecosystem networks in terms of three generic sub-networks: interacting actors and actor bonds, requisite activities and activity links, and requisite resources and resource

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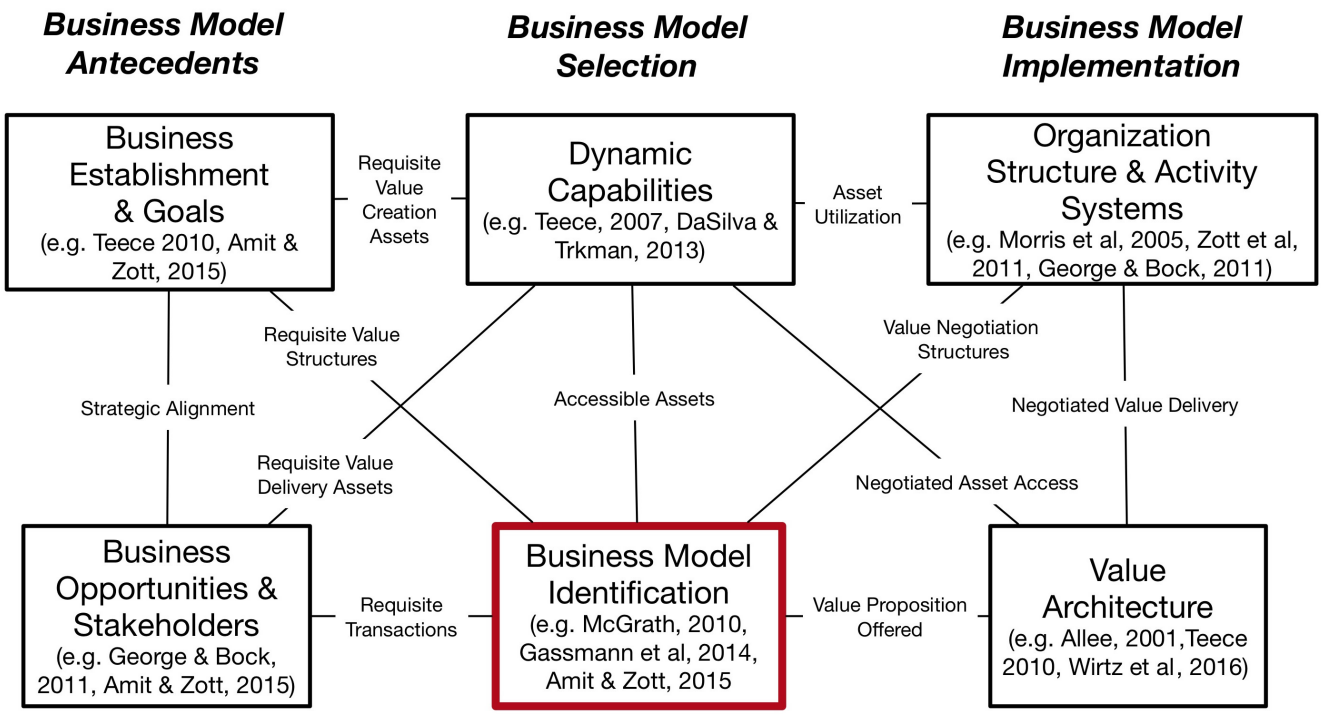

Figure 1. Contextual factors influencing the identification of a suitable business model concept

ties. Matters of individual interactions between companies and business ecosystems (Hakanson & Ford, 2002) and the nature of management practices in this context (Ritter et al., 2004) are considered. In the context of business model structures and previous observations, the following alignment is suggested:

- Actor bonds co-create and deliver value, involving the firm's service entity, its customers, and value network contributors within and external to the firm.

- Activity links are associated with functional transactive structures involving asset ownership exchange or negotiated asset access.

- Resource bonds have financial, physical (product, infrastructure), intangible (software, brand), and intellectual (information, knowledge) components

Viewing business activities in this way introduces the idea that business model structures may be represented as interconnected networks of functional activities.

A number of researchers have drawn on systems engineering tools to help represent and optimize business models:

- Exploring ways in which system dynamics modelling (simulation) tools could be used to support business model design (Cosenz, 2017)

- Considering the interplay between business model and enterprise architecture views of a firms' operations (Fritscher & Pigneur, 2013)

- Drawing on the Zachman (2003) Enterprise Architecture Framework as a tool to help align enterprise architecture with business goals (Nogueira et al., 2013)

- Exploring the idea of system modularity in the context of business model design (Aversa et al., 2015)

It was observed that mapping business model components and their interaction is necessary, that information flows support the linking of value, transactive, and resource structures, that utilizing enterprise architecture tools can give insights into operational activity systems, and that multiple levels of granularity may have to be accommodated.

Architecture by design

Our point of departure here is consideration of system design processes, which include both the consideration

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of the intended system role and requisite functionality, and an architecture description showing how the functional components fit together. Jones and Gregor (2007) reviewed experience with information systems design theory and expanded on a design process view identified by others, learning initially from product design practice. They identified eight evolutionary stages to be considered, with potential iterations involved, which resonates with calls in the literature for a need to consider the evolution and performance of different business models.

In a previous study of the application of design thinking to business model design, we compared traditional design and (proposed) business model viewpoints at concept, requirements, and implementation levels of analysis. This is illustrated in Figure 2, along with a component-based (modularity) view of business model design (Aversa et al., 2015). The discussion earlier in this article has suggested we need to include an overarching context level, and that between the implemented model and the requirements level there needs to be a sub-component definition level, consistent with the multiple viewpoints adopted in the Zachman (2003) Enterprise Architecture Framework. A design process view is shown in Figure 2.

Research Methodology

The research question we are exploring is: *What tools might help us design an enterprise-specific business model?* The authors have prior experience with different business process modelling applications and systems design/operations in a defense industry setting, and we compiled a list of tools used for those purposes (e.g. Mo & Beckett, 2018) that could be applied to help answer the research question.

We firstly viewed business models as complex activity systems that have an underlying architecture (Zott & Amit, 2010). Secondly, we followed the lead of Osterwalder and Pigneur (2013) in considering the utility of information systems tools in supporting business model design. Our initial objective was to support the development of system architecture descriptions, and we drew on an international standard, ISO/IEC 42010:2007 (ISO, 2007) for that purpose. This standard had evolved over several years with contributions from many researchers and practitioners. Elements of this standard reflect observations made in the prior discussion on business model design, for example, that multiple viewpoints are required. The core of the standard – bringing together stakeholders, multiple viewpoints, and an associated rationale – is seen to be consistent with the application of stakeholder theory (e.g., Jensen, 2010). One of the authors had more than five years of experience using this standard, which showed that mapping interactions between multiple viewpoints was greatly facilitated using Design Structure Matrices (Browning, 2016). Simple matrices such as the Boston Consulting Group (BCG) Market Growth-Share Matrix, where one variable is mapped against another, have long proven helpful in exploring business scenarios. Table 1 represents an example of this kind of matrix. Another form of matrix, the Relationship Matrix, shows which system entities are connected and may describe some attributes of each connection. We have used this in exploring interactions between different business model components.

Findings

Developing a complex system architecture description
An adapted overview of the ISO/EIC 42010 architecture description framework (ISO, 2007) is shown in Figure 3. Some elements of the framework are shown as representing business model antecedents. The core system architecture description represents a detailed set of requirements and is informed by inputs from stakeholders and multiple viewpoints that represent a knowledge base drawing on prior experience and models, by a generic form of architecture and by the rationale for the selection of a particular design.

We suggest this latter set of activities represent the approach adopted by practitioners using Osterwalder and Pigneur's (2009) Business Model Canvas in mapping a firm's current business model elements. Generally working in a facilitated workshop setting, a cross-section of stakeholders contribute multiple viewpoints that provide detailed firm-specific information about each component of the business model canvas.

A business model view linked to activity theory
We have followed the lead of Zott and Amit (2010) and represent the business model architecture element as a six-component model based on an activity theory that also considers interactions between elements (Engestrom, 2000; Jones & Holt, 2008). Some attributes of an activity theory framework are:

- All six components are interconnected, with 15 dyadic two-way links, and tensions within these linkages can point to opportunities for innovation. For example, the buyer wants to minimize price but the seller wants to maximize it.

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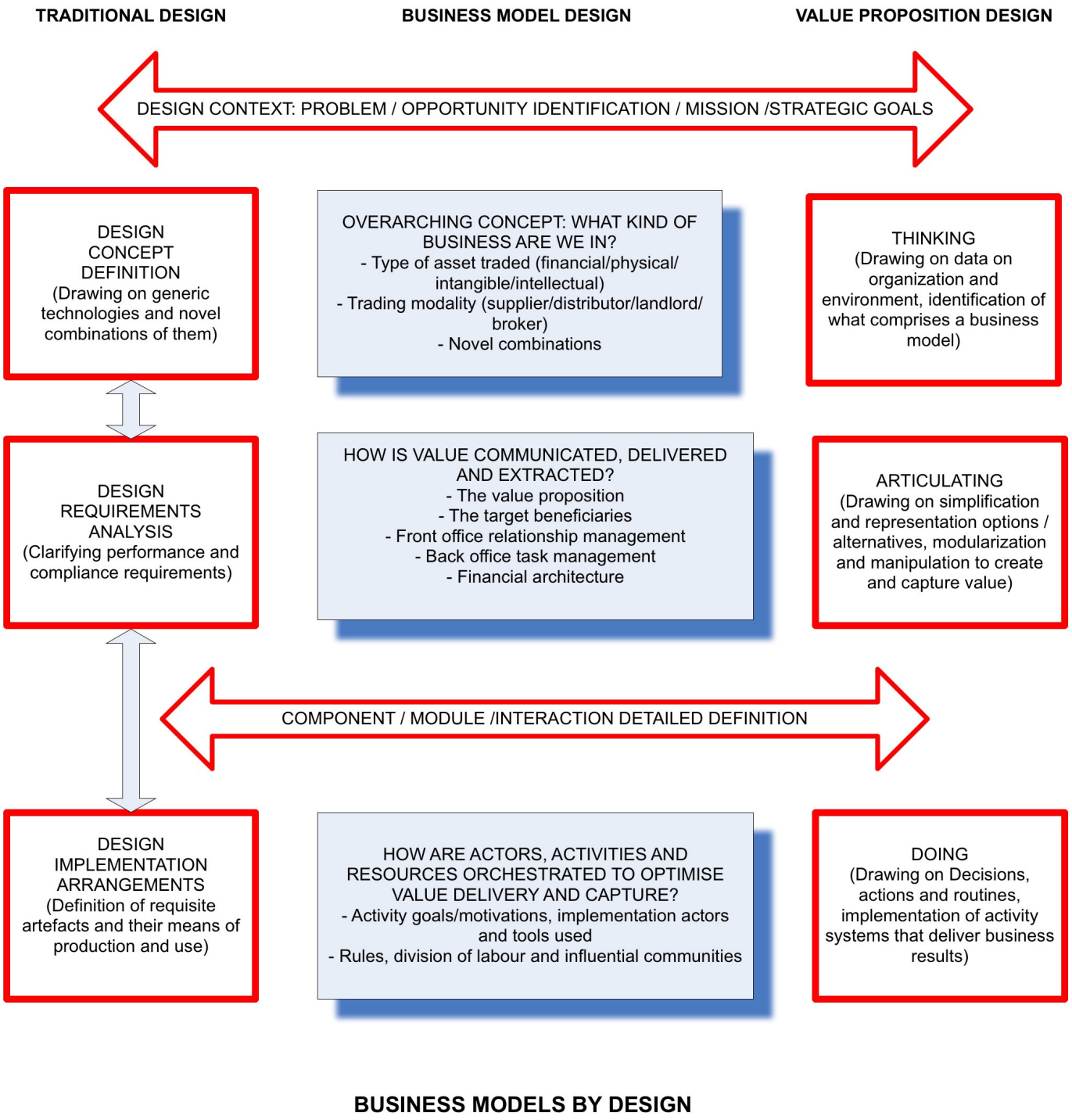

