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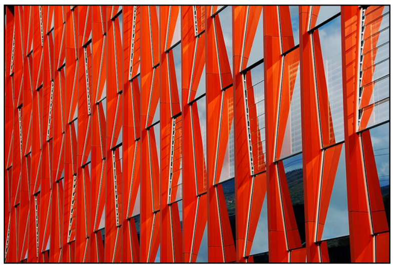

Insights

Welcome to the July 2014 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.

Carleton University

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Overview

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

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

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Editorial: Insights

Chris McPhee, Editor-in-Chief

Welcome to the July 2014 issue of the *Technology Innovation Management Review*. In this issue, our authors present insights about business models for the Internet of Things; standards and platforms in the video game industry; improvisation in entrepreneurship; the relationship between commercialization and societal benefits; value co-creation in knowledge-intensive business services; and ambidextrous strategies for innovation in firms.

In the first article, **Mika Westerlund**, **Seppo Leminen**, and **Mervi Rajahonka**, from universities in Finland and Canada, investigate the challenges of designing business models for the Internet of Things. In light of two underlying trends – the shift from viewing the Internet of Things as a technology platform to a business ecosystem, and the shift from firm-centric business models to ecosystem-centric business models – they argue that "value design" is a preferable concept to "business model" when evaluating the different ways that value is created and captured in a business ecosystem. By identifying four interconnected "pillars" representing the drivers, nodes, exchanges, and extracts of value, the authors lay the foundation for a new design tool to help managers focus on value opportunities and develop business models that complement other actors within the emerging Internet of Things ecosystem.

Next, **Mikael Laakso** and **Linus Nyman** from the Hanken School of Economics in Helsinki, Finland, retrace the evolution of the video game industry to show how technological standards and platforms can enable commercialization and innovation. From the earliest computer games and arcades to consoles and mobile games, the authors examine the emergence and consolidation of standards and platforms and reveal how they mitigate fragmentation and enable higher-level innovations that span multiple standards or platforms.

Tom Duxbury from Carleton University in Ottawa, Canada, reviews the role of improvisation in helping startups adapt to changing environments. Duxbury argues that entrepreneurs improvise not just out of necessity, but because they self-select entrepreneurship as an occupation that matches their own disposition towards improvisation. He shares entrepreneurial lessons from contexts in jazz and theatre and recommends that evidence of past success with improvisation be used to select candidates for improvisational work.

Sandra Schillo from the University of Ottawa, Canada, examines the goal of achieving positive contributions to society through publicly funded science and the perception that it may be in conflict with the restrictions many commercialization arrangements place on the use of knowledge. Although compatibility is not a given in all cases, Schillo argues that commercialization can be a complementary or even critical component of pursuits toward societal contributions. Her article seeks to reframe the discussion of how science can contribute to society in an era of increased openness and interaction.

Lysanne Lessard from the University of Ottawa, Canada, proposes a framework for the design and management of engagements with knowledge-intensive business services. Through multiple case studies of academic R&D service engagements, Lessard examined i) the alignment of actors' interests, value propositions, and resources, and ii) the actors' ability to integrate the engagement's deliverables and outcomes as a basis for their perception of the engagement's value. The resulting framework is intended to help firms monitor and manage collaborative relationships in which they are providing knowledge-intensive business services.

Nehemiah Scott from the University of Toledo, USA, proposes a framework for continual innovation based on a firm's ambidextrous strategies and priorities. Scott modifies the concept of ambidexterity (i.e., exploration, exploitation, coordination) to reconceptualize business, marketing, and information-systems strategies as ambidextrous strategy constructs. He also discusses the relationships between constructs and the implications of this reconceptualization for researchers and managers.

Finally, this issue also includes a report on a recent TIM Lecture by **David Harris**, Director of the Laboratory for Analytic Sciences (LAS; ncsu-las.org). The LAS is a government, academic, and industry collaboration whose mission is to imagine, investigate, and implement innovative classified and unclassified solutions for a variety of tactical and strategic analytic challenges, including those related to cybersecurity. Harris introduced the laboratory and its analysis framework, including a collaboration tool used to help improve the lab's efficiency and enhance its analytic approach.

Editorial: Insights

Chris McPhee

We hope you enjoy this issue of the TIM Review and will share your comments online. Please contact us (timreview.ca/contact) with article topics and submissions, suggestions for future themes, and any other feedback.

Chris McPhee
Editor-in-Chief

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Keywords: business models, business ecosystems, Internet of Things, value design, standards, platforms, improvisation, entrepreneurship, publicly funded research, public good, value co-creation, knowledge-intensive business services, ambidexterity, innovation, strategy

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 and BScH and MSc degrees in Biology from Queen's University in Kingston. He has over 15 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.

Designing Business Models for the Internet of Things

Mika Westerlund, Seppo Leminen, and Mervi Rajahonka

> *New web-based business models being hatched for the Internet of Things are bringing together market players who previously had no business dealings with each other. Through partnerships and acquisitions, […] they have to sort out how they will coordinate their business development efforts with customers and interfaces with other stakeholders.*
>
> Stefan Ferber
> Director for Business Development of the Internet of Things & Services at Bosch Software Innovations GmbH
> HBR Blog Network, May 7, 2013

This article investigates challenges pertaining to business model design in the emerging context of the Internet of Things (IOT). The evolution of business perspectives to the IOT is driven by two underlying trends: i) the change of focus from viewing the IOT primarily as a technology platform to viewing it as a business ecosystem; and ii) the shift from focusing on the business model of a firm to designing ecosystem business models. An ecosystem business model is a business model composed of value pillars anchored in ecosystems and focuses on both the firm's method of creating and capturing value as well as any part of the ecosystem's method of creating and capturing value. The article highlights three major challenges of designing ecosystem business models for the IOT, including the diversity of objects, the immaturity of innovation, and the unstructured ecosystems. Diversity refers to the difficulty of designing business models for the IOT due to a multitude of different types of connected objects combined with only modest standardization of interfaces. Immaturity suggests that quintessential IOT technologies and innovations are not yet products and services but a "mess that runs deep". The unstructured ecosystems mean that it is too early to tell who the participants will be and which roles they will have in the evolving ecosystems. The study argues that managers can overcome these challenges by using a business model design tool that takes into account the ecosystemic nature of the IOT. The study concludes by proposing the grounds for a new design tool for ecosystem business models and suggesting that "value design" might be a more appropriate term when talking about business models in ecosystems.

Introduction

According to Gershenfeld and Vasseur (2014) the impressive growth of the Internet in the past two decades is about to be overshadowed as the "things" that surround us start going online. The "Internet of Things" (IOT), a term coined by Kevin Ashton of Procter & Gamble in 1998, has become a new paradigm that views all objects around us connected to the network, providing anyone with “anytime, anywhere” access to information (ITU, 2005; Gomez et al., 2013). The IOT describes the interconnection of objects or “things” for various purposes including identification, communication, sensing, and data collection (Oriwoh et al., 2013). “Things” range from mobile devices to general household objects embedded with capabilities for sensing or communication through the use of technologies such as radio frequency identification (RFID) (Oriwoh et al., 2013; Gomez et al., 2013). The IOT represents the future of computing and communications, and its develop-

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ment depends on dynamic technical innovation in fields such as RFID, sensor technologies, smart things, nanotechnology, and miniaturization (ITU, 2005).

The strategic research agenda of the Cluster of European Projects on the Internet of Things (CERP-IoT, 2009) suggests that the IOT is expected to change business, information, and social processes, and provide many unforeseen possibilities. According to Kyriazis and Varvarigou (2013), the dynamic, rapidly changing, and technology-rich digital environment of the IOT enables the provision of added-value applications that exploit a multitude of devices contributing to services and information. Moreover, they add that, as technologies for the IOT mature and become ubiquitous, emphasis will be put upon approaches that allow things to become smarter, more reliable, and more autonomous. However, research on the IOT and related business models from the ecosystem perspective have been virtually nonexistent, because the scarce studies on the IOT have focused on the technological platform and a single firm's business models (Uckelmann et al. 2011; Leminen et al., 2012). Therefore, this study examines business model design under the transition from company-specific business models towards networked and more comprehensive ecosystem business models. In particular, the study focuses on the challenges that hinder the emergence of IOT business models.

This conceptual study is organized as follows. First, after this brief introduction, we review the theoretical background of paradigm changes regarding ecosystems and business models related to the IOT. Second, we discuss the major challenges of designing business models for the IOT. Third, we approach these challenges by proposing grounds for a new tool for designing ecosystem business models for the IOT. Finally, we conclude by reviewing our key implications.

Theoretical Background

In today's networked world, businesses are becoming parts of complex business ecosystems. This complexity increases when transforming from centralized towards decentralized and distributed network structures (Barabasi, 2002; Möller et al., 2005). Different structures emphasize different types of activities in the ecosystem, and a continuously increasing level of complexity calls for new types of value systems (cf. Möller et al., 2005). Muegge (2011) describes business ecosystems as institutions of participation "where organizations and individuals typically self-identify as an ecosystem, both in their own internal discourse and in the brand identity they convey to others". He also points out that a business ecosystem refers to an organization of economic actors whose individual business activities are anchored around a platform, and that a platform is an organization of things.

The technological platform forms the core of a business ecosystem (Cusumano & Gawer, 2002). Muegge (2011) defines a platform as a set of technological building blocks and complementary assets that companies and individuals can use and consume to develop complementary products, technologies, and services. Furthermore, Muegge (2013) presents a system of systems view (i.e., an "architecture"), according to which a *platform* is an organization of things (e.g., technologies and complementary assets), a *community* is an organization of people, and a *business ecosystem* is an organization of economic actors. Therefore, the core of an IOT ecosystem refers to the interconnections of the physical world of things with the virtual world of Internet, the software and hardware platforms, as well as the standards commonly used for enabling such interconnection (Mazhelis et al., 2012).

Moore (1996) defines a business ecosystem as "an economic community supported by a foundation of interacting organizations and individuals." A business ecosystem includes customers, lead producers, competitors, and other stakeholders. He argues that the leadership (keystone) companies have a strong influence over the co-evolutionary processes. Peltoniemi (2005) refers to systems theory by arguing that "the system is more than the sum of its parts" and reminds us that the operation of the system cannot be understood by studying its parts detached from the entity. She also argues that a socio-economic system such as a business ecosystem is a complex adaptive system, and that its population develops through co-evolution with the greater environment, self-organization and emergence (i.e., the ability and process to create new order), and adaptation to the environment.

From the business model of a firm to ecosystem business models

Since the early 2000s, the concept of "business model" has surged into management vocabulary, and the use of the term has become fashionable (Shafer et al., 2005). It is a powerful concept (Zott & Amit, 2008) and has become of increasing importance since the dot.com era (Demil & Lecocq, 2010). The academic research into business models is under developed, with no commonly accepted view of what the business model should consist of (Morris et al., 2005; Osterwalder et al., 2005; Schweizer, 2005). According to Zott, Amit, and Massa (2011), previous literature has viewed a business model in a multitude of ways, including a statement, a description, a representation, an architecture, a conceptual tool or model, a structural template, a method, a pattern, and a set. Furthermore, they found that the business model is often studied without an explicit definition of the concept.

In general, the thinking around business models has changed over the past decade. According to Achtenhagen, Melin, and Naldi (2013), there has been a fundamental change from "what business models are" towards understanding "what business models are for". There seems to be a consensus among scholars that a business model spells out a particular firm's way of doing business (cf. Osterwalder et al., 2005; Rajala & Westerlund, 2008; Casadesus-Masanell & Ricart, 2010; Teece, 2010). For example, Osterwalder, Pigneur, and Tucci (2005) argue that "a business model is the blueprint of how a company does business". Moreover, business models are understood as entities, breakable into components or various modules. Shafer, Smith, and Linder, (2005) identify up to 20 different business model components categorized into four main areas, and Osterwalder and Pigneur (2010) discuss the various components as nine pillars. Muegge (2012) uses the components view to provide a method of business model discovery for technology entrepreneurs.

Although scholars are unified in their view of the business model as a firm-level construct, they emphasize its systemic nature (Rajala & Westerlund, 2008). For instance, Timmers (1998) describes business model as the "architecture of the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; and a description of the sources of revenues". The literature on business ecosystems suggests the need for a deeper network view on business models (cf. Carbone, 2009; Muegge, 2013). Existing business model templates and frameworks are adequate when examining the challenges faced by single existing organizations but are less suited to analyzing the interdependent nature of the growth and success of companies that are evolving in the same innovation ecosystem (Weiller & Neely, 2013). Considering the development of the IOT field, it is clear that interdependency due to being connected with other actors through technical and business ties is becoming more and more essential.