Figure 2. Multiple design viewpoints

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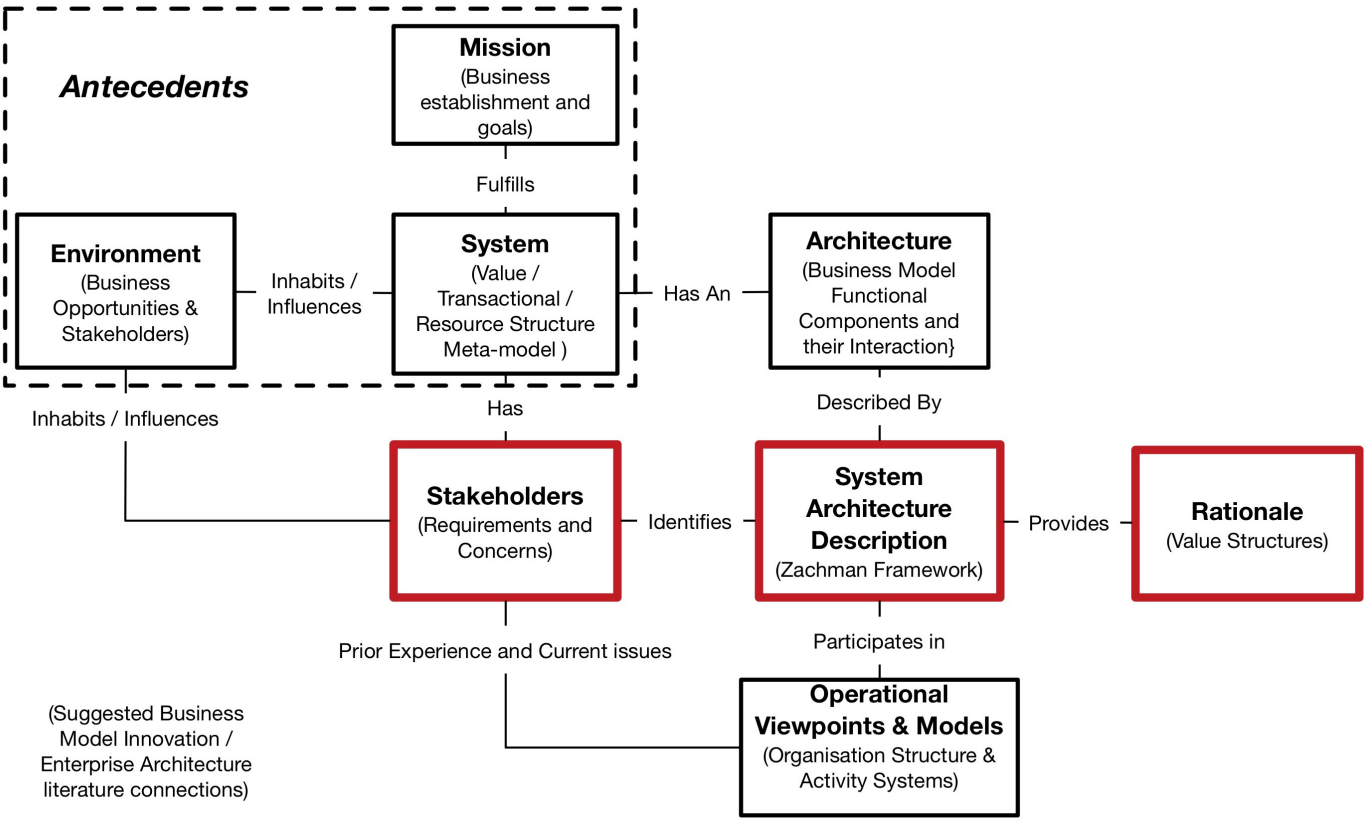

Figure 3. An ISO/EIC 42010:2007 representation of a business model architecture description framework (ISO, 2007)

- Each dyadic link may be influenced by a third moderating component. For example, there may be rules moderating subject (service entity) – object (value proposition) activities.

- The six-component framework can be adopted as a way of thinking and used in a recursive manner. For example, a separate object may be to develop new dynamic capabilities, but who will do it, what tools might be used, and what is the potential impact on the higher-level activities?

A representation of this framework in a business model context is shown in Figure 4. Deal-making activities are at the core, and it is the role of a service entity to stimulate and support such events-in-time. Deal-making events are not continuous, and each one may have some unique characteristics. The term service entity has been used to represent the activity theory subject as it may be a person, a team, or an intelligent agent. The nature of the negotiated deal and the deal-making process may require interaction with the four other elements: the marketplace, the firms' dynamic capabilities, its value network, and benefit/cost architecture (e.g., what may be offered at what cost). If we were to view all 15 interactions in this way, we would have 60 topics to consider, reflecting the underlying complexity.

We propose the Zachman (2003) framework be used as a tool to map a system architecture. It supports descriptions at multiple levels of granularity consistent with design stage viewpoints (e.g., Figure 2), and the six interrogatives can be aligned with the activity theory elements, as shown in Table 2.

Consideration of the "When?" viewpoint introduced a topic not well represented in the business model literature. Different kinds of businesses have quite different engagement dynamics and mechanisms. A large project-based firm may only negotiate contracts a few times a year or every few years, whereas a firm selling consumables may be negotiating deals every few minutes. Each requires quite different types of service entity.

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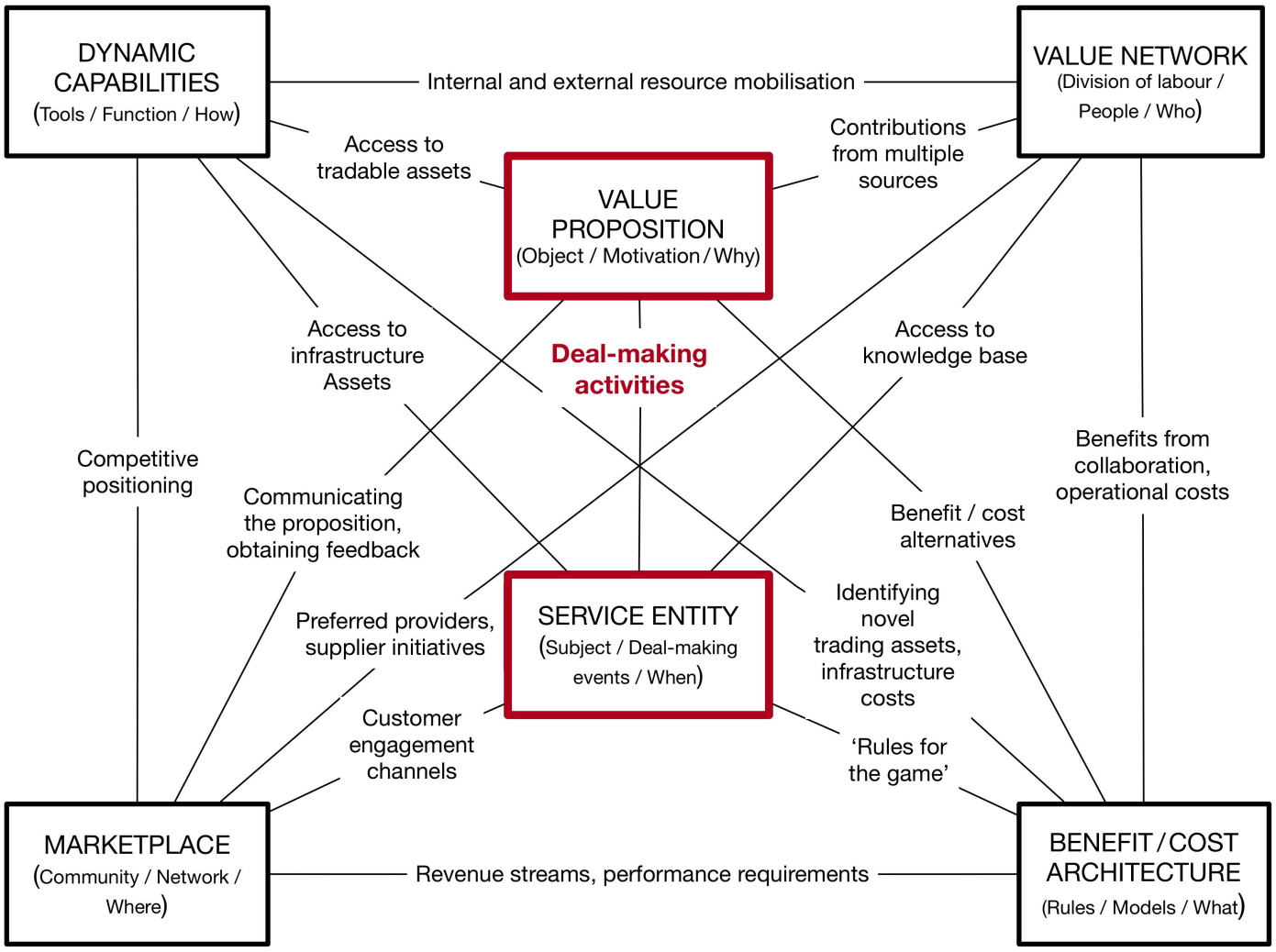

Figure 4. Business model components and their interactions. The figure represents a combination of an Activity Theory framework (Engeström, 2000) and the Zachman (2003) Enterprise Architecture Framework Interrogatives, shown in brackets as (Activity Theory / Zachman Entity / Zachman Question).

Mapping interactions between components of a business model

We used the Design Structure Matrix tool extensively in conjunction with other tools in researching detailed combinations of interactions. For example, we extended Table 1 using the four types of assets plus the four types of trading to create an 8x8 matrix. One quadrant represented the view presented in Table 1, which could be read as given a particular trading mode, what kinds of asset do we primarily offer. The complementary view suggests, given a strength in a particular asset class, what are our trading options? The asset/asset quadrant suggests a resource-based view: given we trade in a particular kind of asset (e.g., intangible, like software), what other assets are needed to support this (financial, physical, intellectual or additional intangibles)? The trading mode /trading mode combination might suggest: what combination of trading modes might we assemble as a foundation for a unique business model? By way of example, the Uber taxi service model may be viewed and a broker / landlord combination. These conversations may be helpful in designing innovative business model concepts

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Table 2. Aligning business model concepts: Zachman (2003) Architecture Framework Interrogatives and Activity Theory (Engeström, 2000)

Business Model Concept	Zachman Architecture Framework Interrogatives	Activity Theory Business Model Representation
Value Structures: What is the deal?	Why? (Motivation for buy-in)	Object: A mutually beneficial value proposition
	What? (Models of business transactions)	Rules: Revenue, benefit / cost trade-offs and regulatory contract conditions
Transactive Structures: Value / Deal Negotiation	Where? (Networks of market activities)	Community: Marketplace and its dynamics
	When? (Timing, Events – making it happen)	Subject: Service entity (organization of deal-making events)
Resource Structures: Value / Deal Delivery	Who? (People – creating and delivering value)	Division of Labour: The firm's value network
	How? (Function – driving processes)	Tools: Dynamic capabilities (tradable and infrastructure assets)

Conclusion

The introduction to this article raised three questions related to innovative business model architecture design and what kinds of tools might support this. We make an original contribution by adapting the use of a set of tools previously applied in different professional settings but which may not have been used in a business model architecture design context before.

First question: Where to start?
Our proposal considers matters of context and concept, which are regarded in the business model literature as antecedents of business model design. An antecedent model is illustrated in Figure1. What is the firm's mission, its establishment, and operational rationale? What characterizes its operating environment? What dynamic capabilities are available to the firm? We view dynamic capabilities as a combination of tradable assets (which may be a product or the provision of services) and infrastructure assets that facilitate market engagement, value creation, and value delivery.

Second question: How to innovate?
The design literature suggests following an evolutionary process (e.g., Figure 2) where there may be iterations between stages. Our proposal is to ask key questions about business models as activity systems. Draw on a set of tools comprising the ISO/IEC 42010 architecture description standard (Figure 3), a six-component generic business model architecture that considers interactions between business model components (Figure 4) and an adaptation of the Zachman (2003) Enterprise Architecture Framework, which brings together multiple viewpoints having different levels of granularity. A potential advantage of the Zachman framework is that it can also be used to establish congruent information systems and technology resource overlays on the business model representation. All three tools are claimed to have recursive properties and can be applied at a global system or subsystem/component level.

Third question: What to innovate?
Our proposal is to follow the suggestion of Foss and Saebi (2017): innovate at the component level (e.g., enhance dynamic capabilities) or at the architecture level with a focus on interactions between components (e.g., change relationships with customers (see Osterwalder et al., 2014). Whichever is chosen, use the Design System Matrix to map what else may have to change in conjunction with the innovation.

Amit and Zott (2015) had suggested that matters of governance, architecture, and content be considered in business model design. We suggest that all actors influenced need to be viewed as stakeholders, and drawing

on an activity theoretical model (Figure 4), operational governance may be associated with division of labour/value network arrangements spanning internal and external activities.

We further contribute to theory by illustrating that, although many researchers may search for a single definition of a business model and see the literature as lacking coherence in this regard, viewing a business model as a complex activity system actually requires the amalgamation of multiple viewpoints.

A macro-view links a type of model with enterprise context (Figure 1 and Table 1). At this level, a simple descriptor such as a retailer or manufacturer conveys some level of understanding about the context of a particular business. At this level, business model innovation may be facilitated by changing from one kind of business to another or by considering particular combinations (e.g., manufacturer plus retailer). At a meso-level, the focus is on value creation and value capture rationale delivered from a combination of transactive and resource structures (Massa et al., 2017). Table 2 illustrates the application of an enterprise architecture model to link this viewpoint with six lower-level generic components. Figure 4 shows these components and interactions between them. This representation draws on activity theory (Engeström, 2000) where it is suggested that opportunities for innovation can be found in tensions between the linkages. Other researchers may utilize a larger number of components, introducing a finer level of granularity. It is our contention that however the functional architecture is represented, it is necessary to describe each business model instance at a finer level of granularity again, building on contributions from multiple stakeholders to obtain a usable representation. This practice is demonstrated in the application of the widely utilized Business Model Canvas where facilitated workshops are established to fill in the specifics associated with each component.

One transactive structure attribute introduced by mapping against the Zachman (2003) Architecture Framework is consideration of temporal factors – viewing transactions as events or sets of deal-making events managed by a service entity (Table 2). This resonates with the literature on service dominant logic, and it is a topic for future research.

From a practitioner viewpoint, just as the Business Model Canvas (or alternatively Figure 4) has acted as a boundary object at a component level of analysis, we contend that the ISO/IEC 42010 model (Figure 3) can serve a similar purpose in characterizing the total system. This claim is based on direct experience using it with defence industry practitioners seeking to service innovative public–private partnerships. Instead of a canvas, a set of wiki pages, each representing one element of the model and containing prompts, was used to support the development of architecture descriptions by virtual teams. A design structures matrix was used to show relations between them. In this instance, opportunities for innovation were identified by considering macro-level change scenarios in the business context, with particular reference to the operating environment.

About the Authors

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The Ecosystem Knowledge Explorer: A Tool to Systematically Discover External Knowledge

Behrooz Khademi

> *"Most organizations fail to manage performance effectively because they fail to look into the system holistically."*
>
> Pearl Zhu
> Author of Performance Master: Take a Holistic Approach to Unlock Digital Performance

It is crucial for any organization to discover knowledge from ecosystem-specific sources of knowledge that are considered external to the organization. Since knowledge exploration is a resource-intensive task for organizations, untimely or excessive knowledge exploration have detrimental impacts on the innovativeness and competitiveness of organizations. The benefits of performance measurement and management tools for knowledge management in organizations have been known for many years now. Therefore, the application of similar tools in ecosystems may enable actors to have access to valuable external knowledge. However, there is a paucity of such tools in management scholarship. The purpose of this study is to bridge this gap by proposing a conceptual tool – the Ecosystem Knowledge (EK) Explorer, which generates insightful knowledge for ecosystem actors using codified technical knowledge (e.g., scientific publications and patents). Not only does the EK Explorer reduce the uncertainty and fuzziness of the knowledge exploration phase for ecosystem actors, it also enables them to save resources and have access to strategic knowledge regarding competition, collaboration, technology management, and policy making in ecosystems. Bibliometric analysis, social network analysis, and text mining were used to conceptualize the constructs and measurable variables of the EK Explorer.

Introduction

In today's global knowledge-based ecosystems (Järvi et al., 2018), having access to domain-specific knowledge from external knowledge sources is a matter of organizational life and death. Yet, exploring knowledge is resource-intensive, and requires organizations to have precise plans. Previous research has demonstrated that excessive knowledge exploration may have serious consequences for competitiveness and innovativeness of organizations. First, the timeliness of external knowledge exploration in ecosystems is paramount in the contexts of technology and innovation: being too late in knowledge exploration may endanger the future of organizations (Pellikka & Ali-Vehmas, 2016; Wubben et al., 2015). Second, if the search scope is too broad or too deep, the values appropriated through the explored knowledge might be less than the costs paid for knowledge exploration (Ahuja & Katila, 2004; Laursen & Salter, 2006; Li et al., 2013; Luo et al., 2018). To mitigate the impacts of excessive knowledge exploration, several moderators have been proposed (e.g., Laursen et al., 2012; Sidhu et al., 2007; Zhou & Li, 2012). However, despite previous efforts, there is no clear practical solution for organizations to systematically explore domain-specific knowledge from external knowledge sources, which in turn, may enable them to save resources and foster innovation.

Knowledge management comprises key success factors, strategies, and practices for knowledge creation, knowledge sharing, and knowledge sourcing, and it enables organizations to remain competitive and innovative (Alavi & Leidner, 2001; Lin, 2011). Knowledge

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management practices in intra-organizational processes (Alavi & Leidner, 2001; Durst & Runar Edvardsson, 2012) and enterprise-level performance measurement tools such as the Balanced Scorecard (Hoque, 2014; Kaplan & Norton, 1992) have been widely discussed in management scholarship (Alavi & Leidner, 2001; Durst & Runar Edvardsson, 2012). As they pertain to knowledge management in inter-organizational contexts, earlier theories and concepts extensively discussed how organizations must plan for knowledge management. These include, for instance, open innovation (Chesbrough, 2003), dynamic capabilities (Teece et al., 1997), absorptive capacity (Cohen & Levinthal, 1990), and integrative and dynamic knowledge management capacity (Lichtenthaler & Lichtenthaler, 2009). Disruptive technologies such as digital platforms (Korhonen et al., 2017; Steur, 2018), the Internet of Things (Ikävalko et al., 2018), and data analytics technologies (Kayser et al., 2018; Westerlund et al., 2018) are more recent phenomena, which have been of great value for knowledge management and knowledge exploration in both intra-organizational process management and inter-organizational information management. However, the application of intra-organizational knowledge management practices and solutions is not entirely applicable to ecosystems.

Notwithstanding a few contributions on performance indicators in inter-organizational processes such as in collaborative networks (Camarinha-Matos & Abreu, 2007; Camarinha-Matos & Afsarmanesh, 2007, 2008), supply chains (Chang et al., 2013; Gopal & Thakkar, 2012; Ramanathan, 2014; Ramanathan et al., 2011), and with limited applications in ecosystems (Battistella et al., 2013; Mäkinen & Dedehayir, 2013), efforts to measure and manage the performance of ecosystems remain rare (Aarikka-Stenroos & Ritala, 2017; Graça & Camarinha-Matos, 2017; Ritala & Almpanopoulou, 2017). This rarity may be due to a conceptual difference between the objectives of knowledge management practices in organizations versus in ecosystems. Ecosystems have ambiguous structures (Ritala & Gustafsson, 2018), and the interactions between ecosystem actors are complex (Ritala & Almpanopoulou, 2017). Competition is not the only strategy to create and capture value in ecosystems, and organizations collaborate, compete, and sometimes do both simultaneously (e.g., using co-optitive strategies) to survive. Furthermore, although organizations are responsible for appropriation of their own share from collectively created value in ecosystems, their captured value still depends on the ability of other actors in creating and capturing value (Chesbrough et al., 2018). To address the conceptual difference between knowledge management in an organization versus in an ecosystem, I use the term "ecosystem knowledge management". Assimilation of ecosystem knowledge management is the prerequisite for conceptualizing knowledge management tools in ecosystems. Such tools may then enable to measure and manage the performance of ecosystems.

The objective of this study is developing a conceptual performance measurement and management tool called the Ecosystem Knowledge (EK) Explorer, or EK Explorer, which is designed to be used for systematic exploration of non-market types of external knowledge such as science, technology, actors, and geography from globally-operated and platform-based ecosystems. Bibliometric analysis, social network analysis, and text mining are used to conceptualize the tool. Not only may using such a tool save time and resources for organizations, it may be beneficial for managers in providing valuable knowledge that could not be explored otherwise. The generated knowledge may be used for making decisions regarding competition, collaboration, technology management, investments, and policy making in ecosystems.

Conceptualizing the Structure of the EK Explorer

According to Järvi and colleagues (2018), boundaries for (knowledge-based) ecosystems have become blurry and, nowadays, ecosystems must be analyzed from a global perspective. Therefore, I adopt *a* globally-operated ecosystems view – rather than one focused on spatially bounded ecosystems – to develop the EK Explorer tool. Integrating this view with Valkokari (2015), an ecosystem of a specific knowledge domain consists of *all* actors worldwide contributing to the production and flow of knowledge in that domain: scientific communities, inventors and innovators, technology entrepreneurs, innovation policy makers, innovation brokers, funding agencies, and intermediators.

Codified technical knowledge is referred to explicit technical knowledge that is stored and can be transferred from one person to another. It is the output of innovation in ecosystems, which is produced and exchanged by knowledge workers, inventors (R&D personnel or independent inventors), personnel of engineering departments, and worldwide researchers from

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research organizations and universities (scientific communities). Codified technical knowledge may stem from innovation in new product development, process optimization, or service-oriented projects. In technological innovation, the outputs of innovation may be stored and legally protected as copyrights (such as publications, technical drawings, databases, architectures, software, mobile applications, source codes, algorithms, databases, or mathematical concepts), patents, or industrial designs (WIPO, 2004).

The focus of this study is those platform-driven ecosystems where technical knowledge is peer-reviewed and examined for robustness and novelty before codification (i.e., scientific publications and patents). These data sources contain bibliographic and citation-related information. To develop the EK Explorer, I use the structure of stored data in patent and scientific publication databases. When analyzing bulk data for scientific publications and patents, not only does codified technical knowledge disclose information regarding the relevant knowledge domain and its growth over time, it also generates insights regarding contributors to the created knowledge. Therefore, using codified technical knowledge as input, the EK Explorer comprises two distinct units of analysis: codified technical knowledge and contributors to such knowledge.