Pitfalls of Making Money in the Internet of Things

Previous research is nearly silent of the challenges related to monetizing the IOT. Wurster (2014) is among the few to categorize the barriers that prevent companies from moving ahead in terms of making money with the IOT. According to her, the IOT has a major technological impact, which brings about problems for companies. These issues include the challenge of identifying horizontal needs and opportunities, the managerial challenge related to internal team alignment (i.e., matching technology and to the objectives of business developers), and the ways to overcome the market maturity problem for novel IOT technology. We extend this view and identify three contemporary challenges of the IOT, comprising the diversity of objects, the immaturity of innovation, and the unstructured ecosystems. These challenges are generated based on a literature review and discussions with experts on the IOT. Relying on Muegge (2011), these challenges focus on platform, developer community, and business ecosystem spheres of the formation of IOT-based ecosystem business models.

Diversity of objects

The problem of diversity of objects refers to the difficulty in designing business models for the IOT due to a multitude of different types of connected objects and devices without commonly accepted or emerging standards. The IOT is a network of interconnected objects (Evans, 2011), where everything from toothbrushes and sportswear to refrigerators and cars will have an online presence. For all these different kinds of "things", it will be extremely challenging to standardize the interfaces with which they can connect to the Internet. The diversity of objects brings about another challenge for managers given that there are virtually endless ways of connecting an object, a thing, a business, and a consumer together (Leminen et al., 2012). Therefore, a continuum of possible business models is increasing. Whereas recent estimates put forward that there are presently 10 billion connected devices and there will be 50 billion devices by 2020, more than 99 percent of physical objects that may one day join the network are still not connected (Evans, 2011). These estimates suggest that an unprecedented number of objects will be part of the future Internet. In addition, Espada and colleagues (2011) note that more and more physical objects, called "things", are becoming available in digital format. These "virtual objects" are digital elements that have a specific purpose, comprise a series of data, and can perform actions. They integrate with other applications and physical "things", and may require specific business logics (Espada et al., 2011).

Immaturity of innovation
Immaturity refers to the current "mess" of emerging technologies and components: today's quitessential IOT innovations have not yet matured into products and services. They have not yet been standardized or modularized for wider usage and often require engineering work to couple them together in another application area. Modularized objects, including a "plug and play" character of components, are prerequisites for the emerging market. Coupling components together enables developers to experiment and create products and services for an IOT ecosystem, as well as to learn from market experiences when designing business models. The popular model of the technology adoption lifecycle (cf. Moore, 2006) recognizes five types of adopters of innovation, including innovators, early adopters, early majority, late majority, and laggards. The major challenge is to advance from early adopters to early majority, because the business model must allow for "scaling up" the business. The early adopters are willing to tolerate the immaturity of innovation, but the early majority likes to evaluate and buy whole products, including the product, ancillary products, and any related services (Moore, 2006). In addition, Downes and Nunes (2013) argue that big-bang disruption, which is enabled by new digital platforms, such as those underlying the IOT, does not follow the five-step model. Rather, new products are perfected with a few trial users and then are embraced quickly by the vast majority of the market. Again, the innovation must be mature enough for customers to adopt it rapidly.

Unstructured ecosystems
Unstructured ecosystems lack defined underlying structures and governance, stakeholder roles, and value-creating logics. There may not be appropriate or required participants in an emerging ecosystem; for example, IOT operators or potential customers could be missing. Pursuing new business opportunities demands opening new relationships in new industries, or extending existing relationships, takes time and is a challenge for managers. The complexity of an ecosystem is associated with the number of participants (Möller et al., 2005), and an early ecosystem is an unstructured, chaotic, and open playground for participants. The IOT is still in its infancy, just like the Internet once was. The Internet has been a driver for an incredible richness of rival and complementary business ecosystems that all use the Internet in different ways, such as the ecosystem anchored around Amazon Web Services (AWS), or the ecosystem anchored around Google's AdSense platform, or the mashup ecosystem enabled by open APIs and open data, or the many business ecosystems anchored around community-developed platforms. There is a need for the emergence of keystones that would shape the IOT business ecosystems through business model innovation (cf. Carbone, 2009). However, presently, it is too early to tell which will be the significant yet evolving ecosystems in the IOT field and which participant(s) will become keystone players within them. Such stakeholders could be, for example, an object/device supplier, a supplier of software infrastructure, a supplier of hosted solutions or smart services, an IOT operator, a value-added service provider or a full service integrator, data collector/analyzer, or even an (open source) user community (cf. Carbone, 2009). Therefore, instead of focusing on the key stakeholder(s), it may be better to focus on the generation and capture of value in the ecosystems. The unstructured IOT ecosystems result in the need for IOT-specific business model frameworks that help construct and analyze the ecosystem and business model choices and articulate this integrated value for the stakeholders.

Potential Solutions

We propose that managers can overcome the previously discussed challenges and be able to design feasible business models for the IOT if they change their focus towards an ecosystem approach of doing business and if they use business model design tools that consider the ecosystem nature of the IOT rather than emphasize an individual company's self-centered objectives. These endeavours are discussed in this section.

We suggest that managers need to shift their focus from "the business model of a firm" to "ecosystem business models". However, the term "ecosystem business models" has at least three interpretations in the literature. First, the term can refer to a business model with specific properties – in this case, a business anchored in ecosystem concepts (e.g., the concept of a "green business model" that appeals to ecologically-motivated stakeholders and has specific "green" qualities) (Westerlund, 2013). Second, an ecosystem business model (or category of business models) can be shared by participants of an ecosystem (e.g., the term "fabless semiconductor business model", which implies that all fabless semiconductor firms are more or less the same) (Low & Muegge, 2013). Third, it can refer to a construct at a level of analysis above the firm that explains how the entire ecosystem works towards common goals rather than how the firm-level business works (cf. Bat-

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tistella et al., 2013). However, the third interpretation usually refers to the ecosystem structure and mechanisms rather than focusing on the ecosystem as a business model (Ritala et al., 2013).

Rather than understanding these various interpretations as distinct concepts, this study understands them as different views of the same phenomena. We argue that an ecosystem business model is composed of a set of value pillars (cf. Osterwalder and Pigneur, 2010) anchored in ecosystems, which focus on both the firm's method of creating and capturing value as well as any part of the ecosystem's method of creating and capturing value to the ecosystem.

There have been attempts to define the IOT business ecosystem from the platform perspective (cf. Mazhelis et al., 2012), but the present focus of IOT players on fragmented solutions and applications fails to support these efforts. The basic approach towards understanding IOT business models is looking at the value for all actors in the IOT business ecosystem. This approach identifies the value for the actors that enable the IOT platform. Many telecommunications vendors and operators, as well as IOT platform vendors (e.g., machine-to-machine platform vendors), try to articulate the value of the IOT by using this approach to design their business models. However, the resulting business models are often biased toward the vendor and lack drivers for shared value as one of the explicit components.

This study underlines a need to understand integrated value drivers (i.e., shared overall value for an entire IOT ecosystem) rather than fragmented value drivers (i.e., individual actor's value from specific applications or services). Therefore, this study suggests shifting the focus on value creation and value capture in business models from the company level to the ecosystem level. Business model frameworks for the IOT should assume a higher-level perspective to articulate the integrated value of the IOT rather than address the fragmented value drivers. Weill and Vitale (2001) introduce a set of simple schematics intended to provide tools for the design of e-business initiatives. Their "e-business model schematics" include three classes of business model components: participants (firm of interest, customers, suppliers, and allies), relationships, and flows (money, information, product, or service flows).

Similarly, Tapscott, Lowy, and Ticoll (2000) suggest a value map for depicting how a business web operates. The value map depicts all key classes of participants (partners, customers, suppliers) and value exchanges between them (tangible and intangible benefits and knowledge). By the same token, Gordijn and Akkermans (2001) propose a conceptual modelling approach, the "e3-value ontology", to define how economic value is created and exchanged within a network of actors. Their ontology puts forward a number of useful value-related terms, such as value object and value port. Muegge (2011) argues that the engine driving innovation in an ecosystem is a resource cycle from the platform to the business ecosystem, to the developer community, and back to the platform. He also argues that the developer community is the locus of value creation (innovation) and the business ecosystem is the locus of value capture (innovation commercialization).

Lastly, Allee (2000) argues that a "value network" generates economic value through dynamic and complex exchanges between companies, suppliers, strategic partners, community, and customers and users. According to her, these value exchanges can be mapped as flow diagrams showing goods, services, and revenue streams, as well as knowledge flows, and creation of value. Dynamics, which is visible through the value network perspective, is relevant even when describing business models at a company level. For instance, Casadesus-Masanell and Ricart (2010) argue that a business model consists of a set of managerial choices and their consequences. Each choice may result in different outcome; thus, they drive dynamism. Moreover, they summarize three characteristics of a good business model: it is aligned with company goals, it is self-reinforcing (i.e., dynamic and cyclical), and it is robust. These characteristics support business sustainability in ecosystems (cf. Iansiti & Levien, 2002).

Principles of a Design Tool for Designing Ecosystem Business Models

The major deficits in existing business model frameworks, such as the popular business model canvas (cf. Osterwalder & Pigneur, 2010) or any other component-based design tools include the fact that they focus on the architecture of the business model. They provide "an exploded view", showing the "parts of an engine". However, these frameworks fail to explain the dynamics between the components, or "how the engine works". Because a system cannot be understood by studying its parts detached from the entity, we aim to establish a foundation for a business model tool that considers the ecosystem nature of the IOT and focuses on the action instead of the parts. Previous research has suggested the integration of actors, various resource flows, and value exchange between them to map an

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ecosystem's operation (cf. Battistella et al., 2013; Ritala et al., 2013). Drawing from the ideas presented by, for example Allee (2000) on value networks, our principles for designing ecosystem business models build on different value flows and aspects in the IOT ecosystem.

The relevant literature shares the view that business models are about value creation and value capture. We argue that managers can design viable IOT business models by taking into consideration a variety of aspects related to these two essential value tasks. First, there are different *value drivers* in ecosystems. They comprise both individual and shared motivations of diverse participants, and promote the birth of an ecosystem to fulfill a need to generate value, realize innovation, and make money. We anticipate that a focus on shared value drivers is crucial to create a non-biased, win-win ecosystem. Without respect for the objectives of other actors, a long-term relationship cannot be built. However, each separate value driver will also serve as an individual value node's motivational factor. Sustainability, cybersecurity, and improved customer experience are examples of value drivers that different participants may share in an IOT ecosystem.

Second, these *value nodes* include various actors, activities, or (automated) processes that are linked with other nodes to create value. Moreover, these nodes may include autonomous actors, such as smart sensors, preprogrammed machines, and linked intellingence (avatars). Thus, the ecosystem is a compound of different value nodes; in addition to single activities, automated services, and processes, individuals, or commercial and nonprofit organizations, these value nodes may be groups of such organizations, networks of organizations, or even groups of networks. In short, there is a significant heterogeneity of value nodes in IOT ecosystems.

Third, *value exchanges* refer to an exchange of value by different means, resources, knowledge, and information. The value exchange occurs between and within different value nodes in the ecosystem, and exchanges can be described through different value flows. Literature on value networks (e.g., Allee, 2000) describes these flows as tangible and intangible. Fundamentally, these flows show "how the engine works" by exchanging resources, knowledge, money, and information by different means. In other words, they describe the action that takes place in the business ecosystem in order to create and capture value. Value exchanges are crucial, because they also specify how revenues are generated and distributed in the ecosystem.

Fourth, not all created value is meaningful from the commercialization point of view. *Value extract* refers to a part of ecosystem that extracts value; in other words, it shows the meaningful value that can be monetized and the relevant nodes and exchanges that are required for value creation and capture. Value extract is a useful concept because it can help to focus on a relevant portion of the ecosystem; for example, a manager can "zoom in" and "zoom out" of the ecosystem to focus on something that is beneficial from the business point of view. This portion may be single activities, automated processes, individuals, or commercial and nonprofit organizations, or groups of such organizations, networks of organizations, or even groups of networks and value flows between these nodes. Value extract is helpful in defining the core value and its underlying aspects in the ecosystem.

Finally, the concept of *value design* illustrates how value is deliberately created and captured in an ecosystem. That is, value design is an overall architecture that maps the foundational structure of the ecosystem business model. On one hand, it provides boundaries for the ecosystem and describes the whole entity that creates and captures value. On the other hand, it is a sum of the four value pillars and results in a pattern of operation. In this vein, value design is a concept that is quite similar to the concept of business model. The difference is that, whereas a "business model" is typically associated with the business model of a firm, value design can be defined to apply at the ecosystem level. Thus, we argue that "value design" could be better suited to the context of ecosystems than "business model". In addition, we view that different value designs can be categorized, examined, and compared similarly to different types of business model.

Figure 1 illustrates the key value pillars, which we anticipate to be better suited for designing business models for ecosystems than the components put forward by previous business model frameworks. We believe that these value pillars serve as a basis for a new type of design tool for ecosystem business models. The actual tool needs further research and could likely be built around the idea of value webs and their related illustrations.