Accordingly, based on different types of codified technical knowledge and different types of actors involved in ecosystems, the EK Explorer comprises four major components: Scientific Communities (1) and R&D Networks (2) for analyzing actors (i.e., contributors to codified technical knowledge), and Scientific Research Management (3) and Technology Management (4) for analyzing technical knowledge. To better understand the components, let us consider a wind energy ecosystem as an example. The codified technical knowledge of a wind energy ecosystem consists of all patents and scientific publications relevant to wind energy technologies, which are used for analyzing the components Technology Management and Scientific Research Management respectively. The direct contributors to codified technical knowledge in a wind energy ecosystem are inventors and public or private sector R&D units (R&D Networks), and researchers, research organizations, and universities (Scientific Communities). Although indirect contributors such as state-level and federal-level policy makers, governments, funding agencies, and investors are not immediately considered in the EK Explorer tool for performance measurement (because they do not directly create technical knowledge), they are considered as beneficiaries of the tool for *performance management*.

To define the main constructs and variables for the EK Explorer, different data analysis techniques in bibliometrics, social network analysis, and text mining are used. The techniques include local and global citation analyses (e.g., Facin et al., 2016; Gomes et al., 2018), co-citation analysis (e.g., Castriotta & Di Guardo, 2016; Egghe & Rousseau, 2002; Facin et al., 2016; Gomes et al., 2018; Loi et al., 2016; Randhawa et al., 2016), bibliographic coupling (e.g., Egghe & Rousseau, 2002; Park et al., 2015), undirected social networks (e.g., Chen et al., 2019; Cong & Shi, 2019; Taddeo et al., 2019), measures of centrality in social network analysis (Borgatti et al., 2018), and word/n-gram counting in text mining (Ignatow & Mihalcea, 2018).

Constructs and variables for Scientific Communities
For Scientific Communities, a node may represent a researcher, a research organization, a region, or a country. Accordingly, separate units of analysis must be taken into account. Table 1 lists the constructs, variables, and measuring system used for Scientific Communities.

Constructs and variables for R&D Networks
For R&D, a node may represent an inventor, an R&D unit, a region or a country. Accordingly, separate units of analysis are considered. Constructs, variables and measuring system for R&D Networks are explicated in Table 2.

Constructs and variables for Scientific Research Management
For Scientific Research Management, a node may represent a research paper, a knowledge domain or a knowledge sub-domain (unless the unit of analysis is stated otherwise in Table 3). Constructs, variables and measuring system for Scientific Research Management are described in Table 3.

Constructs and variables for Technology Management
For Technology Management, a node may represent a patent, class/sub-class of technology – classes and subclasses of patents defined in International Patent Classification, commonly known as IPC (WIPO, 1971), or Cooperative Patent Classification, commonly known as CPC (USPTO & EPO, 2010) – knowledge domain or a knowledge sub-domain. Constructs, variables and measuring systems for Technology Management can be found in Table 4.

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Table 1. Structure of the Scientific Communities component of the EK Explorer tool

No.	Construct	Variable	Measurement
1	Actor engagement	Degree of actor engagement	The degree to which a node contributes to scientific research in a specific knowledge domain. The variable is measured by the share of the number of publications (by the node) from all the publications in a specific knowledge domain/sub-domain.
2	Actor influence	Degree of influence	The degree to which a node plays the role of knowledge broker in the relevant scientific community. This variable is measured by betweenness centrality in the relevant directed network.
3	Actor impact	Degree of impact	The degree to which a node is popular (impactful) in their relevant directed network. This variable is measured by the indegree of nodes.
4	Actor activity	Degree of activity	The degree to which a node is active in their relevant directed network. This variable is measured by the outdegree of nodes.
5	Actors' similarity	Degree of similarity	The degree to which nodes have similar research outputs. This variable is measured by the frequency of co-cited publications.
6	Actor collaborativeness	Degree of collaboration	The degree to which nodes collaborate in their relevant network. This variable is measured by the number of co-authored publications.
7	Potentiality for collaborative research	Degree of potentiality for collaborative research	The degree to which nodes have similar research output (provided that no previous co-authored publications exist between the nodes). This variable is measured by the frequency of co-citing documents.

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Table 2. Structure of the R&D Networks component of the EK Explorer tool

No.	Construct	Variable	Measurement
1	Productiveness	Degree of productiveness	The degree to which a node contributes to R&D output in a specific knowledge domain/sub-domain. The variable is measured through the share of published patents by the node from all the published patents in the knowledge domain/sub-domain.
2	Effectiveness	Degree of effectiveness	The degree to which a node contributes to R&D output in a specific knowledge domain/sub-domain. The variable is measured through the share of granted patents invented by the node from all the granted patents in that knowledge domain/sub-domain.
3	Actor influence	Degree of influence	The degree to which a node plays the role of knowledge broker in the relevant directed network. This variable is measured by betweenness centrality in the relevant network.
4	Actor impact	Degree of impact	The degree to which a node is popular (impactful) in their relevant directed network. This variable is measured by the indegree of nodes.
5	Actor activity	Degree of activity	The degree to which a node is active in their relevant directed network. This variable is measured by the outdegree of nodes.
6	R&D similarity	Degree of similarity	The degree to which nodes have similar granted patents. This variable is measured by the frequency of co-cited patents.
7	Technological competence	Degree of technological coreness	The degree to which nodes have technological coreness in their patent portfolio and cite their own work rather than imitating others. This variable is measured by the share of self-cited (backward citation) patent families from the total number of patent families granted to an organization.
8	R&D uniqueness	Degree of uniqueness	The degree to which nodes are cited by themselves rather than by others. This variable is measured by the share of self-cited (forward citation) patent families from the total number of patent families granted to an organization.
9	R&D collaborativeness	Degree of collaboration	The degree to which nodes collaborate in their relevant undirected network. This variable is measured by the number of co-patented technologies.
10	Potentiality for R&D collaboration	Degree of potentiality for joint R&D	The degree to which nodes have similar granted patents (provided there exist no co-patenting activities between the nodes). This variable is measured by the frequency of co-citing patents. Technological distance must be taken into account when considering this construct.

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Table 3. Structure of the Scientific Research Management component of the EK Explorer tool

No.	Construct	Variable	Measurement
1	Sub-domain engagement	Degree of sub-domain engagement	The degree to which a sub-domain is involved in the evolution of research. The variable is measured by dividing the number of scientific publications in that sub-domain by all the papers published in the relevant knowledge domain.
2	Research impact	Degree of impact	The degree to which a node is considered impactful in their relevant network. This variable is measured by the number of indegrees of the node controlling for citation lags.
3	Research output similarity	Degree of similarity	The degree to which nodes are similar in terms of content (based on citations). This variable is measured by the number of times two documents are co-cited.
4	Research foundationality	Degree of foundationality (influence on new knowledge formation)	The degree to which sub-domains influence the formation of a new knowledge domain. The variable is measured through the share of cited documents of each of the sub-domains from all the cited documents.
5	Sub-domain independence	Modularity of sub-domains	The degree to which sub-domains in a knowledge domain are independent from each other. This variable is measured through the degree of modularity in co-citation analysis.
6	Research growth	Degree of research growth	The overall trend of evolution of a knowledge domain/sub-domain over time. This variable is measured through the overall growth in number of publications in a domain/sub-domain over a certain period of time.
7	Research growth pace	Research growth pace	The pace of growth of a knowledge domain/sub-domain. The variable is measured through the division of "degree of research growth" by the number of years of analysis.
8	Theme presence	Percentage of theme presence	The share of a theme/sub-theme from all the themes/sub-themes in a certain period of analysis. This variable is measured through the division of the count of words/n-grams relevant to a theme/sub-theme by the total number of words/n-grams relevant to all themes/sub-themes (after text pre-processing steps such as tokenization, stop word removal, stemming, and lemmatization) in a certain period of analysis.
9	Theme transition	Degree of theme transition	The degree to which evolution of a theme/sub-theme changes (or fluctuates) over time. This variable is measured through the change in "percentage of theme presence" from one period of analysis to another.
10	Theme strain	Theme strain	The overall growth of a theme in a certain knowledge domain/sub-domain over time. The term "strain" (same as strain in material deformation) is used for this variable to make judgements about the growth of themes over time more rigorous. This variable is measured through subtracting the count of words/n-grams in the last period of analysis from the count of those words/n-grams in the first period of analysis divided by the count of words/n-grams in the first period of analysis.
11	Rate of theme strain	Rate of theme strain	The growth rate of a theme in a certain knowledge domain/sub-domain. This variable is measured through the division of a theme strain by the number of years of analysis.

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Table 4. Structure of the Technology Management component of the EK Explorer tool

No.	Construct	Variable	Measurement
1	Sub-domain engagement	Degree of sub-domain engagement	The degree to which a sub-domain is present in the evolution of technology for a specific knowledge domain/sub-domain. The variable is measured through the share of granted patents in that sub-domain from all the patents granted in the relevant knowledge domain.
2	R&D impact	Degree of technology impact	The degree to which a node is considered impactful in their relevant network. This variable is measured by the number of indegrees of the node controlling for citation lags and patent renewal fees. Although there exist different constructs and measures for technology impact and patent value, this construct provides an instant overview of the R&D impact.
3	Technological similarity	Degree of technological similarity	The degree to which two nodes are similar in terms of content. This variable is measured by the number of times nodes are co-cited.
4	Technological foundationality	Degree of foundationality (influence on new knowledge formation)	The degree to which sub-domains influence the formation of a new knowledge domain. The variable is measured through the share of cited documents for each sub-domain from all the cited documents.
5	Technological sub-domain independence	Modularity of sub-domains	The degree to which sub-domains in a knowledge domain are independent from each other. This variable is measured through the degree of modularity in co-citation analysis.
6	Technology growth	Degree of research growth	The overall trend of evolution of a knowledge domain/sub-domain over time. This variable is measured through the overall growth in number of granted patents in a domain/sub-domain over a certain period of time.
7	Technology growth speed	Rate of technology growth	The rate of growth of a knowledge domain/sub-domain. The variable is measured through dividing "degree of technology growth" by the number of years of analysis.
8	Theme presence	Percentage of theme presence	The share of a theme/sub-theme in a certain period of analysis. This variable is measured through the division of the count of words/n-grams relevant to a theme/sub-theme by the total number of words/n-grams (after text processing) in a certain period of analysis.
9	Theme transition	Degree of theme transition	The degree to which evolution of a theme/sub-theme changes (fluctuates) over time. This variable is measured through the change in "percentage of theme presence" from one period of analysis to another.
10	Theme strain	Theme strain	The overall growth of a theme in a certain knowledge domain/sub-domain. This variable is measured through subtracting the count of words/n-grams in the last period of analysis from the count of those words/n-grams in the first period of analysis divided by the count of words/n-grams in the first period of analysis.
11	Rate of theme strain	Rate of theme strain	The growth rate of a theme in a certain knowledge domain/sub-domain. This variable is measured through the division of theme strain by the number of years of analysis.

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Using the EK Explorer for Systematic Knowledge Exploration

So far, the need for performance measurement and management tools in ecosystems as well as the proposed conceptual EK Explorer tool for the above-mentioned purpose have been explicated. It might, however, still be unclear what questions can be systematically answered by applying the tool in practice, which will unlock the insights and value of the EK Explorer. To clarify this issue, I show what knowledge could potentially be explored using the EK Explorer by delineating the possible research questions that could be systematically formulated and answered in each of the four components. For the component Scientific Communities, Table 5 enables the user to systematically disentangle the scientific communities of an ecosystem, compare the performance of the actors, and identify potential opportunities for future collaborative research. Likewise, for the component R&D Networks, Table 6 allows the user to systematically disclose the assignees (patent holders) of an ecosystem, compare their performance, and identify potential opportunities for joint R&D projects. As it pertains to Scientific Research Management, the questions in Table 7 assist with systematically analyzing the evolution of scientific research in an ecosystem and identifying state-of-the-art research themes. Similarly, with respect to Technology Management, Table 8 helps the user to systematically explore technological trajectories in an ecosystem in addition to highlighting promising technologies and technological themes.