There are certainly limitations in our research, but this conceptual study is intended to present the first attempt – "a plum pudding model" (tinyurl.com/36x8pv9) – to create a business model design tool for the IOT ecosystem. Although we have not provided an actual tool or its illustration at the present, the study established

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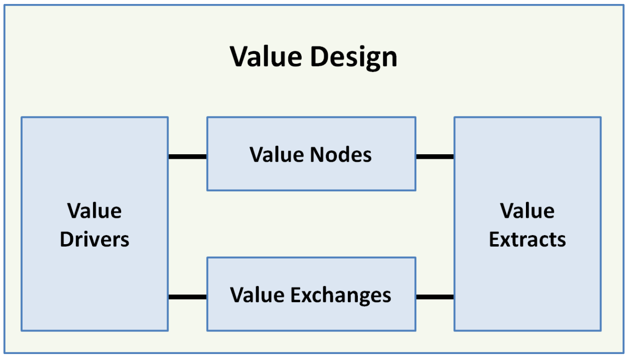

Figure 1. Key pillars of a business model design tool for IOT ecosystems

key pillars of the anticipated tool. Future research should verify these pillars and apply them into practice in order to develop the tool. Therefore, we call for more research on business model frameworks in the emerging IOT context, which is a fruitful field for developing a design tool for ecosystem business models. The IOT field has potential not only to radically change our lives, but also our ways of thinking about networked business.

Conclusions

This research focused on the challenges of designing business models for the emerging Internet of Things (IOT). The study acknowledged that there are ongoing paradigm shifts towards ecosystem thinking both in the discussion of platforms and in the design of business models. The study highlighted three major problems that prevent companies from designing business models and monetizing the IOT; the diversity of objects, the immaturity of innovation, and the unstructured ecosystems. We argue that managers can overcome these challenges and design successful business models if they focus on the ecosystem approach of doing business and use business model design tools that consider the ecosystem nature of the IOT.

We provided grounds for a novel tool for designing ecosystem business models required in the IOT context. The pillars of the tool build on the different aspects of creating and capturing value in the ecosystem. They consist of the drivers, nodes, exchanges, and extracts of value. The pillars are interconnected, and, in contrast to existing business model frameworks, they aim to explain the flows and action of a business model rather than components of the model. That way, they form the value design, which is a concept comparable to that of a business model. This aim underlines a shift in scholarly and managerial thinking from the business model of a firm towards ecosystem business models, in which every participant's business model depends on the others in the ecosystem.

Our study contributes to managerial understanding of ecosystem business models by different means. First, the study addresses the value pillars that managers should be looking at when designing business models in IOT ecosystems. By identifying value pillars, managers will be able to broaden their views on business model development and procedures from a single-company perspective to a broader, ecosystem context. For the ecosystem to bloom, the business models of different actors and the entire ecosystem should somehow resonate; the pieces of the puzzle should fit together. This on one hand guarantees that the ecosystem as a whole moves in the same direction, and on the other hand, guarantee that the business models of different actors are complementary. For example, if one actor wants to streamline its processes, another actor can receive new business by offering new solutions to meet the needs of the first actor. Second, managers may review their existing underlying assumptions on business model design by designing new value nodes and value exchanges in an ecosystem. This change of a mindset is important because it allows managers to view business model design – and later receive related benefits – at an ecosystem level instead of the restricted company level. We argue that our vision of a possible business model design tool can be used for IOT-related issues, but is applicable in other emerging ecosystem-seeking structures where technological solutions are not yet ready and where existing industry borders must be crossed, if necessary. Finally, our value pillars enable managers to focus on value opportunities in the emerging IOT ecosystem by understanding key challenges of ecosystem business model design.

For academics, this study is important because we call for a major shift in business model research. We argue that business models should not be broken down into a number of unconnected components in the way of the majority of previous business model research. Instead, studies should focus on investigating ecosystem business models and the way these models generate and capture value through different value flows. That way, the concept of business model, which is traditionally associated with a single organization's business model, could be replaced with the term "value design", which is better suited to ecosystems.

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Innovation Opportunities: An Overview of Standards and Platforms in the Video Game Industry

Mikael Laakso and Linus Nyman

> *Man will always use his most advanced technology to amuse himself.*
>
> David Crane
> Co-founder, Activision

The video game industry offers insights into the significance of standards and platforms. Furthermore, it shows examples of how new entrants can offer innovative services, while reducing their own risk, through bridging the boundaries between standards. Through an exploration of both past and present, this article aims to serve as a primer for understanding, firstly, the technological standards and platforms of the video game industry, and secondly, the recent innovations within the video game industry that have enabled products to be made available across platforms.

Introduction

Over a billion people worldwide play video games (eMarketer, 2013). The revenues of the video game industry (including consoles, hardware and software, online, mobile, and PC games) for 2013 were estimated to total $93 billion USD (Gartner, 2013). This revenue is significantly larger than, for instance, the box office revenues of all films released worldwide ($35.9 billion [MPAA, 2013]) and global recorded music sales ($15 billion [IFPI, 2014]) for that same year combined.

What has led the industry to such success? Whereas the foundation of a successful game may be that it is "easy to learn and hard to master" (a phrase attributed to Atari founder Nolan Bushnell), the foundation of the success of the video game industry as a whole, we argue, is standardization – and the innovation that has been able to spring from and around its standards.

Standards have the capability to mitigate both technological and market fragmentation by reducing diversity in solutions where multiple solutions to a specific problem compete. Without the restrictive effect of standards, the potential for both innovation and commercialization is significantly hampered due to a lack of common ground to build upon. Furthermore, standards have served to level the playing field, lower barriers of entry, and allow actors both big and small to compete on more even terms.

The article is structured as follows. First, we offer a brief definition of standards and platforms and how they relate to the video game industry. Then we discuss the emergence of video game platforms and their standards. Finally, we discuss recent as well as upcoming changes and innovations in the video game industry – changes that go beyond improvements within a standard to products and services that span multiple standards.

Standards and Platforms

Technology standards come in many varieties and can emerge through different processes. Thus, succinctly defining the term "standard" poses a challenge. The following definition is used throughout this article:

"A standard is an approved specification of a limited set of solutions to actual or potential matching problems, prepared for the benefits of the party or parties involved, balancing their needs, and intended and expected to be used repeatedly or continuously, during a certain period, by a substantial number of the parties for whom they are meant." (de Vries, 2005)

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The spectrum of openness in standards is broad, with potential for complex implications for commercialization (West, 2003). Despite the benefits of technology standardization, the process of settling on a standard can be problematic: it is often, if not always, in tension with technology development. The video game industry has traditionally emphasized having the most advanced graphics and technically impressive presentation. By the time a standard becomes established and widely adopted, it may no longer reflect state-of-the-art hardware or software. Indeed, the video game industry is awash with examples of new innovations and new standards that render previously successful standards all but obsolete. Furthermore, the adoption of a standard – for example, the size of the install base for a specific video game system – influences the availability of software and other complementary products, such as accessories. This network effect creates an environment where a more long-term use of standards and systems is strengthened (Shankar & Bayus, 2003; Prieger & Hu, 2006).

In the video game industry, standards form a key ingredient of platforms (for discussion on the composition of platforms, see, for example: Eisenmann et al., 2008). Indeed, each gaming platform implements a myriad of standards, including those for electric current, connector types, etc. However, for content creators, three central types of standards apply to: i) hardware architectures, ii) operating systems, and iii) software development environments, including both compatibility and compliance guidelines to match the platform holder's requirements. Figure 1 depicts the layered relationships between each of these types of standards. As will be shown throughout the article, innovations in one of these layers affect the others.

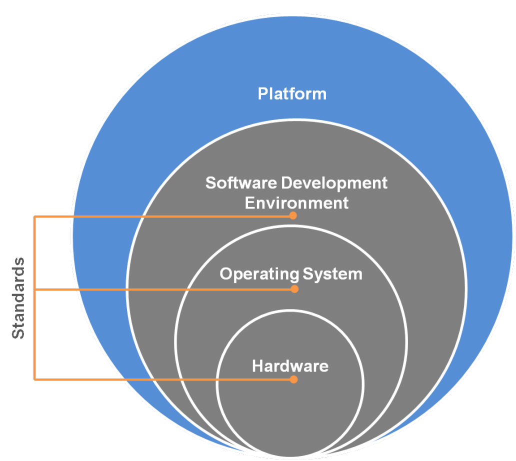

Figure 1. Layers of standards used to create video game platforms

Although standards create platforms, platforms create markets by establishing a common ground between developers and end users. Through platforms, developers know the specific features and functionality of the targeted software and hardware environment, while end users benefit by knowing that adopting a specific platform (e.g., buying a specific video game system) will enable them to access everything developed for it. The adopters of a specific platform define the maximum audience and the content market, while developers produce the content.

The Emergence of Video Game Platforms and Their Early Standards

In this section, we briefly cover the computer, video arcade, console, and mobile phone platforms, as well as the standards that they are built upon. Such an historical overview allows for viewing the bigger picture of the significance of both the initial lack of certain standards, as well as their later emergence. Additionally, how some platforms, regardless of standardization, have fallen out of public favour due to successful innovations in others.

Computer games

The earliest computer games of the 1940s and 1950s were housed within massive, custom-built contraptions intended to showcase what computers were capable of (e.g., Donovan, 2010). These computers could only run the one single (and simple) game for which they were built. However, as computers evolved, video games caught the public interest as a form of entertainment. An early favourite, *Spacewar!*, was released in 1962, making it one of the earliest digital computer games. Computers at the time were not only few and far between, they were also incompatible with other models of computers. Thus, although *Spacewar!* made famous the PDP-1 (tinyurl.com/mquub) computer for which it was written (for details, see the Computer History Museum: tinyurl.com/y9dgav2), it could not be run on other models of computer without rewriting the source code.

Increased standardization was stimulated during the early 1980s by the introduction of IBM-compatible computers, all of which could run MS-DOS. This standardization in turn greatly facilitated game development. As a platform, computers are the most flexible when it comes to choice, because there are multiple viable producers for each major platform standard (i.e., hardware, operating system, software development environment) and users can mix and match between them as they see fit.

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Computers built around x86 processors are currently the dominant hardware architecture, with the main standards for operating systems being Windows, Mac OS, and Linux. For video gaming purposes, Windows remains dominant as the most popular operating system among game developers; however, Mac OS and Linux are seeing an increasing number of high-profile titles released for their platforms as well. Various software development environments are available for all three operating systems, which provide developers with tools to produce compatible software to run on top of the operating system.

Arcade games

In addition to its significance to computer gaming, *Spacewar!* also served as the inspiration for the first arcade game, Galaxy Game (tinyurl.com/mzw8qs4), released in 1971. At that time, arcade games were one-off unique creations: big black boxes designed to accept coins in exchange for the opportunity to play one specific game. Each new arcade game system could largely be designed from scratch, without much concern regarding uniformity in either hardware or software across the line of existing arcade games. The business model was similarly designed around delivering one-off, bite-sized experiences (i.e., insert coin, play the game) without requiring that the consumer buy or invest in the system outright, lessening the need to establish conformity among arcade systems.

Though it took longer than in other video game platforms, arcade games also saw the introduction of influential standards. The Japan Amusement Machinery Manufacturer's Association standard (JAMMA; tinyurl.com/cv88dpk), developed in 1985 by an industry consortium of arcade game developers, made it possible to create more modular hardware, with arcade games programmed on detachable game cartridges. These cartridges, hidden inside the arcade cabinet itself, enabled the arcade owner or operator to change a game while keeping the same arcade cabinet. The same hardware could thus be used to run different software, lowering manufacturing costs for the arcade boards and reducing the need for expensive logistics for switching cabinets around different locations. However, advances in both home computers as well as consoles would soon usher in the end of the golden age of the video arcade. Throughout the rest of the article, focus is placed on other platforms that still have a strong presence today.

Consoles

Video game consoles for home use made their debut in the late 1960s (*TIME*, 2014). The first devices came with only one, or sometimes a few, built-in games, without any possibility of running additional software code. As with arcade games, this one-off nature of the product lessened the need for any strict standards to be implemented, given that the systems were closed from further hardware or software expansions.

A significant development for home consoles came with the release of the first systems for which one could program games for later individual purchase. This advancement also introduced a new source of income and fundamentally different business model for platform holders. It was the Atari 2600 (tinyurl.com/odlwg), released in 1977, that popularized the use of game cartridges. During its heyday, another breakthrough happened in the dynamics of game development for game consoles: third-party development (Barton & Loguidice, 2008). In the past, it had mostly been console manufacturers that created and published games for their own platforms, but third-party development for the Atari 2600 thrived, despite initial legal efforts from Atari to thwart the sale of such games (e.g., Atari & Tengen vs. Nintendo, 1992). Though the relationship between platform holder and third-party developer can usually be assumed to be symbiotic, there have been multiple attempts by software developers to circumvent software licensing fees and potential authentication methods by reverse engineering compatible cartridges (see, for example: Linhoff, 2004).