In practice, the EK Explorer can be used in ecosystems, where the codified technical knowledge is science-intense, patentable, or (ideally) both. One major benefit of using the EK Explorer is that it enables managers to access knowledge without a need for collecting primary data from ecosystems – at least in the preliminary phases of knowledge exploration. Accordingly, different organizations and managers in different locations of ecosystem structure may benefit from the EK Explorer. Strategy, R&D, and innovation managers may significantly benefit from using the tool in practice. This is regardless of the size of the firm as the EK Explorer can be used for different purposes that suit managers' goals (collaboration, competition, technology management, investment, policy making, etc). Research organizations and universities may use the tool to define new collaborative research partners and identify emerging research trends. Policy makers and government authorities may benefit from the outcome for more systematic intervention policies (more systematic funding of collaborative projects, etc). Investors can use the tool as a new source of information for their future investments. Outsiders with potential future research or technology ideas (e.g., entrepreneurs and SMEs with strong technical ideas or diversified large companies with prospective products relevant to the ecosystem) may use the tool as a new source of information for their next strategic decisions. Intellectual property (IP) consultants, patent attorneys, and in-house IP lawyers may use the tool to retrieve more relevant information about the state-of-the-art technologies to prevent their clients from infringing patents or to identify the cases of infringement.

Table 5. Knowledge discovery in the Scientific Communities component of the EK Explorer

Research Questions: Scientific Communities
1. Which actors have the highest/lowest degree of engagement?
2. Which actors have the highest/lowest degree of influence?
3. Which actors have the highest/lowest degree of popularity (impact)?
4. Which actors have the highest/lowest degree of activity?
5. Which actors have the highest degree of research similarity?
6. Which actors have the highest/lowest degree of collaboration?
7. Which actors are the most common potential candidates for collaborative research?

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Table 6. Knowledge discovery in the R&D Networks component of the EK Explorer

Research Questions: R&D Networks
1. Which actors have the highest/lowest productivity?
2. Which actors have the highest/lowest degree of effective contribution?
3. Which actors have the highest/lowest degree of influence?
4. Which actors have the highest/lowest degree of popularity (impact)?
5. Which actors have the highest/lowest degree of activity?
6. Which actors have the highest degree of similarity?
7. Which actors have the highest degree of core technological competence?
8. Which actors have the highest degree of uniqueness?
9. Which actors have the highest/lowest degree of collaboration?
10. Which actors have potential for joint R&D projects?

Table 7. Knowledge discovery in the Scientific Research Management component of the EK Explorer

Research Questions: Scientific Research Management
1. What are the major sub-domains?
2. What are the most impactful research publications?
3. What are the most impactful research publications over the past five years?
4. What are the most/least impactful sub-domains in this area of research?
5. What are the most/least impactful sub-domains over the past five years?
6. What are the main clusters of research?
7. What are the most influential research papers (breakthroughs that build a new stream of literature) in the past 20 years?
8. What are the main theoretical foundations for the influential sub-domains in the past 20 years?
9. To what extent sub-domains are independent from each other?
10. What is the degree of research evolution?
11. What is the degree of research evolution for sub-domains?
12. Which sub-domains have the highest/lowest rate of evolution?
13. Which sub-domains have the highest/lowest rate of evolution over the past 5 years?
14. What are the most/least important themes discussed over the past 20 years?
15. How have the most important research themes transitioned over the past 20 years?
16. Which themes have the highest/lowest strain? (or, which themes have gained the most/least popularity?)
17. Which themes have the fastest/slowest rate of strain?
18. Which themes have got the fastest/slowest rate of strain over the past five years?

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Table 8. Knowledge exploration in the Technology Management component of the EK Explorer

Research Questions: Technology Management
1. What are the major sub-domains of technology?
2. What are the most/least impactful patents in the past 20 years?
3. What are the most/least impactful patents in the past 5 years?
4. What are the major clusters of patents?
5. What are the main technological breakthroughs and sub-domains?
6. What are the main technological foundations for new sub-domains in the past 20 years?
7. To what extent sub-domains of technology are independent from each other?
8. What is the overall degree of evolution of technologies?
9. What is the degree of evolution for sub-domains?
10. Which sub-domains of technology have the fastest/slowest rate of evolution in the past 20 years?
11. Which sub-domains of technology have the fastest/slowest rate of evolution in the past 5 years?
12. What are the most/least important themes over the past 20 years?
13. How have the most/least important themes transitioned over the past 20 years?
14. Which themes have the highest/lowest strain? (in other words, which themes have gained the highest popularity?)
15. Which themes have the fastest/slowest rate of strain in the past 20 years?
16. Which themes have the fastest/slowest rate of strain over the past five years?

Conclusion

Excessive or untimely knowledge exploration may have detrimental impacts for innovativeness and competitiveness of organizations. Despite exploring several moderators to reduce those impacts, as identified by previous research, academic research has thus far failed to propose a conceptual performance measurement tool for ecosystems. The objective of this study was to propose a tool for systematic knowledge exploration in knowledge-based ecosystems. The conceptual tool I proposed here, the EK Explorer, consists of four major components and altogether 39 constructs and measurable variables, which can be used in knowledge-based ecosystems for collaboration, competition, technology management, investment, or policy making purposes.

My study contributes to the intersection of different streams of literature – those relating to ecosystems, knowledge management, and operations management – in two ways. First, I defined a new term "ecosystem knowledge management" to fill the gap between the existing understandings of knowledge management in organizations versus in ecosystems and developed the conceptual EK Explorer tool for systematic knowledge exploration in ecosystems with various new constructs. Second, while research approaches in ecosystem studies are mainly exploratory (Dedehayir et al., 2018) and using data-driven and network visualization approaches for analyzing ecosystems is quite common and popular among scholars (See e.g., Basole et al., 2015; Basole, 2009; Huhtamäki & Rubens, 2016; Russell et al., 2015; Still et al., 2014), using the EK Explorer tool may make the design phase of research less fuzzy.

The EK Explorer tool has two major limitations. First, as mentioned earlier, the only sources of codified technical knowledge for the inputs of the tool are peer-reviewed sources and, in particular, scientific publications and patents. In technological innovation, although scientific publications and patents may be applicable to the majority of knowledge domains and knowledge-based ecosystems, they are not entirely applicable to all. For example, technical knowledge that is created in software or service ecosystems may not be

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patentable and, thus, should be stored as source codes, algorithms, or as similar sources. To generate insights from sources other than patents and scientific publications, however, the EK Explorer lacks relevant constructs and thus, is not viable. Second, the EK Explorer is not capable of generating insights regarding technology market, commercialization of innovation, and customers.

Future research may focus on designing similar tools that can 1) apply data sources other than scientific publications and patents as inputs and 2) generate market-related knowledge to be used by and for ecosystem actors. In addition, the application of the proposed tool EK Explorer should be tested in empirical contexts to examine whether the tool can disclose similar patterns for individual (behavioural), organizational, regional, national or international strategies in ecosystems. This would then be of great value in formulating relevant hypotheses and building theory.

About the Author

Behrooz Khademi is a Higher Degree by Research Candidate in Technology and Innovation Management at Royal Melbourne Institute of Technology (RMIT) in Melbourne, Australia. He received his BSc degree in Production and Manufacturing Engineering from the National Technical University of Ukraine in Kiev, Ukraine, and his MSc degree in Industrial Engineering and Management from Lappeenranta University of Technology in Lappeenranta, Finland. His research focuses on value creation, value capture, and knowledge management in ecosystems. He applies a variety of scientometric, patentometric, and text mining methods in his research.

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Digital Payments: Impact Factors and Mass Adoption in Sub-Saharan Africa

Leigh Soutter, Kenzie Ferguson, and Michael Neubert

> *"Alas! how deeply painful is all payment!"*
>
> Lord (George Gordon) Byron (1788–1824)
> Poet and politician

This study explores impact factors that affect the adoption of digital payment systems in sub-Saharan Africa. In this article, we investigate the impact factors that subject-matter experts consider most important to the success of FinTech payment models. The data and their responses are evaluated through the lens of Christensen's market-creation theory, which contends that the adoption of market-creating innovations by a mass swathe of heretofore non-consumers "pulls" framework conditions into place, including missing infrastructure and enabling regulation. Then, we compare the findings with the literature and three case studies of mobile money adoption in Kenya, South Africa, and Nigeria. This study addresses a gap in the literature regarding the payment and money transfer segment of FinTech innovations in Africa using a multiple case study methodology. We drew together information from multiple sources, including semi-structured interviews, archival data in the form of industry and regulatory reports, and observational field notes. Our findings suggest that enabling environments (Kenya) do jumpstart adoption and difficult frameworks (Nigeria) do evolve. This study will help FinTech innovators, academics, and policymakers to understand how technology and framework conditions impact payment business models in Africa.

Introduction

New FinTech firms, business models, and customer solutions are entering the sub-Saharan market at increasingly high rates (EY Global, 2019). But, is the explosion of innovation combined with the growing need for new financial services a match made in heaven? With 46 countries, sub-Saharan Africa is a patchwork quilt of framework conditions (Burns, 2018) with a track record of successes as well as false starts for products with good technical specifications (Christensen et al., 2019; FinMark Trust, 2017). The failures typically are pinned on shortcomings such as corruption, infrastructure, regulation, skills shortage, and over-expectations of the emerging middle class (Christensen et al., 2019; Simanis & Duke, 2014; Sun, 2017).

Approximately 60% of adults in sub-Saharan Africa are unbanked (Demirgüç-Kunt et al., 2018; Medina et al., 2017). These non-consumers of formal financial services deal mainly in cash despite academics, development organizations, and governments urging for their participation in the formal economy because financial inclusion is foundational for poverty reduction and economic growth (Demirgüç-Kunt et al., 2018). Christensen, Ojomo, and Dillon (2019) state that, in sub-Saharan Africa, there are great opportunities for businesses that truly understand and enable non-consumers at low margins, and the engagement of the authors sparks institutional evolution and instigates long-term prosperity where the opportunities are adopted.

The purpose of this multiple-case-study is to explore subject-matter experts' perceptions of how demand, technology, and framework conditions impact the success of digital money transfer or payment business models in Africa. The methodology combines multiple sources of evidence, including semi-structured interviews, archival data in the form of industry reports, and observational field notes. Data triangulation is conducted to validate the study's data analysis and findings.

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This study follows a call for research from Gomber, Koch, and Siering (2017), who state that FinTech innovations are based on easy usage and lower cost from the customer perspective and regulation and technological innovations called for a further verification and extension of their findings in other jurisdictions and industries. This study tries to close this gap in the literature by exploring how the dynamic tension between consumers, technologies, and institutions impacts the success of digital payment systems in sub-Saharan Africa.

The article is structured into five parts. The first part covers a brief review of the current literature, introduces the theoretical framework, and describes the case studies. The second part covers the research methodology. The third part presents the findings. The fourth part discusses the findings and compares them to findings of other studies. The fifth part is the conclusion.

Literature Review

Africa's FinTech sector

In sub-Saharan Africa, approximately 60% of the adult population does not use formal financial services (Demirgüç-Kunt et al., 2018). Cash is the predominant method of value exchange, as it is easy to use, widely accepted, and ingrained to a user's psyche as having value (Weichert, 2017). Moreover, there are obstacles to banking such as distance to bank outlets (and risks when carrying cash), lack of trust, daunting paperwork, and overwhelming identity and documentation requirements (Realini & Mehta, 2015).

The main force driving financial inclusion in sub-Saharan Africa is mobile money (Demirgüç-Kunt et al., 2018). Where it has been successful, the market has grown rapidly, for example, increasing from 75 million accounts in 2012 to almost 340 million in 2017 (GSMA, 2018a). In a recent International Monetary Fund (IMF) publication, Sy and co-authors (2019) compare mobile money uptake in 17 economies in sub-Saharan Africa, and their report shows mobile money rapidly surpassing traditional banking for the region. According to the authors, "FinTech is not only helping improve financial inclusion in the region, but it also serves as a catalyst for the emergence of innovations in other sectors, such as agriculture and infrastructure, which promotes economic growth and development." (Sy et al., 2019). However, relevant to the studies examined here, among the 17 economies examined by Sy and co-authors (2019), Kenya ranked second but Nigeria and South Africa ranked near the bottom in mobile money transactions.

Currently, over 260 companies operate in the FinTech sector in sub-Saharan Africa (EY, 2019). The payments segment and the services that enable it to "dominate" the space (EY, 2019). These technologies include mobile money (i.e., making financial payments with mobile devices), electronic money (i.e., storing money in an electronic account), peer-to-peer payments (i.e., financial payments from one person to another through an intermediary, such as a payment app), digital currency (i.e., a currency that is only available in digital form), and blockchain (i.e., a distributed ledger technology), but mobile money is the primary FinTech solution used in sub-Saharan Africa (Sy et al., 2019). EY (2019) projects that payment solutions will dominate the SSA FinTech for the foreseeable future, at least until the need for financial inclusion is sufficiently addressed.

Mobile money business models

Chironga, De Grandis, and Zouaoui (2017) identify five business model archetypes for African mobile money providers (Table 1), according to which segments of the value chain they cover:

1. MNO-dominant in which the mobile network operator (MNO) is responsible for most steps of the value chain
2. MNO-led partnerships in which a banking partner supports the MNO with products beyond payments
3. Bank-led partnerships in which an MNO provides online capability
4. Bank models in which the bank provides the digital services
5. FinTech solutions

Chironga and co-authors (2017) show that MNOs have dominated the mobile money industry in Africa for the past 10 years. They attribute the success of MNOs to three key factors: 1) a large customer base with strong market concentration (i.e., mobile phone penetration compared to banking penetration); 2) a superior client experience; and 3) the ubiquity of the MNOs' local agent distribution networks (e.g., compared to ATMs). The cash distribution agents – which provide local cash-in-cash-out (CICO) services, register accounts and, for mobile phone providers, top up prepaid phone accounts – are the primary way to convert money (e.g., a shoebox of cash) into a digital asset (e.g., e-money in a mobile money account), and they are key to the growth of the mobile money industry (Juma & Wasunna, 2018; Realini & Mehta, 2015).

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Table 1. Mobile money business model archetypes (adapted from Chironga et al., 2017)

	Value Chain Element				
Archetype	**Deposit Holder**	**E-Money Issuer**	**Payment Platform**	**Agents**	**Telecom Channel**
MNO-dominant	Bank	Telco	Telco	Telco	Telco
MNO-led	Bank	Bank / Telco	Telco	Telco	Telco
Bank-led	Bank	Bank	Bank	Bank	Bank / Telco
Bank-dominant	Bank	Bank	Bank	Bank	Telco
Third party	Bank	FinTech	FinTech	FinTech	Telco

Enabling environments for mobile money

Burns (2018) found that the best results of entrepreneurship and experimentation in financial technology do not necessarily occur in nations that devote the most resources to financial inclusion. "Instead, the greatest success stories have occurred in nations where the government has restricted itself to merely creating an 'enabling' environment for entrepreneurs" (Burns, 2018). His study of enabling environments considered factors such as population, economic freedom, whether the country has a dominant telecom provider, regulatory approach, and the number of mobile money accounts. His findings, as summarized in Table 2, show that the countries with "enabling" FinTech regulations have a substantially more mobile money accounts compared to the four "non-enabling" countries.

Another influential factor is the depth of banking and its innovativeness, such as for fundraising innovations (Neubert, 2019). According to Chironga and co-authors (2017), where banking is strong and there are numerous bank outlets (e.g., South Africa), the uptake of mobile money is relatively slow. Their research shows that the maturity levels of mobile money operators are highest where the financial services market is fragmented and where regulators have allowed telecoms to compete (e.g., Kenya and Tanzania). Sleeping giants (e.g., Nigeria) have both a reasonably well-developed banking system and regulations that constrain mobile money operators (Chironga et al., 2017), as the slow and stony development of Paga, a Nigerian FinTech payment solution with today 13 million customers and more than 21,000 agencies, and licensed by the Central Bank of Nigeria, shows (Lepoutre & Oguntoye, 2018).

Sy and co-authors. (2019) describe enabling conditions for network effects, "Policymakers should look beyond the potential benefits of FinTech in just the financial sector to consider the possible impact on employment and productivity, the digital economy, and more broadly, the scope for much needed structural transformation." Thus, FinTech and especially financial inclusion might be considered as drivers for economic growth and prosperity (Naboulsi & Neubert, 2018).

In his seminal work, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail,* Clayton Christensen (1997) describes how established companies lose market leadership to new disruptive innovations that may sacrifice the performance that current customers expect but offer a different package of attributes that can open up entirely new markets. The focus shifts to emerging economies in *Prosperity Paradox: How Innovation Can Lift Nations Out of Poverty* by Christensen and co-authors (2019), who describe disruptive innovations that solve basic problems at low margins for wide swathes of heretofore non-consumers. Their framework for business models in this market includes:

- Non-Consumption: Rather than target customers of existing products, the business aims for would-be consumers who are unable to purchase the existing product because it is too expensive or difficult to use for large segments of the population.

- Enabling Technologies: The business generally involves an enabling technology that improves performance at low cost or provides a competitive edge.

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Table 2. Enabling and non-enabling environments for mobile money in Africa (2007 to 2017) (adapted from Burns, 2018)

	Characteristic				
Country	**Enabling**	**Dominant Telecom**	**Moderate / High Population Density**	**Moderate Economic Freedom**	**Mobile Money Accounts (millions)**
Nigeria	No	Yes	Yes	Yes	< 0.9 (0.5%)
Botswana	No	Yes	Yes	No	< 0.3 (12%)
South Africa	No	Yes	Yes	Yes	< 0.5 (0.01%)
Ghana	No	Yes	Yes	Yes	< 2.0 (7%)
Kenya	Yes	Yes	Yes	Yes	30.00 (80%)
Uganda	Yes	No	Yes	Yes	18.50 (60%)
Tanzania	Yes	No	No	Yes	41.40 (80%)
Zimbabwe	Yes	No	No	No	7.35 (66%)
Somalia	Yes	No	No	No	7.25 (66%)

- Emergent Strategies: The innovator adopts a flexible strategy and learns from their would-be customers to refine products and pursue markets that are not yet defined.
- New Value Networks: Businesses may rethink and radically change traditional inputs, processes, and distribution strategies to make products that are useful and affordable to the heretofore non-consumers.
- Pull Strategy of Development: Non-consumers pull the innovation into their lives, and the job creation, tax flow, and so on "pull" necessary infrastructure and institutions into society.

According to their theory, successful innovators in emerging markets may need to navigate politically and economically unstable environments, without the benefit of ideal institutional guidance and regulation. They may need to reconfigure their value networks to include consumer education and missing fundamental elements that are readily available in a developed economy, including infrastructure, product inputs, peripheral functions, and distribution channels (Christensen et al., 2019; Simanis & Duke, 2014; Sun, 2017). Christensen and co-authors (2019) claim that, while long-term prosperity ultimately requires good governance, market-creating innovations can ignite the economic engine of a country, and the new markets and their network effects pull the required infrastructure and institutions into place.

Examples of FinTech markets in sub-Saharan Africa

Our case studies focus on FinTech journeys with respect to mobile money for Kenya, South Africa, and Nigeria (see Table 3), which are widely regarded as the key technology hubs in sub-Saharan Africa (EY Global, 2019) and accounted for more than two-thirds of total venture funding ($580M USD) in 2017 (GSMA, 2018b).

Kenya

Kenya is the flagship economy of East Africa, the epicentre of mobile money in Africa, and home to mobile money innovator M-Pesa (safaricom.co.ke). Telecom Safaricom launched M-Pesa in Kenya in 2007 when 30% of the population had mobile phones, fewer than 25% of Kenyans had bank accounts, and there were only seven ATMs per 100,000 people (Table 3) (Naboulsi & Neubert, 2018).

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Table 3. Mobile money adoption framework statistics for Kenya, South Africa, and Nigeria

	Country		
Characteristic	**Kenya**	**South Africa**	**Nigeria**
Population (millions) [1]	50 million (2017)	57 million (2017)	191 million (2017)
Informal economy (% of GDP) [2]	33% (2016)	25% (2016)	65% (2016)
ATMs per 100,000 people [1]	7 (2007) 9 (2016)	30 (2007) 68 (2017)	4 (2007) 16 (2017)
Households with a personal computer [1]	0.5% (2000)	14.8% (2007)	5.1% (2007)
Households with a telephone [1]	1.2% (2007)	9.8% (2007)	1.0% (2007)
SIM penetration [3]	30% (2007) 93% (2018)	85% (2007) 172% (2018)	28% (2007) 79% (2018)
Prepaid mobile accounts (% of connections) [3]	97% (2018)	89% (2018)	96% (2018)
Internet penetration [4]	46% (2017)	54% (2017)	48% (2017)
Facebook penetration [4]	39% (2017)	73% (2017)	20% (2017)
Technological readiness (scale 0–7) [1,4]	3.7 (2017)	4.6 (2017)	3.0 (2017)
Mo Ibrahim governance index (scale 0–100) [5]	60 (2017)	68 (2017)	48 (2017)
Moderate economic freedom [6]	Yes (2007–2016)	Yes (2007–2016)	Yes (2007–2016)
Mobile money business model [7]	MNO-dominant	Bank-dominant	Third party
Enabling regulation [6]	Yes (2007–2016)	No (2007–2016)	No (2007–2016)
Mobile money penetration [6]	80.00% (2016)	0.01% (2016)	0.50% (2016)
Mobile money transactions per person [1]	53 (2016)	0.1 (2016)	0.5 (2016)

Sources:
1. World Bank (2019a)
2. Medina et al. (2017) for IMF
3. GSMA (2019)
4. Sy et al. (2019) for IMF
5. IIAG (2018)
6. Burns (2018)
7. Chironga et al. (2017)

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Institutionally, M-PESA was formed in a de facto sandbox. When it launched, mobile money technology had champions in government who saw it as a way to move informal money "out from under the mattress" (Sun, 2017), and neither the communications commission nor the central bank had authority over the service at its inception (AFI, 2010). After accumulating over five million customers in just two years, a formal risk assessment was performed and M-Pesa was officially allowed to operate under non-bank status (AFI, 2010).

M-PESA currently has 15 million registered users (GSMA, 2018a), 40,000 mobile money agents (Safaricom, 2019), and a thriving ecosystem around it (e.g., M-Shwari for loans, Lipa for merchants, M-Tiba for healthcare, and M-Kopa for pay-as-you-go solar). Regulators in Kenya have since taken a "test and learn" approach to regulation of FinTech innovations and formalized sandboxes. Despite significant differences in regulation, M-PESA started to expand quite early to foreign markets, first within sub-Saharan Africa and later into Asia and Eastern Europe, similar to other born-global firms (Neubert, 2017, 2018).