Although the hardware and software standardization involved in cartridges allowed for compatibility within a console, there was also an effort at creating a cross-company platform standard for consoles. This effort came in the form of the short-lived 3DO project (tinyurl.com/on7gb2n), released in 1993. 3DO was a consortium owned by several manufacturers, allowing anyone within the consortium the right to manufacture a 3DO-compatible console as long as they paid a license fee. This approach can be compared to, for instance, VHS and DVD standards, where anyone could produce compatible hardware.

The major hardware release cycles in the video game industry are commonly referred to as generations, with the latest console releases (e.g., Xbox One: tinyurl.com/n72ba7c; PlayStation 4: tinyurl.com/nfs5yuq; and Wii U: tinyurl.com/8zgpyz3) being Generation 8. A shift from one generation to the next has often left software from previous generations incompatible with the new platform's hardware, meaning that the software library is often thin during the initial launch period. Backwards compatibility has been suggested to facilitate the success of the system (Kramer & de Vries, 2009). However, having to potentially design the new system around old standards for hardware architecture and media format might constrain the degree to which the system can introduce state-of-the-art features.

Mobile phones
Standards played a critical role in the evolution of mobile phones and the subsequent smartphones and tablets. Though appearing several decades later than consoles, mobile phones have in many respects echoed their evolution. Mobile phones, like consoles, initially came with a limited amount of built-in games and without any means of expansion. It was not until the first smartphones that it became possible for users to install additional software on handsets. However, actual widespread adoption of software expansion had to wait for several years due to technological fragmentation and a lack of viable methods for both distribution and payment. Before the App Store, Google Play, and Windows Phone store, the only way to install software on smartphones was to side-load the installation files by first downloading them from the web, potentially paying for them, and then executing the files through a file manager. By standardizing the means of acquiring games and apps, a new – and hugely profitable – market was created.

Mobile phones have evolved from dedicated appliances into small powerful computers. Currently, smartphones and tablets are almost exclusively built around architectures implementing ARM processors on the hardware level. On top of this common ground, differentiation is achieved through hardware configurations and operating systems (e.g., Apple's iOS, Google's Android, Microsoft's Windows Phone). Each of these platforms has their own development environments and storefronts for distributing software. Apple controls the entire stack: hardware, operating system, and software development environment. Microsoft and Android provide the operating system and software development environment; although they do not provide the hardware, they offer guidelines for hardware manufacturers to abide by for compatibility.

With the move to mobile devices (i.e., phones and tablets), many significant changes occurred in the gaming industry. One such change was improved access as games became more readily available on non-dedicated gaming devices. Many, including those that had not previously engaged with games, now carried with them a device on which they could play games. By way of example, in 2013 more than half of US mobile phone owners (125.9 million people) were estimated to have played games on their phone (eMarketer, 2013). The increase in gamers, as well as potential gamers, resulted in the rise in popularity of casual games (e.g., puzzle games and match-three games). Significant changes also occurred on the business model front. Though income initially was generated from selling the games, other business models soon emerged: generating income through ads, through offering in-app purchases, or a combination of the two.

Not surprisingly, developers large and small are responding to the increased demand for mobile games: over 220,000 games were released on Apple's iOS alone during the first four years since its launch, making games the largest category of application overall (Pocket Gamer, 2012). The most financially successful mobile games generate incomes in the millions of dollars per day (Strauss, 2013). However, the rise of the mobile gaming industry has been a significant generator of revenue for platform holders as well, as they take a cut of all sales.

Standardization patterns
As can be seen even from so brief an overview of the evolution of the video game industry, wherever a new form of video game was developed, standardization inevitably followed. Indeed, as games moved out of the arcades and into our living rooms, and more recently onto our mobile devices, the significance as well as proliferation of standards has grown considerably.

Although the triple layer of hardware, operating system, and software development framework is applicable across gaming platforms, there are differences in its implementation. Video arcades are perhaps most notable in this sense in that they did not commonly include an operating system. Modern consoles bundle the entire stack into one product, whereas computers and mobile phones (to varying degrees) allow for variability in the stack by either hardware manufacturers or users themselves.

Over time, development and standards have evolved to become more high-level. Where initially there was very little separating the programmer from the hardware, today development frameworks and other middleware facilitate development by providing toolsets that let programmers focus on creating content rather than having to learn and manage the intricacies of the hardware architecture. High-level development also facilitates porting, meaning releasing games across multiple platforms. A further significant development is that game developers have become more involved in the standardization process. Whereas the console or platform holder previously dictated standards, they now commonly evolve as more of a joint effort among several stakeholders.

Beyond Standards

While innovations such as the App Store and Google Play have made accessing mobile device software easier for consumers, other new entrants have sought to bridge both computer hardware and operating system platform divides. Good old Games (gog.com) offers old games rewritten to work across a broader spectrum of hardware and operating systems. Game publishers have similarly launched their own storefronts, or platforms, combining elements such as digital distribution, digital rights management (DRM), multiplayer, and social networking. The three main storefronts are: Electronic Arts' Origin (origin.com), Ubisoft's Uplay (uplay.ubi.com), and Valve's Steam (store.steampowered.com). These storefronts, commonly available for several different operating systems, provide online purchasing of, and subsequent access to, games by both the publishers themselves and by other developers. However, because these storefronts are not a platform defined at the hardware level, they do not guarantee that the customer's hardware is compatible with the game requirements. Steam is arguably the most successful such storefront, and has to a great extent managed to unify a fragmented computer market despite the diversity in hardware specifications and non-standardized DRM practices across publishers.

Browser-based games also span hardware and operating system divides, allowing access through any platform (not just computers) that offers access to a standard web browser, regardless of hardware or operating system. HTML5 has enabled advanced native web programming functionality, rendering the use of external browser plugins, such as Adobe Flash, optional. Similarly, massively multiplayer online games (MMOGs; tinyurl.com/fzbyv) commonly offer separate game clients for different operating systems, thus allowing common access to a game regardless of operating system.

Some of the most significant platform spanning has occurred in the area of software development environments. Traditionally, developers had to choose, before starting a project, for which platform they wanted to develop their game, and they were subsequently more or less locked in to that platform. Innovations in the industry have granted developers substantial freedom from such limitations. Game development tools such as the Unreal Engine (unrealengine.com) and Unity (unity3d.com) have enabled game developers to work largely independent of platform considerations. These tools make it possible to develop a game first, and then publish to one or multiple platforms upon completion.

In the not-so-distant future, gaming may become almost completely detached from platforms and hardware considerations due to platform spanning on the side of end users. Online video game streaming services, currently pioneered by Onlive (games.onlive.com) and Playstation Now (tinyurl.com/mbbqav5), work like Software as a Service (tinyurl.com/2j3d5z): the actual game being played runs on a remote server. The gamer's controller inputs (i.e., what they want to do in the game) are transmitted to the server, and the video and audio feed of the game (i.e., what then happens in the game) are transmitted back to the gamer's screen. This architecture results in minimal hardware requirements on the user's end, while the back-end at the service provider can be upgraded without the user making any new hardware purchases. However, low-latency, high-speed broadband access is essential for this approach to become commonplace, something that is currently not ubiquitous on a global scale.

During the last two decades, there has been a substantial performance gap between the technological capabilities of stationary versus mobile devices, a gap that has been closing as technology has evolved. Shigeru Miyamoto, the top game designer at Nintendo, recently stated that they are considering the unification of their home and portable console hardware architectures to facilitate more efficient game development (Kaiser, 2014). This unification would mark a historical change in their hardware and software development strategy, which has been split in two distinct components since the 1980s.

Conclusions

The early years of the video game industry were a time of almost exclusive in-house development, with little in the way of standards either within or across platforms. This early phase was followed by a gradual standardization, which opened up the gaming industry to third-party development. More recent innovations have enabled the spanning of platforms, making games more easily available across several platforms, as well as making it easier to develop games for multiple standards.

An Overview of Standards and Platforms in the Video Game Industry

Mikael Laakso and Linus Nyman

The lines between platforms are blurring and unification is happening on many fronts due to the proliferation and advancement of standards, some becoming so integrated that their implementation and use is transparent on the surface. This process is happening both on the side of game development as well as for players.

The gaming industry offers insights into the importance of standardization, but goes beyond that to show the opportunities that exist for those who manage to offer products or solutions either on a higher level of standard, or indeed that can span multiple standards or platforms.

Even an evolving industry can find itself become near-obsolete. Advances and innovations within video arcades were rendered all but irrelevant by advances and innovations in the home computer and console platforms. Now, some believe gaming computers and consoles may be going the way of the arcade due to advances in handheld devices, offering ease of access as well as promising to turn tablets into de-facto gaming computers for the home through streaming services.

As shown through the history of the video game industry, standards traditionally mitigate both technological and market fragmentation. Standards have been used to create technological platforms on to which content creation and commerce can be conducted. However, these platforms have mostly been isolated due to a lack of cross-compatibility, which segments the market for both software developers and end users. It is only recently that platform spanners have emerged for both software developers and end-users, creating bridges between platforms. The hierarchy for the chain of relationships is depicted in Figure 2.

Where an individual platform can be left abandoned by new technological advances being introduced and the market migrating to more modern options, innovative platform spanners do not rely on the success of any single platform. This flexibility benefits all major stakeholders in the videogames industry and facilitates a more inclusive market space where more content is made available on more devices than ever before.

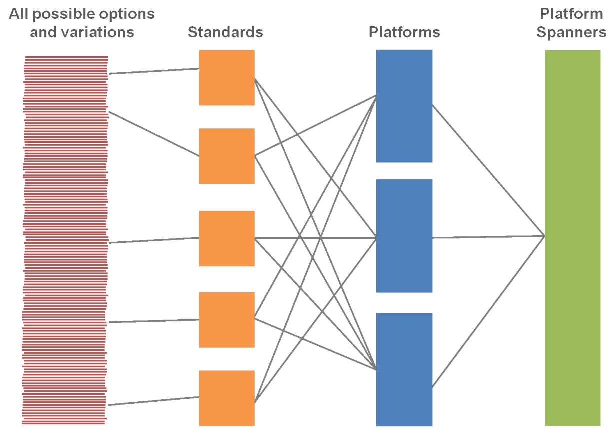

Figure 2. Innovative platform spanners unify standards and platforms with potential benefits to both developers and consumers

Recommended Reading

- *Replay: The History of Video Games* (Donovan, 2010; tinyurl.com/bwu4qyz)
- "For Amusement Only: The Life and Death of the American Arcade" (June, 2013; tinyurl.com/aawzxev)
- "Industry Life-Cycle Theory in the Cultural Domain: Dynamics of the Games Industry" (Peltoniemi, 2009; tinyurl.com/nx27wy9)
- "Structure and Competition in the US Home Video Game Industry" (Williams, 2002; tinyurl.com/lh223ys)
- "Entry into Platform-Based Markets" (Zhu & Iansiti, 2011; tinyurl.com/p5c22uu)

An Overview of Standards and Platforms in the Video Game Industry

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Improvising Entrepreneurship

Tom Duxbury

> *"People in organizations are often jumping into action without clear plans, making up reasons as they proceed, discovering new routes once action is initiated, proposing multiple interpretations, navigating through discrepancies, combining disparate and incomplete materials and then discovering what their original purpose was. To pretend that improvisation is not happening in organizations is to not understand the nature of improvisation."*
>
> Frank J. Barrett (1998a)
> Professor of Management and Organizational Behaviour

Improvisation is reviewed in the context of mainstream routines that modern startups use to adapt to changing environments. The increasing interest in flexible methodologies such as lean startup is one indication that organizations need to consider alternatives when the rate of change exceeds the ability to plan for it. Empirical studies indicate that improvisation is an important, yet understudied part of organizational life in new ventures. It is argued that entrepreneurs improvise not just out of necessity, but because they have chosen an occupation that is congruent with the practice and likely have a disposition towards the behaviour. Lessons from contexts in jazz and theatre are provided for entrepreneurs, and it is recommended that evidence of past success with improvisation be used to select candidates for improvisational work.

Introduction

Improvisation, considered to be as prevalent in organizational life as theatre, has been celebrated both for life-saving creativity, and denounced as a last-ditch failure to plan properly (Cunha et al., 1999; Weick, 1993). In organizations, improvisation is the spontaneous convergence of design and execution while producing something novel (Moorman & Miner, 1998). Improvised behaviours are often observed in entrepreneurial settings, where rapid change and uncertainty in the environment combine with little time or resources for planning alternatives. Improvisation should not be considered the antithesis of planning; rather, it is a coping alternative for situations when change and turbulence exceeds the capacity to plan and adapt. Much anecdotal evidence suggests that improvisation is a trainable skill, and although startups differ in many aspects from jazz combos, lessons about improvisation may be drawn from that context. This article begins with an overview of organizational processes for adapting to uncertain and changing environments today. These processes differ from improvisations, which are described next. The article concludes with an elaboration on three essential cues for improvising entrepreneurs: embracing the process, setting the organizational climate, and selecting team members for the task based upon behaviours.