South Africa

In South Africa, approximately 80% of the population has a formal bank account, and the regulatory environment strongly favours banks (Table 3). Still, South Africans mainly deal in cash, and informal merchants are reluctant to use non-cash methods.

Mobile money has not "taken off" in South Africa. A first wave of mobile money effectively ended in 2016 when competitors M-Pesa (vodacom.co.za) and MTN Mobile Money (mtn.com) discontinued offering solutions there. FinMark Trust (2017) autopsied the situation and discovered that, in South Africa, mobile money was plagued by regulatory issues, poorly performing technology, and difficulties with the local agent cash-in-cash-out services.

While the Finmark Trust study (2017) concludes that mobile money can be successful in South Africa with more favourable regulation and new business models, it has not happened yet. However, there appears to be renewed interest for the service in South Africa now, including, for example, public news and press releases for MTN Mobile Money reveal plans to relaunch in South Africa (e.g., plus new interoperability and a Pan-African partnership).

Nigeria

Nigeria has the largest population and largest GDP in Africa, and while oil dominates Nigeria's economy, almost 50% of the population lives in below the international poverty line of $1.90 per day (World Bank, 2019b). Despite mobile phone penetration greater than 75% (Table 3), mobile money is yet to be successful in Nigeria.

The Central Bank of Nigeria (CBN) published its first regulatory framework for mobile payments in 2009 to create an "enabling" environment that promotes financial inclusion. By 2015, there were more than 20 licensed mobile money operators (MMOs) competing in a fragmented environment. They siloed their solutions, failed to simplify the cash-to-mobile money handoff, could not scale or lacked sufficient capital or industry knowledge to be successful (USAID, 2018). The central bank authored new regulation to correct the situation (CNB, 2015a, 2015b), and despite mobile network operators (MNOs) tending to be sufficiently capitalized for this role, the CBN would not license MNOs for mobile money services, apparently owing to anti-monopoly concerns (USAID, 2018). By 2017, mobile money had stalled in Nigeria – there was less than one transaction per adult per year compared to 52 transactions in Kenya (IMF, 2019). However, in 2018, Nigeria opened licensing for mobile money operation to MNOs (CBN, 2018a) and subsequently released additional guidance (CBN, 2018b) for a shared agent network to promote financial inclusion. Within one month of the announcements, the telecom MTN announced plans to obtain licensing and start their mobile money solution in Nigeria (Quartz Africa, 2018).

Research Methodology

A qualitative multiple-case study research design is used to answer the exploratory research questions (Yin, 2017). This research design allows for more flexibility using different sources of evidence, offers the possibility of a cross-case analysis, and can go deeper and in greater detail than a quantitative assessment (Yin, 2017). This research methodology is aligned with the purpose of this study, because we want to explore the perceptions of the interviewed experts (see Table 4) based on their experience in the digital payment system sector in sub-Saharan Africa, including all the complexities and subtleties of innovative technologies in developing markets.

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Table 4. Professional experience of interviewed experts in the African financial service industry

Expert	Education	Professional Level	Professional Experience in Africa	Professional Experience in Finance or Technology?
1	Master	Entrepreneur / Owner	Direct	Yes
2	Master	Entrepreneur / Owner	Direct	Yes
3	Master	Senior Manager	Direct	Yes
4	Master	Senior Manager	Direct	Yes
5	Doctorate	Entrepreneur / Owner	Direct	Yes
6	Master	Senior Manager	Direct	Yes
7	Master	Senior Manager	Direct	Yes
8	Master	Senior Manager	Direct	Yes
9	Master	Entrepreneur / Owner	Direct	Yes
10	Master	Entrepreneur / Owner	Direct	Yes
11	Doctorate	Senior Manager	Direct	Yes
12	Master	Entrepreneur / Owner	Direct	Yes

In this study, we used a purposive sampling strategy of 12 subject-matter experts with strong theoretical, entrepreneurial, and financial backgrounds in markets in sub-Saharan Africa (Yin, 2017). The sample includes experts with professional knowledge about digital payment systems in sub-Saharan Africa. They all hold degrees at the master's level or higher with multiple years of experience as senior managers and entrepreneurs/owners in the financial or technology sector. Additional sources of evidence include interviews, case studies based on regulatory institution data, and industry data.

This multiple-case study uses semi-structured, qualitative, in-depth interviews to collect the perceptions of the experts about the users of digital currencies in sub-Saharan Africa. The questionnaire contains several open questions to answer each of the research questions. Data collection took place in Paris in November 2018 using an online questionnaire. The interviews lasted between 32–46 minutes.

The following three research questions are addressed in this study:

1. How do subject-matter experts perceive the influence and the impact of customer demand on the success of money transfer or payment business models in Africa?

2. What are the perceptions of subject-matter experts about the main technologies to develop new business models for money transfer or payment systems in Africa?

3. What are the perceptions of subject-matter experts about the required framework conditions and success factors to develop new business models for money transfer or payment systems successfully in Africa?

The data analysis used a standardized process starting from the analysis of industry reports, market reports,

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and regulatory documents, followed by the analysis of each interview, a cross-case analysis to compare the similarities and differences, and a triangulation with other sources of evidence to develop themes, which answer the research questions (Yin, 2017). To facilitate the complex data collection and analysis, the analytical software NVivo was used to analyze the unstructured data from different sources of evidence with the goal to produce robust and qualitative research findings, which might be transferred to other settings.

Findings

Customer demand will grow as awareness of the benefits of digital money transfer spreads

All subject-matter experts in this study express that customer demand is critical to the success of the money transfer and payment business models. Most say it is a "precondition" to the success of the business models; however, the answers also convey that increasing awareness is needed to drive demand.

Experts mention that success stories from "neighbouring communities" about products "designed to meet the exact needs of customers" and "competition among such services will stimulate interest and fuel demand". Five in particular note that rural areas and villages will require significant effort. The answers to the first research question have an element of educating consumers on the technology and the benefits that digital money transfer models offer. Most respondents see the target market coming from the informal economy; they mention "unbanked people" and their "unmet needs in the financial sector" being the "large segment of potential clients to target".

Table 5 lists key responses to this question about customer demand and telling quotes from responses from other questions that confirm that the experts see the unbanked informal economy to be the main audience for the new business models.

The answer to the first research question, "How do subject-matter experts perceive the influence and the impact of customer demand on the success of money transfer or payment business models in Africa?", is that customer demand is necessary for success but needs to be stimulated. In other words, demand will grow as the new businesses solve customer problems and awareness of their benefits spreads, which is consistent with findings by Ferguson and Neubert (2019). The expert responses suggest the primary customers will be largely unbanked, and this is supported by the record of mobile money in Kenya (i.e., in the current case study) and growth of mobile money elsewhere in Africa (Chironga et al., 2017; Demirgüç-Kunt et al., 2018; GSMA, 2018a). In terms of the theoretical framework, this appears to be a classic non-consumption opportunity as described by Christensen and co-authors (2019), who claim that much wealth can be created by efficiently solving "jobs to be done" for bottom-of-the-pyramid customers.

Functional and affordable mobile platforms are central to new business models for digital payment systems in sub-Saharan Africa

Table 6 lists key responses to the second research question. The subject-matter experts unanimously project that new business models for money transfer and payment systems in sub-Saharan Africa will hinge on affordable mobile platforms. Throughout the answers is a fundamental concern for penetration, stability, and transaction speed of connections (cellular, broadband, or Wi-Fi). Two suggest SMS text messaging in particular to perform transfers, presumably due to concerns for lower cost and connection stability.

Six respondents mention security features such as voice, fingerprint, and face recognition to simplify use and offer security, tools such as near field communication (NFC) and encryption, and other risk control measures including insurance and dispute-resolution technologies. Several experts explicitly or implicitly mention ancillary programs so customers "learn [how to work the technology] using applications." Big data and analytics are suggested by three experts for "monitoring of new services" and access to other products such as credit and financing.

New digital money transfer and payment systems in sub-Saharan Africa need to de-risk, lower the cost, and simplify the sending and managing of money

Lowering costs and simplifying the user experience is an important theme within seven responses. The subject-matter experts mention applications for "low-cost" or "free" money transfers and eliminating expensive intermediaries. Three experts call explicitly for direct peer-to-peer transfers, peer-to-peer lending, and, to a lesser extent, crowdfunding. Others call for tools that aid "overall money management including planning and budgeting".

Four respondents specify blockchain (which also enables peer-to-peer transfers) as an underlying technology and four mention cryptocurrency, noting price stability in international transfers (relative to inflation), reduction in exchange charges, enhanced security and

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Table 5. Selected quotations from interviewees in response to questions about customer demand (Research Question 1) and deeper questioning (i.e., about the informal economy)

Category	Quotations (Examples)
Customer demand	• "Customer demand is a precondition for the development of business models" • "Customer demand will shape the business models in Africa" • "Convenience and low cost will drive demand; demand will drive use; use will drive network effects, which will add further convenience and functionality and competition" • "Continuous demand (for MPesa) obliged regulators to implement new regulations and frameworks" • "Customer demand is the reason of the success of money transfer business in Africa" • "As soon as they see success stories from their neighbouring communities, they may also show interest" • "Due to the education level, it may take quite some time until the people from Africa adapt to these developments" • "Competition among such services may also increase, and rural villages may develop in a better way" • "The biggest advantage that MPTS (mobile payment and transfer system) models had over traditional channels is that they were designed to meet the exact need of customers, should they be related to a specific service (money transfer), availability in a specific country, or reaching customers where others can't (rural areas)"
Informal economy	• "In the African environment, the level of unbanked people and the number of unmet needs in the financial sector are probably very appealing to new MPTS (mobile payment and transfer system) models as they would have a large segment of potential clients to target which are not being currently served" • "New technology that enables more access to credit and financing; especially where it enables participants from the informal sector" • "Many of these new technologies hold promise of bringing money that has been sequestered in informal businesses to the larger economy, democratizing access to capital, and increasing the user base in general"

the potential to shorten transfer times. Although one respondent claims blockchain and distributed ledger technology have great potential to "overhaul" value transfer systems, others point to limitations including unreliable Internet and regulatory concerns that make their widespread use impractical in present-day sub-Saharan Africa.

The answers to the second research question, "What are the perceptions of subject-matter experts about the main technologies to develop new business models for money transfer or payment systems in Africa?", show that the respondents believe the current growth of digital payment systems in sub-Saharan Africa will facilitate the success of innovative technologies. We also reported this finding in our previous study (Ferguson & Neubert, 2019). Consistent with the literature (e.g., EY, 2019; Sy et al., 2019), the expert responses suggest that the main focus for the near future is innovation that makes mobile money transfers and payments platforms functional, accessible, easy to use, and affordable. While the experts say cryptocurrencies and blockchain-based platforms could be used "under the hood" to improve mobile money models, not all are convinced that they will replace traditional digital payment systems. Our experts' call for an abundance of supporting features to aid learning and adoption may not be supported by theory, as Christensen and co-authors (2019) caution that a parsimonious approach to product development for bottom-of-the-pyramid opportunities may

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Table 6. Selected quotations from interviewees in response to questions about technologies (Research Question 2)

Category	Quotations (Examples)
Technology	• "A money transfer system needs to be cheaper to succeed in Africa" • "Smart-phones – easy and fast to use and to learn using applications – very high importance" • "Other software and online tools for aiding overall money management including planning and budgeting" • "International and domestic money transfers via SMS" • "Shops like Western Union that enable transfer of funds via cash" • "Peer-to-peer lending is one of the top technologies to develop new business models in Africa for money transfers" • "Many value transfer systems will be overhauled to run on blockchain" • "Big data and cloud services to help storage, analysis and monitoring of new services" • "Big data + AI + ML + IoT – New technology that enables more access to credit and financing; especially where it enables participants from the informal sector" • "Dispute revolution: Convenient, low-cost, efficient, and effective dispute resolution" • "Insurance: Protection against fraud and identity theft or other cyberpiracy"

be required. Thus, businesses need to learn about their customers and focus on the features they can and will use. In the case of Kenya, M-Pesa began with low prices and a simple time-saving product. It was only after they reached a critical mass that the M-Pesa ecosystem began to develop.