From Adaptation to Improvisation

There has been much recent attention paid to processes that help startups adapt to changing and uncertain environments, particularly in the field of technology entrepreneurship. A long-standing stream of strategy literature has recognized the need for "deliberately emergent" approaches that adapt to turbulence by embracing cycles of change (e.g., Mintzberg, 1987; Brown & Eisenhardt, 1997). Although the traditional focus of this literature has centered on strategic competitiveness, routines for adaptively achieving product-market fit in new ventures have emerged as well (Blank & Dorf,

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2012). Eric Ries' (2011) lean startup methodology, for example, emphasizes systematic customer experimentation in search of functional business models with minimal misdirected effort. Making strategic adjustments by "pivoting" and retesting business models is integral to the process. Agile software methodologies are based on precepts of adapting to change over following a plan, customer collaboration, and individual interactions over processes and tools (Fowler, 2001). Sarasvarthy (2001) studied behaviours of expert entrepreneurs and concluded that they followed effectual, rather than the type of conventional causal logic taught in many business schools. By being adaptable and open to surprises, expert entrepreneurs used resources at hand (i.e., bricolage) to achieve ends that were unknowable in advance.

What these routines share is not a rejection of planning, but an acknowledgement that the environment is often changing faster, and with less information visibility, than can be accommodated by traditional analytic regimes. These methodologies, which some might view as ad hoc, trial and error, or experimental, also share these tenets: promotion of effort and rapid learning rather than preventing and punishing failure; developing creative responses that are implemented and validated quickly; and a bias towards action rather than a predilection for analysis. What happens when the need for fast, creative action in businesses surpasses even these adaptive processes is discussed next.

Improvisation: When and Why

For the past 30 years, researchers have been intrigued by the notion of applying to organizations the metaphor of jazz combos, because they embrace creative uncertainty within structured regimes (Cunha et al., 1999). In organizations, improvisation occurs when action and design converge spontaneously to produce something new (Moorman & Miner, 1998). It is the impromptu act of deliberately deviating from a referent, creating a novel production to solve a problem or exploit an opportunity. Referents are pre-planned or implicit courses of action for reacting to the environment; they represent expected norms or the status quo. Unlike processes for adaptation, improvisations are spontaneous responses to events that are both unexpected and unplanned-for and, contrary to their metaphorical counterparts in jazz, are not ordinarily considered deliberate undertakings in organizations.

Improvisation is most often characterized along the two dimensions of speed and novelty (Cunha et al., 1999). "Full scale" improvisations are therefore considered to be those that highly deviate from referents and are very spontaneous, regardless of whether they work out successfully or not. As Chelariu, Johnston, and Young (2002) point out in their typology of improvisations, such highly capable instances are rare and difficult to achieve in practice. Everyday improvisations are commonly minor variances in degrees of novelty, speed, and unscripted actions, depending on the situation (Moorman & Miner, 1998). Improvisations are considered neither positive nor negative in performance; just as in executing pre-planned routines, both outcomes are possible. Successful outcomes from improvisation, however, often require more skill and application of intuitive knowledge than other routines. In Karl Wieck's (1993) description of the Mann Gulch disaster, for example, an unexpected turn of events fatally trapped 13 firefighters after a lightning storm. In a novel improvisation based upon experience, the lone survivor escaped by starting his own fire that consumed the available fuel in that area before the main fire arrived – an action that none of the others considered. In organizational contexts, improvisations are rarely as dramatic or consequential as the Mann Gulch example. The contextual backdrop for improvisation is considered to be anywhere an emergent demand is placed upon an organization for which they have no referent course of action, and little time to formulate a response. Time pressure is implicit in all improvisations, and is related to perceived task importance. Cunha and colleagues (2003) observed that task importance increases the likelihood of improvisation over alternative courses of action. There is ample empirical and anecdotal evidence to suggest that improvisations are frequent occurrences in startups (Baker et al., 2003), new product development (Moorman & Miner, 1998), technology development (Akgun & Lynn, 2002), and even municipal work (Vera & Crossan, 2005).

Why do entrepreneurs improvise? Working with scarce resources under conditions of uncertainty and with little time, expertise, or even inclination for contingency planning, it is not surprising that entrepreneurs are commonly placed in improvisational situations (Baker et al., 2003; Hmieleski et al., 2013). Often lacking organizational memory, human capital, and deep industry experience, many novice entrepreneurs operate without knowledge of existing referent routines for starting businesses. Thus, while others may follow traditional routes to achieving financing, building teams, and engaging customers, for example, novice entrepreneurs are more likely to be improvisational in their decision making and methods (Cunha, 2007). In accord with Holland's (1997) theory of career choice, it is also likely that entrepreneurs improvise because they have self-selected an occupation that is congruent with the practice. Improvisation is an action-oriented behaviour conducted under conditions of uncertainty, time pressure, and task demands. It draws upon intuitive and innovative capabilities, requiring confidence, motivation, and tolerance of ambiguity. All of these traits have been associated with entrepreneurship (Brandstätter, 2011; Shaver & Scott, 1991), and studies have established a link between proclivity for improvisation and entrepreneurial intentions (Hmieleski & Corbett, 2006). Hmieleski and Corbett (2008) also found that repeat entrepreneurs rated higher in measures of improvisational behaviour than novice entrepreneurs, indicating that confidence with improvisation likely improves with experience. Baker, Miner, and Eesley (2003) found that problem-driven improvisational behaviours and competencies in entrepreneurs were key to the process of founding new ventures. Dispositions are a tendency to behave in certain ways (Buss & Craik, 1980), and it is likely that improvisational dispositions result from repeated experience with successful outcomes. Although it remains a subject for further research, these findings suggest that entrepreneurs engage in improvisation not just by circumstance, but because they share traits and dispositions that are suited to the behaviour.

Effective Improvisations

If entrepreneurs are routinely called upon to "think on their feet" by necessity or choice, it seems evident that entrepreneurship training programs should include improvisation. Improvisation is a competency that is trainable (Vera & Crossan, 2005; Weick, 1998), and in the author's own experience, helps to prepare student entrepreneurs for the unexpected contingencies that are part of daily life. It also raises confidence that tasks may be accomplished even when plans fall short, boosting self-efficacy associated with entrepreneurial actions (Zhao et al., 2005). It is not necessary to become a jazz musician or join a theatrical group to learn improvisation; these contexts differ from organizations in many ways, such as goals, leadership, and member participation. Although a significant body of literature has explored the imperfections of such metaphors (e.g., Barrett, 1998b), they nevertheless offers lessons to organizational practitioners, which will be summarized here.

The first lesson is to embrace the process for what it is: creatively "making do" with resources at hand. Uncertainty and time pressure are givens in improvisation, and errors are part of the process. Accepting compromises is often difficult in business settings where performance is normally measured in terms of goal achievement, minimizing errors, and following scripts. If errors are intolerable, then improvised actions are likely inappropriate. If creativity is desired, however, it is useful to adopt what Weick (2002) terms an "aesthetic of imperfection" in recognizing outcomes that are "good enough under the circumstances". Products of improvisations cannot be objectively measured against other types, and arguably a large part of the success of an improvisation is that it was undertaken at all.

The second transferable lesson from jazz and theatre contexts involves designing organizational climates that permit unscripted actions to thrive within boundaries. Minimal structures are those that incorporate nominal leadership, personal autonomy, information sharing, and orientation around simple goals (Kamoche & Cunha, 2001). In line with other findings, Brown and Eisenhardt (1997) noted that such "semi-structures", with few explicit rules over means of achieving goals, favoured improvisation. Control systems that reward initiative, effort, and risk taking without penalizing failed attempts are as essential to improvisation as they are to creative and innovative activities (Zhou & Shalley, 2007; Duxbury, 2012). Anecdotally, many entrepreneurs will recognize creativity-fostering minimal structures during their "founding days"; the challenge is to maintain such structures during subsequent growth stages.

The third lesson for entrepreneurs is to recognize that the spontaneous performance of improvisation is not suited to everyone. Just as in jazz or theatre settings, improvisation in organizations is a potentially stressful activity requiring intuitive expertise. Not everyone who engages in improvisation will achieve success or job satisfaction in doing so. Improvisational situations arise in new ventures in a variety of roles including sales, finance, new product development, operations, marketing, and customer service. When building teams and determining who is to perform improvisational work in entrepreneurial contexts, it follows that improvisational competence be part of the selection criteria. Although some traits (e.g., openness to experience) may indicate a proclivity to improvise, actual behaviours depend on situational factors as well (Chatman, 1989). Although the literature on measuring improvisational dispositions remains underdeveloped, entrepreneurs building teams for improvisational work are advised to seek out past examples of the behaviour when interviewing candidates.

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It appears that improvisation is not an uncommon occurrence in startup contexts due to the unscripted nature of the work. One explanation may be that novice entrepreneurs simply have no referent courses of action; therefore many activities are perceived to be improvisational to the inexperienced observer. It is also possible that organizational settings that embrace flexible, adaptive processes in establishing product-market fit are more likely to engage in improvisations when planning regimes fall short in other areas of the business. Lastly, it has been argued that entrepreneurs likely improvise because they have self-selected a role that is suited to that disposition. All of these explanations remain to be tested empirically, and they represent intriguing opportunities for future research. If startups improvise often to navigate unfamiliar waters and take action (Baker et al., 2003), there appears to be a gap in how we select and prepare entrepreneurs. Future research into a behaviour-based measure of improvisation would help entrepreneurs and researchers quantify an individual's capacity for improvisation when roles demand it.

Conclusion

This article examined how improvisation is used by entrepreneurs to adapt to changing environments. Improvisations occur when there is an emergent, unplanned need for timely and novel departures from existing routines. Improvisations happen because tasks are important, time is short, and organizations support it to some degree. As argued here, improvisations may appear more often in startups due to overlapping dispositions with entrepreneurial behaviour and lack of familiarity with referents. Simply put, many entrepreneurs are improvisers. Lessons for entrepreneurs drawn from jazz and theatre contexts include: i) focusing on the process while adopting an “aesthetic of imperfection” in the outcome, ii) maintaining a supportive climate based upon minimal structures, and iii) ensuring that only people suited to improvisation are selected for such tasks. Many startup roles include situational demands for improvisation that may be considered stressful, demanding, and risky – and unavoidable. It is suggested that a behaviour-based measure be developed to assist entrepreneurs and researchers in assessing dispositions for improvisational work, building new theory, and developing practical training regimes.

Recommended Reading

- "Managing and Improvising: Lessons from Jazz"
  (Barrett, 1998b; tinyurl.com/lssozxj)
- "Improvisation in Action"
  (Crossan, 1998; tinyurl.com/mpmxyco)
- *Organizational Improvisation*
  (Cunha & Kamoche, 2001; tinyurl.com/k3adxza)

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Commercialization and Public Good: Conflict, Complement, or Critical Component?

Sandra Schillo

" ***Andrea:*** *Science knows only one commandment — contribute to science. […]*

Galileo: *To what end are you working? Presumably for the principle that science's sole aim must be to lighten the burden of human existence. If the scientists, brought to heel by self-interested rulers, limit themselves to piling up knowledge for knowledge's sake, then science can be crippled and our new machines will lead to nothing but new impositions.* "

Berthold Brecht (1898–1956)
Gallileo, Scene 14

The controversy regarding the role of science in society – and how science can best achieve its role – may well date as far back as the beginnings of science itself. The specific arguments and the possible mechanisms for science to impact society, however, have changed over time. This article picks up the conversation with regards to the specific role of publicly funded science, presuming, similar to Brecht in this article's opening quotation, that publicly funded science has the goal of making positive contributions to society.

To achieve this goal, today's scientists and research managers face a myriad options of publication venues, protection mechanism, and collaborations with external partners including licensing and other options for commercialization. Oftentimes, the goal of achieving positive contributions to society is perceived as being in fundamental conflict with the restrictions many commercialization arrangements place on the use of knowledge. This article argues that, although commercialization may at times conflict with the goal of achieving positive contributions to society, it can also be complementary to pursuits towards societal contributions, or even a critical component in achieving the desired positive contributions to society. More specifically, it suggests that the use of the term "science for the public good" as description of the goal to achieve positive societal contributions might create confusion with the economic term "public good". Thus, it seeks to reframe the discussion of how science can contribute to society in an era of increased openness and interaction.

Introduction

There are strong expectations that publicly funded science should lead to positive outcomes for society. Oftentimes, these expectations are worded similarly to Deiaco, Hughes, and McKelvey (2012), suggesting that publicly funded research organizations should remain "dedicated exclusively to the creation of public goods for the good of society".

The key argument of this article is that creating public goods does not necessarily lead to the maximization of "the good of society". In fact, the decision to make research outputs available as "public goods" can lead to important research outputs not being utilized at all. For example, if researchers only make their findings available as publicly accessible academic articles, employees of companies would have to read those articles and understand potential implications for their practice in order to be able to use the research results. In some industries, companies follow the academic literature only rarely and such publications are not likely to lead to industry uptake, and subsequent benefits to society. In other industries, companies typically follow the literature, but they know that their competitors are doing the same. If commercialization is expensive in such industries (e.g., in pharmaceutical contexts there are numerous and expensive regulatory procedures), companies may be hesitant to make such investments without some guarantee of exclusive use. Such exclusivity would require patent protection, which generally requires that the original researchers and their institutions apply for such protection before publication. Thus, there are numerous circumstances in which research results will only lead to applications with benefits to society if they are not made publicly available.

This article develops this argument by first discussing the definition and usage of the term “public good”, followed by a consideration of commercialization and public good in universities and government laboratories, highlighting the importance of mandates to deliver benefits to society. Then, various examples are provided in which commercialization (i.e., the creation of private benefits) constitutes a conflict, a complement, or even the critical component to delivering benefits to society. Thus, the relationship between commercialization and the creation of societal benefits is shown to be more nuanced than often assumed, and it becomes clear that expertise and careful consideration are required to ensure that societal benefits are indeed maximized, as discussed in the conclusion.

Public Good: Definition and Usage

There are two fundamentally different definitions of the term "public good", which are both widely used in the context of innovation resulting from publicly funded research. One definition is based on a "common sense" or intuitive interpretation of the term; the other is based on economic terminology.

Common usage refers to the public good as anything that is good for the public, for example activities, services, or products that lead to benefits to citizens or society. The term "public good" is not usually defined explicitly in the academic literature with this connotation (e.g., Heisey & Adelman, 2011), although the concept is clearly much debated in the context of mandates of public sector organizations and commercialization of research results (Deiaco et al., 2012).

The economic definition opposes public goods and private goods, focusing on two characteristics of goods that relate to their use by others: excludability and rivalry. Excludability refers to the possibility of preventing others from using the good. An item purchased by an individual, for example a computer, can be used by the purchaser, and there is no cost to preventing others from using the item. Rivalry refers to whether the item would be consumed through its use. If an item, such as food, is perfectly rivalrous and “it is consumed by one person, none of it remains for any other” (Hindriks & Myles, 2006). In this sense, a pure private good is defined as having perfect excludability and rivalry, and a pure public good shows perfect nonexcludability and nonrivalry (Hindriks & Myles, 2006).

Based on these two characteristics of goods, Table 1 shows that economists also define two related types of goods: club goods and common property resources. This juxtaposition of public and private goods is obviously an abstraction: real goods may not neatly fall into one category.

Public goods, in the economic sense, have been covered extensively in the academic literature, and the distinction between public goods and private goods has been instrumental in explaining why markets are inefficient in providing certain goods, such as basic research or national defence, and why governments therefore need to provide or support the provision of these goods.

In the context of innovation, the market-failure argument underlying most government policy intervention in innovation activities was developed by Arrow (1962). It suggests that, due to the public good nature of many research outputs, markets fail to incentivize companies to invest in research as much as would be optimally required. As stated by Weber and Rohracher (2012):

> *“The argument is that a fully competitive, decentralized market system will provide a sub-optimal level of investment in knowledge development as a consequence of the public good character of certain types of knowledge, of potential knowledge spill-over effects, and of the short time horizon applied by market actors in their investment decisions.”*

The flip-side of this market failure is that governments expect social rates of return on investments in research in addition to the private rates of return companies could achieve. There is extensive research (e.g., Griliches, 1958; Mansfield, 1991, Acs et al., 2009) docu-

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Table 1. Typology of goods, with examples. Adapted from Hindricks and Myles (2006).

	Rivalrous	**Non-rivalrous**
Excludable	**Private Good** Examples: most products, including products incorporating research results, (e.g., computers, cars, medical drugs)	**Club Good** Examples: facilities used by a consortium
Non-excludable	**Common Property Resource** Examples: a lake anyone can use for fishing	**Public Good** Examples: published research, data

menting the extent to which social returns are achieved, and this argument forms the basis of public investment in research in many countries. (For a detailed discussion, see Bleda & del Río, 2013).

Relationship between common usage and the economic definition

In practice, many research outputs are primarily useful to companies. Citizens (i.e., the public) often have limited ability to directly use research outputs, and they instead primarily derive benefits through the activities of companies, which introduce and discontinue products and services, create or reduce jobs, and have positive or negative impact on the environment. Companies typically only have incentives to invest in the development of new products and services if they are able to compete successfully in the market, in other words, if they can derive private returns, in the economic sense.

Therefore, benefits to citizens (i.e., for the public good, in the common sense) often depend on companies successfully using research outputs to create products and services (i.e., private goods, in the economic sense). Hence, there is a seemingly paradoxical situation, where benefits in the public good, in the intuitive sense, only occur if the innovation does not become a public good, in the economic sense.

Publication and Commercialization of Publicly Funded Research

Government laboratories and universities share the common trait that they are partially funded from public sources. Government laboratories typically are mandate-driven, conducting research in support of policy development or economic activity in specific areas such as health, environment, agriculture, or natural resources, and their research activities can fall anywhere in the spectrum of basic to applied research, or they may even support commercialization activities such as testing and certification. Similarly, universities fulfil a range of roles, such as basic research, teaching, knowledge transfer, and contributing to policy development and economic initiatives (Breznitz & Feldman, 2012).

For some time now, government laboratories and universities have been under pressure to place greater emphasis on knowledge transfer functions and the creation of commercially relevant intellectual property (Jaffe, 2000; Henderson et al., 1998). One reflection of this trend is the implementation of Bayh-Dole-style legislation (tinyurl.com/4kbt4xx) in many jurisdictions around the world (Kenney & Patton, 2009; Sampat, 2006). In parallel, academic interest in topics relating to academic entrepreneurship and technology transfer has increased substantially (Perkmann et al., 2013).

Despite much of the motivation of increased commercialization originally deriving from an intent to increase societal benefits, the academic literature has not addressed in depth the relationship between commercialization and societal outcomes (Heisey & Adelman, 2011, Bozeman, 2000). Researchers have focused on topics such as determinants of university-industry technology and the emergence of spin-off companies (Zucker et al., 2010), intellectual property protection and management (Czarnitzki et al., 2009), and licensing practices (Thursby et al., 2001; Thursby & Thursby, 2007).

The closest this academic literature has come to addressing the topic of whether the commercialization of the results of academic research increases or decreases benefits to society is in a stream of research on the relationship between publishing and patenting/licensing. Buenstorf's (2009) question, whether research and commercialization are “competing or complementary”, is representative of this research, and he highlights key arguments by earlier researchers. Although empirical evidence suggests that researchers who have strong records of patenting also have strong publication records (Buenstorf, 2009), there is some evidence that commercialization activities are associated with reduced public dissemination of knowledge (Campbell et al., 2000; Toole & Czarnitzki, 2010; Huang & Murray, 2009; Murray & Stern, 2007). Thus, the debate with regards to conflict or complementarity is ongoing, and concerns remain that increased commercialization outputs (e.g., patents, licences, royalty revenues) may be detrimental to public good research (Heisey & Adelman, 2011).

However, public good research in this context refers to research for the benefit of the public, as discussed in the common usage definition above. It does not refer to research outputs as "public goods" (i.e., publications accessible to everyone, an economic public good). Thus, the question should not be whether publications and commercialization are competing or complementary – or, in economic terms, whether research outputs are disseminated as public or private goods. Rather, the question of theoretical and practical consequence is whether the production of public or private goods – publications or commercialization – leads to benefits for society.

The following section shows that there is no generalizable answer to this question: any answer depends on the specific research results as well as resources and actors available and accessible in markets and society, whether benefits to the public can be achieved through open publication or whether they require more targeted collaboration with external partners.

Conflict, Complement, or Critical Component: Discussion and Examples

Although the mechanisms of achieving outcomes of benefit to society are similar for universities and government laboratories, the emphasis on the different mechanisms and the institutional frameworks show some differences. In government laboratories with specific mandates, the link between research activity and anticipated societal outcomes is typically well articulated. For example, ministries of health are expected to contribute to improved health outcomes among citizens, environment ministries are tasked with achieving environmental outcomes, and each country tends to cover the various dimensions of societal concerns through a range of ministries and agencies. Although universities and some government research institutions with broader mandates do not usually target such specific mandates, there is an expectation that each discipline of research will contribute to societal outcomes in the manner appropriate to the field.

The following subsections explore the relationship between such societal mandates and commercialization of research results.

Commercialization in conflict with societal benefits

As noted above, the conflicts described in the academic literature focus primarily on the trade-offs between publishing and patenting or licensing. The key concern here is that researchers may spend their time producing results that are not publicly available, for example, in the form of publications, but rather producing results that benefit individual companies. Although this empirical evidence suggests there is no conflict with regards to publications versus patents or licensing (Buenstorf, 2009; Van Looy et al., 2004), publication output seems to decrease if researchers are involved in startups (Buenstorf, 2009), and collaborations with academics seem to decrease with increasing industry interactions (Clark, 2011).

However, this discussion is more targeted towards a narrow view of considering the immediate research outputs and their characteristics of public good or private good in the economic sense of the term. A discussion of the public good in the common usage sense would consider whether society benefits from the commercialization of research outputs, and more specifically, whether it benefits more than from open publication of research results.

A priori, one might argue that any successful commercialization leads to positive economic outcomes, and the associated social benefits of personal income for staff, potentially health and other benefits for staff, job security, and perhaps associated outcomes such as improved health outcomes (either through health benefits or through the established link between socio-economic status and health outcomes), multiplier effects in the local economy, or perhaps regional economic development. However, it is also possible that commercialization leads to job losses through increased efficiencies, or otherwise deteriorated working conditions.

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Unfortunately, there is little empirical evidence on this issue, which is also related to the difficulty of measuring societal outcomes and their attribution to specific research contributions. The overall consideration of societal benefits also often requires certain ethical or moral value attributions. For example, the use of research results for governments to increase control over their citizens (e.g., through new software tools aimed at spying on citizens or censoring), the development of advanced weapons, or the adoption of psychological principles to influence voters, can be debated as beneficial or detrimental to society based on political persuasions. At this time, it seems that the approach adopted by many research organizations and funding agencies is to determine publication and patenting record, estimate economic benefits, and then document additional societal benefits through case studies or success stories that demonstrate clearly positive societal outcomes.

As a last comment on the potential conflict between commercialization and public benefits, it should be noted that there are circumstances in which commercialization clearly conflicts with the public interest. Practical experience suggests that such scenarios typically arise out of the failure to negotiate licences and commercialization agreements that protect the interests of the public and the research organization. In many cases, for example, if the right to continue research on the technology is not reserved when an exclusive licence is granted, this shortcoming is attributable to a lack of awareness or human error. Thus, careful attention to the wording of the agreements is warranted (Franza et al., 2012).

Commercialization as complementary to social benefits

Much of the prior research on publishing and patenting or licensing suggests that the relationship between the dissemination of research results as public goods versus private goods in the economic sense is complementary in nature. Scientists who patent more seem to also publish more (Buenstorf, 2009; Van Looy et al., 2004; Zucker et al., 2002), and researchers engaged in commercialization activities seem to maintain appreciation for open science (Shibayama, 2012), even though the open dissemination of results may be slowed down (Perkmann et al., 2013).

As in the case of research suggesting conflicts, this discussion does not extend to the achievement of societal benefits. However, an optimistic interpretation of the finding that increased patenting and licensing activities coincide with increased research outputs might suggest that whatever societal benefits can be achieved through publishing or patenting will be achieved if researchers pursue both routes.

In addition, much like Chesbrough (2003) suggests in the context of open innovation in companies, public research may lead to results that could be used commercially, but are not within mandated areas of government research organizations (Schillo & Kinder, 2013) are outside the area interest of university researchers. If such results can be transferred without distracting from other activities with important societal outcomes, additional, complementary benefits to the public or the economy can be achieved through commercialization.

Commercialization as the critical component to creating societal benefits

Although the two scenarios discussed above – conflict and complement – have been much discussed in the academic literature, this last scenario – commercialization as a critical component to creating social benefits – is rarely mentioned. Practice, however, shows that the commercialization of research results, or even the collaboration with private sector partners, is often instrumental in the creation of societal benefits (see Box 1 for examples). There are two key mechanisms for this realization of societal benefits to occur.