Technology infrastructure, customers, and favourable regulation are required framework conditions for successful new money transfer and digital payment system models in sub-Saharan Africa

The respondents generally agree that three key framework conditions are critical to developing new business models for money transfer and payment systems in sub-Saharan Africa.

Ten subject-matter experts mention the extent and quality of technology infrastructure as a framework condition necessary for the success of the new business models. They especially focus on "reasonably priced, secure internet connectivity" and the ability "to connect with rural areas." Nine respondents also mention penetration of Internet / mobile phone users (i.e., potential customers). Nine experts express concern that heavy-handed regulation will hinder FinTech entrepreneurs and slow adoption. Several point to Kenya's wait-and-monitor approach and sandbox licensing as a success. One expert mentioned RegTech innovations (i.e., regulatory technology: the use of technology to meet compliance requirements) "to enable a better understanding and monitoring of the new mobile ecosystem".

Throughout the responses is an eye toward cooperation and collaborations that facilitate consumer adoption. For example, one expert mentions payment incentives to achieve "network effects" with government and employer payments (inbound) and discounts on taxes, bus tickets, and point-of-sale transactions (outbound). One cautions against a fragmented market with unhealthy competition that slows uptake with siloed solutions, and digging deeper, we see concern for regulation that limits "bank–FinTech collaboration" and "cross-sector partnerships".

The answers to the third research question, "What are the perceptions of subject-matter experts about the required framework conditions and success factors to develop new business models for money transfer or payment systems successfully in Africa?", reveal that the respondents view technology infrastructure, customers, and favourable regulation as key framework conditions for the new businesses (see Table 7), and this finding is consistent with our previous work (Ferguson & Neubert, 2019). A deeper look at the responses also reveals that cooperation and collaboration (e.g.,

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Table 7. Selected quotations from interviewees in response to questions about framework conditions and success factors (Research Question 3)

Category	Quotations (Examples)
Customer	• "Penetration of smartphone usage among potential customers (including low cost and availability)" • "The level of unbanked people and the number of unmet needs in the financial sector is probably very appealing to new MPTS (mobile payment and transfer system) models as they would have a large segment of potential clients to target which are not being currently served"
Technology	• "Technology, physical infrastructure, and training required to provide Internet / phone access" • "Communication infrastructure to connect with rural areas" • "Technological infrastructure (high-speed Internet access to allow instant peer-to-peer payments" • "Cybersecurity should be as innovative as the new channels implemented to ensure a higher protection to clients, the platform, and the suppliers"
Institutions	• "Identity verification" • "Regulation (smart regulation, consumer protection, privacy, provider must guarantee payments)" • "Experimental regulatory approach to new technologies, with a focus on customer protection" • "Political and economic stability" • "A fragmented market with multiple players may hinder the path to the critical tipping point. If there are too many players with closed systems, it will be difficult to reach the critical mass required."
Collaborative / synergistic effects	• "Network effects: Inbound Payment Incentives (such as government payments, employer payments, and the like)" • "Network incentives: Outbound Payment Incentives (such as points or discounts on taxes, bus tickets, Uber, point-of-sale transactions, and other transactions)" • "Fintechs, telecommunication operators, financial institutions, and the government should work together in a common ground" • "Big data and cloud services help storage, analyze, and monitor the new services"

within and between leadership, institutions, and competitors) are important success factors. We found support in the literature, regulatory records, and industry reports for conclusions regarding technology infrastructure (Sy et al., 2019), customer base (Demirgüç-Kunt et al., 2018), regulation (Burns, 2018), and collaboration (Chironga et al., 2017). Christensen and co-authors (2019) contend that framework conditions evolve with technology adoption, and the opportunity size warrants dealing with lack of infrastructure and inefficient institutions and internalizing essential activities even if they are not core to the business. Indeed, a look at the case studies shows the regulatory stance of Kenya and Nigeria evolved over time, and in the case of Nigeria there are explicit calls for cooperation collaboration on interoperability and money agent networks.

Discussion

Framework

The findings presented above confirm our previous research, and in this section, we adopt a framework presented in Ferguson and Neubert (2019) to the lens of non-consumption described by Christensen and

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co-authors (2019). Our framework in Figure 1 consists of three main factors that impact the adoption of digital money transfer and payment systems in Africa: 1) Customers, 2) Technology, and 3) Institutions. The solid black lines represent interactions and the dashed gray lines represent the flow of funds. Arrows in the figure point in both directions as the customer base, products, and supporting institutions interact and evolve together through customer adoption.

Customer

Our review of the literature and the expert responses shows that the primary customers for the new payment and money transfer systems generally spend cash and participate in the informal economy. The link from the entrenched product (cash) to the customer is a reminder that, in terms of Christensen and co-authors (2019), this is a classic market-creating opportunity that addresses a massive low-income customer base at low margin. In Figure 1, the black two-way connections between the Customers, Technology, and Adoption represent the customer focus that will be needed to generate demand and ultimately adoption (Theme 1). Understanding, teaching, and iterating with the customer in their environment will be central to innovating a product that solves the customer's "job to be done" in a way that breaks cost and usability barriers (Christensen et al., 2019).

Technology

Our research shows that the new digital money transfer and payment systems in sub-Saharan Africa should be based on readily available affordable mobile platforms (Theme 2) with front ends that radically simplify, lower the cost, and de-risk the sending and managing of money (Theme 3). As a group, the findings appear largely agnostic to the particular technologies "under the hood" except to underscore the need for improved technology infrastructure and the important roles of customer security, big data and analytics (e.g., features, regulation, and training). They also auger that blockchain and cryptocurrency innovations have great potential (i.e., to reconfigure the value chain, accomplish more, lower costs, and do this in a way that is invisible to the user), but see many uncertainties (e.g., regulation and transaction limits).

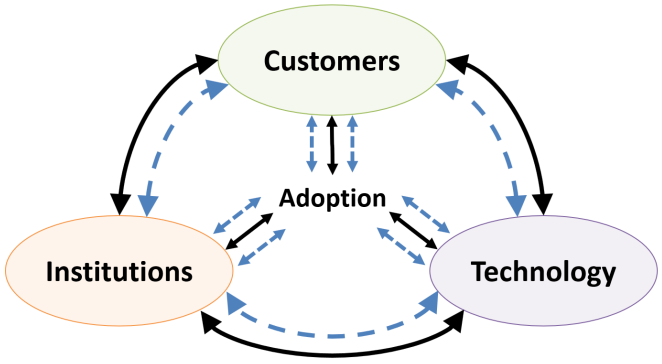

Figure 1. Framework of factors that affect FinTech adoption in sub-Saharan Africa

Institutions

Our experts include good technology infrastructure and regulation as necessary conditions for the success of the industry (Theme 5) but also allow that these may evolve with the market. The view that institutions and governance evolve with technology and market needs is consistent with the work of Christensen and co-authors (2019), who shows that market-creating innovations can "pull" enabling conditions into place; for example, they produce jobs to make, market, distribute, and sell the new products, and the profits flow as taxes to fund public missing services in society, government and regulators, education, infrastructure, and health care. Consider the M-Pesa ecosystem in Kenya. In Figure 2, the arrows to and from Institutions represent technology regulation, market regulation, and infrastructure spending (Technology). Likewise, there is regulation for customer protection and spending for supporting services (Customer). We also multiply the number of arrows to and from Adoption to represent momentum gains from collaboration and synergies as the customer base, the technology, and the institutional framework increasingly manifest an enabling environment (e.g., institutional evolution in Nigeria). In terms of our theoretical foundation, Christensen and co-authors point out that market-creating innovations have fueled the institutional and economic emergence of many countries (e.g., the United States, Japan, and South Korea) and claim they can do the same for Africa (Christensen, 2017; Christensen et al., 2019).

Comparison to our previous study

In a previous study (Ferguson & Neubert, 2019), we analyzed the same database through the lens of Gourville (2005, 2006) and presented a framework with three main impact factors that affect innovation adoption of digital payment systems in Africa: 1) Technology Innovation, 2) Regulation, and 3) Customer Demand. In the current study, which analyzes the data through the lens of Christensen and co-authors (2019), the impact factors we identify are: 1) Customers, 2) Technology, and 3) Institutions (Figure 2). In the previous interpretation (Ferguson & Neubert, 2019), Demand and Innovation are

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part of the framework conditions, but in the current interpretation (Figure 1) demand and innovation are evolutionary processes. In the current article, we also use the more generalized term Institutions as a catch-all for aspects of good governance (e.g., regulation, institutions, supporting infrastructure and services). More importantly, we mention the centre of our theoretical framework "Customer" first – the customers effectively co-design the product and, by "pulling" it into their lives, they bring about the necessary institutions to support the industry.

Conclusions

This article contributes to the body of research on FinTech services by looking into impact factors for the successful adoption of digital payment and money transfer systems in Africa through the lens of the theoretical framework by Christensen and co-authors (2019), who champion low-margin market-creating innovations that target non-consumption. We provide a framework of the impact factors (customers, technology, institutions) and their relationship to adoption that can be used by FinTech innovators and policymakers when considering opportunities in emerging markets. This work follows a previous study (Ferguson & Neubert, 2019), which analyzes the same fundamental data through the lens of Gourville (2005, 2006).

In this article, we specifically identify the primary market for new money transfer and digital payment in Africa as non-consumers of formal financial services that are relatively new to technology. Our study shows that generating demand likely will involve stimulating awareness and educating customers. To create this market will require innovation that radically simplifies, lowers the cost, and de-risks money transfers, but the particulars of the technology are less important than the cost and usability.

The experts see a large customer base, technology infrastructure, and a favourable regulatory/institutional environment as pre-conditions for success, but they understand that these co-evolve as the market develops. This is supported by Christensen and co-authors (2019), who claim that institutional development is ineffective when top-down, and instead market-creating innovations trigger a "pull strategy" of institutional development that leads to prosperity. We point to the rapid adoption and growth of the mobile money under favourable framework conditions (Kenya) to show the potential for FinTech innovation on the continent. We also recognize that, on longer time frames, the co-evolution of technology, institutions, and demand are paving the way for renewed opportunities in Nigeria in particular and across Africa in general.

Our findings support the conclusion that mobile money is the foundation for the success of other digital money and transfer business models (EY, 2019). Further research, specifically quantitative research, is recommended to test the proposed framework. This article identified three additional areas for further study: FinTech adoption in individual markets because of the vast diversity within Africa; collaborations (e.g., cross-sector and pan-African), their regulation, and the growth of the industry; and FinTech innovations that accommodate the transfer of unbanked assets to the formal economy (e.g., unique identification, credit scoring, asset digitization, and registry).

We close by reminding the reader that the FinTech industry is positioned to enable sustainable growth in the economy of sub-Saharan Africa (EY Group, 2017) and holds the potential to improve the lives of hundreds of millions of citizens (Demirgüç-Kunt, 2018).

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Keywords: FinTech, mobile money, payments, blockchain, sub-Saharan Africa, non-consumption, adoption

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