First, societal benefits typically arise from the use of products, processes, or services derived from research. For example, pharmaceutical medicines, energy-saving production processes, or water-safety testing services will only lead to improved health or environmental outcomes if they are applied. In fact, the resulting societal benefits will be maximized only if they are applied on a large scale. This application typically implies the involvement of commercial partners, because publicly funded research organizations are usually not mandated to produce products or apply processes on a commercial scale. Even where governments are involved in the provision of services, for example in food or water safety, they usually rely on commercial partners to provide test kits or equipment to conduct the tests. Thus, the benefits resulting from the application of research results can only manifest if they are successfully commercialized. However, note that *successful* commercialization also implies that companies achieve sustainable profits, either on the sale of the products or services themselves or on the sale of related products and services. Thus, these companies have positive rates

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Box 1. Societal benefits from interactions between companies and research organizations

In the practice of interactions between companies and research organizations, examples for scenarios in which societal benefits can only be achieved through interactions with companies are extremely common and span most fields and disciplines:

1. A government laboratory requires test kits to ensure food is safe. Constantly arising new food safety threats require new test kits. The agency routinely ranks research requirements according to priorities. Before they are approved, industry partners are identified to ensure the test kits will be developed to commercial scale and can be provided by the commercial partner to the government agency for testing purposes.

2. Researchers develop a method to remove soil contaminants. This method works and is scalable. But, if no company licenses it, the public cannot benefit from it.

3. Researchers discover a new vaccine and publish the results to make sure they are publicly accessible. This action (almost) precludes any company from licensing the vaccine, investing in its approval, and attempting to sell it.

of return; in economic terms, these are private returns to the company. In addition, there are public returns through the widespread use of the research results.

Second, societal benefits can arise indirectly through increased further research outputs derived from collaboration with private sector partners. This scenario has been discussed in the literature. A much-cited study by Van Looy and colleagues (2004) suggests that researchers who engage in entrepreneurial activities also have increased publication output. A similar trend was observed earlier in the seminal work by Zucker, Darby, and co-authors who showed that, in the field of biotechnology, top scientists are both leaders in publications and commercialization (Zucker & Darby, 2005; Zucker et al., 1998; Darby & Zucker, 2003; Zucker et al., 1998, 2002). To the extent that products and services based on biotechnology have made positive contributions to society, for example through the development of new medicines or environmental applications, the commercialization of research results can be considered a critical component to the achievement of public health outcomes.

In addition – and this aspect had not been addressed in the literature on technology transfer, either – the trend towards "big data" has made collaborations with private sector companies important to research endeavours in a broad range of fields from computer science, to health sciences, and to social sciences. In this context, academic research and publications are often based on data collected by the private sector, and the resulting research-industry collaborations bring benefits to the private sector players as well as public sector researchers – and by extension hopefully to society through further application of research results.

Thus, research and practice suggests that commercialization may be a critical component to either the immediate delivery of societal benefits, or the creation of new knowledge and research results that may in turn benefit society in the long run.

Comment on Intellectual Property Rights

Although the above arguments can be made without consideration of intellectual property rights, there is substantial debate on the role of intellectual property in the context of commercialization of publicly funded research. One of the key arguments for strong intellectual property protection is that "in the absence of clearly defined property rights, private firms would not invest in the commercial development and application of the results of federally funded research" (Mowery & Sampat, 2001). This argument has been countered with the mention of individual technologies that have been commercialized without any assurance of exclusivity. In addition, open innovation business models are showing that the traditional mechanisms of protecting intellectual property to derive commercial benefits are not the only models that can lead to commercial success.

However, even open innovation business models show that: i) companies that openly "give away" some of their intellectual property tend to fiercely guard other intellectual property (e.g., Google's free search service and its closely guarded information on users) and ii) many business models are based on the fact that most end users cannot use the open information without purchasing additional products or services (e.g., open source software companies selling consulting services to customize the software, publishers selling reviews). Thus, intellectual property rights become central to the business model in both open and closed models, but they are perhaps even more important in open models (Chesbrough, 2003), and publicly funded research organizations need to carefully manage their intellectual property rights to achieve the maximum of benefits to society (Schillo & Kinder, 2013).

Conclusion

As described in this article, the relationship of commercialization and public benefits as conflict, complement, or critical component has shown that there is very little empirical evidence on the topic. However, this lack of evidence has not prevented policy developers, researchers and the interested public in engaging in this debate over decades (Mowery & Sampat, 2001).

The article has demonstrated that, in theory, each of the scenarios – conflict, complement, and critical component – is possible and that they do occur in practice. Thus, there is a strong argument to be made for researchers to consider all three scenarios in the design of future studies. In addition, the summary of the limited empirical evidence available shows that most researchers consider the difference between publication and patenting/licensing, and the impact of each on scientific research. Future research should extend this approach and aim to establish the relationship between the different forms of dissemination and societal outcomes.

About the Author

Sandra Schillo is an Assistant Professor in the Telfer School of Management at the University of Ottawa, Canada. She has worked in and studied the area of science and technology, research and innovation management and entrepreneurship. Her professional work experience includes employment with the National Research Council Canada and the Canadian Food Inspection Agency, and work with Industry Canada in the area of Innovation Policy. She has completed consulting work for Industry Canada, many Canadian Federal Science-based Departments and Agencies, and non-government organisations active in innovation and entrepreneurship. Sandra completed her doctoral studies at the Institute for Entrepreneurship and Innovation Management, University of Kiel, Germany. Her dissertation work focused on spin-off companies. She obtained her Masters' degree in Engineering Management from the University of Karlsruhe, Germany, majoring in corporate strategy and specializing in innovation management and technology transfer. As a consultant, Sandra integrates her experience in research commercialization, her in-depth academic expertise, and her communication skills for the benefit of public and private sector clients. Sandra is fluent in English, French and German, and has working knowledge of Italian.

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Designing and Managing Value Co-Creation in KIBS Engagements

Lysanne Lessard

> *“The word VALUE, it is to be observed, has two different meanings, and sometimes expresses the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys. The one may be called "value in use;" the other, "value in exchange." The things which have the greatest value in use have frequently little or no value in exchange; on the contrary, those which have the greatest value in exchange have frequently little or no value in use.”*
>
> Adam Smith (1723–1790)
> Moral philosopher and "father of modern economics"

Knowledge-intensive business services (KIBS) such as IT development, IT outsourcing, and research and development (R&D) services have become a key component of most industrialized economies; they have been identified as an important source of employment growth in many countries and help improve the performance of firms belonging to most other sectors. KIBS have been discussed in innovation-related literature for over 15 years, with the assumption that models of innovation developed for manufacturing firms were not appropriate for them. This body of literature has also helped to identify the key characteristics and types of KIBS. However, although some empirical studies have investigated KIBS at the level of management – for example, how to manage customers’ co-production processes – there has not been much research on how to successfully establish and manage engagements among KIBS providers, clients, and other collaborators. Moreover, informal conversations with KIBS professionals show that these activities are often approached in an ad hoc manner. Yet, given the importance of KIBS, taking a more systematic approach to their design and management could improve the contribution of knowledge-intensive business service activities to our economy.

This article proposes a framework for the design and management of KIBS engagements. The framework has been developed from a multiple-case study of academic R&D service engagements, as one type of KIBS engagement. It consists of a set of information to be gathered and questions to be asked by professionals responsible for establishing, monitoring, and managing KIBS engagements. The information and questions are articulated around two key processes of collaborative value creation (or value co-creation) in KIBS engagements: i) the alignment of actors’ interests, value propositions, and resources, and ii) the actors’ ability to integrate the engagement’s deliverables and outcomes as a basis for their perception of the engagement’s value. Using this framework could help to establish more successful collaborations among KIBS providers, clients, and partners; it should also help to monitor the performance of a given KIBS engagement in terms of its collaborative processes, deliverables, and outcomes from the varied perspectives of participating parties. Although the framework accounts for these different and sometimes conflicting perspectives, it is intended to be used by KIBS provider firms whose success depends at least in part from their ability to manage collaborative relationships.

Designing and Managing Value Co-Creation in KIBS Engagements

Lysanne Lessard

Introduction

There has been a surge in research on the nature of services (Delaunay & Gadrey, 1992) as well as their design, management, and engineering over the past twenty years or so (e.g., Bullinger et al., 2003; Johns, 1999; Miles, 1993; Shostack, 1984; Solomon, 1985). The growing importance of the service sectors in industrialized economies, and of service activities within firms belonging to other sectors, made both industry and academia stand up and take notice (Chesbrough & Spohrer, 2006). The major segment of revenue of many large organizations such as IBM, for example, have become the services that they provide around their products rather that the products by themselves (Spohrer & Maglio, 2008). And, it has become generally agreed upon that the techniques and processes used to manage the production of goods are not fully adapted to the production of service activities, if at all (Chesbrough & Spohrer, 2006).

As the introductory quotation shows, Adam Smith distinguished between two types of values: value-in-exchange and value-in-use. Crudely, the former means the price one puts on a good being sold in the marketplace, whereas the latter refers to the perceived value of that good (product or service) as it is being used by someone in a given context and for a given purpose. Whereas Smith focused on value-in-exchange to develop his well-known theories about nations' wealth, authors such as Normann (2001) and Vargo and Lusch (2004) argue that value-in-use is more relevant to understand service exchanges and the economy more generally. These arguments do not rely on a perceived inherent difference between the nature of goods and services; rather, they are proposed as a new understanding of how our modern economies have functioned all along. From this perspective, the rise of the service economy simply emphasizes the weaknesses in industrial-era theories of value. The concept of value co-creation is drawn from that of value-in-use; it states that value is always collaboratively created by interdependent actors in the market (providers, clients, partners, etc.), and that it is always determined by the beneficiary of the service (Ramirez, 1999; Vargo et al., 2008). At the core of this understanding is the view that value is not "added" by the producer, ready to be consumed by customers, but rather created collaboratively among actors (Ramirez, 1999).

A number of approaches for the design and management of service activities rely on the concept of value co-creation. However, these propositions are often based on illustrative or real-life examples of retail or otherwise business-to-customer (B2C) services (e.g., Patrício et al., 2011; Rosenbaum & Massiah, 2011). Other propositions claim to be applicable to any type of business-to-business (B2B) service, without considering differences between, say, professional cleaning services and management consulting (e.g., Legner & Vogel, 2007; Ordanini & Pasini, 2008). Yet, one can identify varied service contexts (Glushko, 2009) and levels of design and management (e.g., internal service firm activities, networks of providers/clients). Although these approaches can be very useful for transactional service interactions or those with limited collaboration, they do not address important characteristics of highly collaborative, organization-to-organization service engagements.

Indeed, in this type of context, the boundary between front-end and back-end activities becomes blurred as actors across organizations jointly define and produce the service to be delivered. Moreover, in particular when the deliverable requires complementary areas of expertise, relationships are not established in a dyadic manner (provider and client), but in the form of a network: provider(s), client(s), third-party actor(s), funding or regulatory organization(s), etc. These relationships are then typically organized as medium- or long-term projects, or as more stable engagements such as alliances. Organizing the moments and activities in which network actors interact in this type of context can facilitate resource and information sharing; however, a more strategic, inter-organizational perspective is needed for the initial establishment of these relationships and their monitoring from the perspective of all involved parties.

Knowledge-intensive business service engagements

The type of highly collaborative, organization-to-organization service engagements described above are core to the service sector known as knowledge-intensive business services (KIBS). KIBS correspond to the subsector 54, "Professional, Scientific and Technical Activities" of the North American Industry Classification System (NAICS; tinyurl.com/o4stkje). This sector, which includes services such as R&D, management consulting, and IT outsourcing, has become a key component of most industrialized economies (Strambach, 2001). KIBS have characteristics that distinguish them from other B2B services: they are knowledge-intensive in the sense that they rely on expert employees or provide knowledge-based solutions to their clients; clients are typically involved in the co-production of these solutions; and provider-client exchanges tend to be of a relational rather than transactional nature (Bettencourt et al., 2002; Czarnitzki & Spielkamp, 2003; Miles et al., 1995; Muller & Doloreux, 2009).

KIBS have been discussed in innovation-related literature for over 15 years, with the assumption that models of innovation developed for manufacturing firms were not appropriate for them (Muller & Doloreux, 2009). This body of literature often investigates the KIBS sector at the regional or national level, helping us to understand their importance in fostering innovation in industrialized economies. Firm-level studies of KIBS have also emphasized the importance of employees and clients in the co-production of knowledge-based service solutions (Bettencourt et al., 2002; Larsen, 2001) and the role of KIBS as transfer agents of innovation for their partners and other companies (Czarnitzki & Spielkamp, 2003). Issues of knowledge management have been a key focus at that level. For example, it has been found that the knowledge needed by KIBS firms to create solutions for their clients and to innovate not only lies in each firm's individual employees but is created through their interactions with each other and with external collaborators (Larson, 2001). The competencies needed by KIBS providers to successfully process such knowledge thus extend beyond the mere transfer of knowledge to their client; they encompass the ability to transform knowledge from tacit to codified and back, to generalize from customer cases and apply locally from previous generalized knowledge, as well as to associate varied types of knowledge or dissociate needed dimensions (Gallouj, 2002). Despite these studies, however, much work remains to be done to support the design of KIBS at the (inter-) organizational level, thus to support the creation of successful KIBS engagements.

Value co-creation focuses on, among other things, knowledge and skills, the collaborative process between provider and client, and the wider space in which value is configured (Normann & Ramirez, 1993; Vargo & Lusch, 2008; Vargo et al., 2008). From this perspective, knowledge is given particular importance as a key *operant resource* (i.e., that acts on other resources), in contrast to *operand resources* (i.e., that are acted upon, such as natural resources) (Chesbrough & Spohrer, 2006; Vargo & Lusch, 2008). As such, the concept of value co-creation is in line with the core characteristics of KIBS. Yet, the way in which value co-creation actually happens in KIBS has not been extensively investigated as a basis for improving the management and design of that specific type of service. It is important to account for the particular context of KIBS because value co-creation processes, enablers, and inhibitors in the context of KIBS differ from those found in transactional services or those where collaboration is superficial (Sarker et al., 2012). Moreover, value co-creation processes in KIBS contexts are dynamic and complex (Stucky et al., 2011), which poses challenges that have yet to be fully addressed by current service design methods (Gkekas et al., 2012). This research addresses the conceptual gap between what we know about value co-creation and what we know about KIBS in current economies by presenting a framework derived from the understanding of value co-creation processes in the specific context of KIBS engagements.

Methodology

To understand what drives value co-creation in the specific context of KIBS engagements, a multiple-case study of two academic R&D service engagements as one type of KIBS was undertaken. Although academic R&D services are not formally considered to belong to the KIBS sector as defined above, the cases selected for the study adhered to the key characteristics of KIBS: the academic partners relied on the expertise of participating faculty and students, and provided knowledge-based services to their clients; the latter were involved in co-producing the agreed-upon deliverables; and parties actively sought to develop long-term relationships with each other beyond the studied engagement. Moreover, the two cases can be categorized according to recognized types of KIBS, namely traditional professional services (P-KIBS) and technologically oriented services (T-KIBS), where new technology, in particular information and communication technology (ICT), is used intensively (Miles et al., 1995; Muller & Doloreux, 2009). Indeed, the first case can be categorized as a T-KIBS because it concerned the development of a virtual computer environment for a municipality, whereas the second case falls into the P-KIBS category because it concerned the creation of a new curriculum for health care aides.

The study was guided by key concepts of value co-creation identified in extant literature, but refined their understanding by identifying causal processes of value co-creation from data. The framework for the design and management of KIBS engagements presented in the following section was derived from the results of this research. Specifically, this research followed the explanation-building strategy of case study research, where tentative hypotheses generated from data in a single case can are revised through their application to successive cases (Yin, 1994). In each case study, key stakeholders in the provider and client organizations were interviewed; meetings were also observed and project documentation was reviewed. Data were first coded using inductive grounded theory coding procedures (Charmaz, 2006). Emergent categories were then interpreted through key concepts of value co-creation identified in the literature, for example value propositions, resources, and valuing (Spohrer & Maglio, 2010).

These categories, representing mechanisms of value co-creation processes, were then related into a conceptual framework of value co-creation, the first part of the design framework. This step was achieved through the identification of the properties of each category (i.e., what is concerned, who is involved, why, how and when this category comes into play, and the consequences of its activation). In order to guide the analysis of future KIBS engagements, the second part of the design framework focuses on the relationship between each pair of components, and between each causal process, to identify the design-oriented questions that this relationship suggested. In other words, given the way in which mechanisms and overall processes are related, which questions should be asked in order to successfully design relationships for KIBS engagements? For example, given that an actor's *high-level interests* have been found to shape the potential *benefits it perceives* from the engagement, one of the design questions seeks to evaluate the alignment between each actor's perceived benefits and high-level interests.

Framework for the Design and Management of KIBS

The framework is composed of two dimensions: descriptive and analytical. The descriptive dimension concerns the individual mechanisms that make the value co-creation processes evolve: developing high-level interests, perceiving benefits, creating value propositions, organizing resources, articulating deliverables, and valuing. These mechanisms become elements about which information needs be gathered by a KIBS professional wanting to establish, monitor, or improve a new or existing KIBS engagement. The analytical dimension concerns the relationships between each pair of mechanisms (e.g., the shaping of perceived benefits by an actor's high-level interests, the need to align one actor's value proposition with the benefits (potentially) perceived by another actor). This dimension consists of a series of questions to be asked about the engagement, whose answers should be derived from the information previously gathered.

Moreover, two key processes of value co-creation were identified through the study: aligning and integrating. The process of aligning connects the direct mechanisms *developing high-level interests, perceiving benefits, creating value propositions, organizing resources,* and *articulating deliverables*. All of these individual mechanisms need to be aligned in order for actors to commit to a service engagement. Indeed, if interactions and negotiations successfully lead to the development of value propositions that meet other actors' perceived benefits, and that necessitate resources whose cost is not greater than expected benefits, actors are likely to commit to the service engagement.

Each individual mechanism is itself a process, but what is key to value co-creation is how each one aligns with the others. A breakdown in any individual mechanism can cause a breakdown in the overall process of aligning. As, for example, actors realize that more resources are needed, or change their high-level interests, or give greater or lesser importance to the benefits they perceive, the alignment between mechanisms needs to be re-negotiated or re-established. Aligning is then a dynamic, continuous process throughout the service engagement. Commitment needs to happen for a service engagement to truly begin, but it frequently needs to be re-affirmed during the engagement as situations and actors change.

The process of integrating connects the individual mechanisms of *developing high-level interests, perceiving benefits, articulating deliverables, valuing,* and *organizing resources*. In an ideal scenario, these mechanisms are linked in a way that leads to a positive determination of value by actors. Specifically, the determination of value in KIBS engagements first emerges from the perception that the quality of the service engagement's deliverables and collaborative process meets actors' expectations (derived from perceived benefits); this dimension of valuing is conditional to the integration of deliverables and outcomes as resources. Second, it emerges from the perception that benefits actually, or planned to be, derived from integrating deliverables and outcomes as resources are in line with actors' high-level interests.

Breakdowns can happen at any point in the process: deliverables and outcomes may not meet expectations, actors may not be willing or able to integrate them as resources, or changes in an actor's high-level interests may render integration undesirable. Moreover, integration is not a monolithic process. Each actor integrates

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only aspects of deliverables and outcomes that are perceived to be of interest. In some cases, it may be the outcomes of the engagement process – for example stronger relationships – rather than deliverables that are integrated. If the importance of these outcomes is high enough for the actor, it may still result in the perception that value has been created through the service engagement. These processes are not fully "phases" in an engagement, but the process of aligning comes first and must be successful for the process of integration to begin; however, aligning continues throughout the engagement.

Table 1 summarizes the elements about which information should be gathered in relation to each process. As stated in the table, information needs to be gathered about *each* actor taking part in the engagement. Indeed, the KIBS providers in the cases studied typically focused on issues of alignment with their client, sometimes at the expense of other actors such as third-party collaborators; this approach reduced commitments in time and other resources that negatively impacted deliverables and outcomes. Table 2 shows the questions that should be asked to increase alignment and support integration. Particular attention should be paid to the

Table 1. KIBS engagement information to be gathered in relation to each process

Process	Elements: Information to Gather
Aligning	• **High-level interests**: general interests, vision and objectives pursued by each participating actor • **Perceived benefits**: potential benefits to be gained from the service engagement for each participating actor • **Value propositions**: offers from each participating actor to other actors • **Resources to organize and their costs/risks**: resources needed to fulfil each participating actor's value proposition(s) • **Deliverables to co-produce**: hoped-for outputs of the service engagement
Integrating	• **High-level interests**: general interests, vision and objectives pursued by each participating actor • **Perceived benefits**: realized benefits from the service engagement for each participating actor • **Resources to organize**: resources needed to integrate the resulting deliverables and outcomes in a way that meets each participating actor's high-level interests • **Co-produced deliverables**: actual outputs of the service engagement • **Valuation**: each participating actor's judgment of the value gained from the collaborative process, deliverables and outcomes

Table 2. Questions to ask to improve chances of success in a KIBS engagement

Process	Questions
Aligning	• Is the *value proposition* of each actor well aligned with *benefits* of interest to the beneficiary actor? Are there potential risks for each actor associated with another actor's value proposition? • Are there other *benefits* that could better meet each actor's *high-level interests*? • Do actors have the means to access, allocate, or create the *resources* required to fulfil their *value propositions*? If not, are they available through other actors? • Is the cost of *resources* required by each actor to fulfil its value proposition on par with the *benefits* that it perceives from the engagement?
Integrating	• What is the (likely) rating of the quality of co-produced deliverables by each actor? Which indicators may be used as a basis for this judgment? • Which resources does each participating actor require to integrate these deliverables and the outcomes from the collaborative process in a way that meets its high-level interests? Which indicators may be used to judge the value hence created?

issue of defining the indicators that will be used by each actor as a basis for judging the quality of deliverables and the value created by integrating these deliverables and the engagement's outcomes. The lack of explicitly defined and agreed-upon indicators was another typical issue in the cases studied, leading to sometimes surprising and often lower perceptions of value by clients than anticipated.

These findings are supported by other empirical research on the same topic. For example, another multiple-case study of value creation in T-KIBS engagements explained the emergence of perceived value as resulting from systems of "governing" (i.e., proposing value and authorizing the engagement) and "actualizing" (i.e., realizing the service and the resulting business value) (Stucky et al., 2011). Similar break points were identified in these processes, for example the client's failure to acknowledge any value because of a lack of alignment between the deliverable and the client's interests beyond the engagement. Findings and the resulting framework thus emphasize the strategic dimension of value co-creation; indeed, they show that value co-creation does not proceed solely from organizing resources, but must rather be understood from the high-level interests and perceived benefits of participating actors (Lessard & Yu, 2013).

The information to gather and the questions to ask about resources to organize should be understood as encompassing both operant (e.g., knowledge) and operand (e.g., money) resources. Yet, knowledge remains one of the most important types of resources to organize to integrate deliverables and outcomes from the engagement, thus to co-create value (Ordanini & Pasini, 2008). KIBS-specific knowledge-management activities such as knowledge acquisition, recombination, and transfer (Muller & Zenker, 2001), and the knowledge competencies needed to accomplish them (Gallouj, 2002), thus undoubtedly play a critical role in ensuring the long-term success of KIBS provider firms. However, the framework proposed in this research lies at the strategic level of establishing and monitoring KIBS engagements, not at the level of daily knowledge-management activities.

Using this framework at the onset of an engagement could help KIBS professionals to ensure the commitment of clients and partners, and to put in place the elements needed for them to derive value from the engagement. The framework can also be used during an engagement to monitor the situation and take corrective actions if needed. Indeed, ensuring that each party comes out of an engagement with a positive perception of the value hence created is important not only for that particular engagement, but for their long-term willingness to collaborate.

Conclusion

This article has described a practical framework for KIBS professionals, tailored to their particular concerns. Indeed, it focuses on the processes and outcomes of value co-creation that are paramount to successful long-term relationships with clients and partners. As such, it is squarely aimed at addressing KIBS characteristics rather than transactional services or those leading to a superficial type of collaboration among parties. Moreover, this framework can help to establish and manage KIBS engagements in a more systematic and comprehensive manner than what is typically being done in KIBS contexts. Finally, it focuses on the strategic dimension of relationships (i.e., the "why") rather than on activities (i.e., the "how"). It can thus be used as a complement to process-based approaches such as service blueprinting (Bitner et al., 2008).

However, the results of this research are derived from a limited number of case studies set in only one type of KIBS (academic R&D service engagements). This focus potentially limits the scope of applicability; indeed, different types of KIBS have been shown to differ in terms of patterns of innovation (Doloreux & Shearmur, 2010), and they may thus differ in dynamics of value creation as well. Current research is underway to integrate the results of all existing empirical studies on value co-creation in KIBS engagement in order to strengthen and refine the framework presented in this article, as well as to broaden its scope of applicability. Another fruitful avenue for research would focus on the development of computer-supported tools to help gather and analyze information relevant to value co-creation and to visualize the results of analysis. Finally, further research should further investigate the interplay between value co-creation processes and knowledge-management processes in KIBS.

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About the Author

Lysanne Lessard is Assistant Professor at the University of Ottawa's Telfer School of Management in Ottawa, Canada. Her research focuses on the development of design and modelling approaches for inter-organizational contexts such as knowledge-intensive business service (KIBS) engagements. In these contexts, she investigates how organizational actors and ICTs form infrastructures in which information and knowledge are collaboratively created, shared, and transformed. This understanding leads to the creation of models, methods, and ICTs for the design, development, and evaluation of service systems. The results of this research enable greater value creation and innovation in today's networked economies.

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Ambidextrous Strategies and Innovation Priorities: Adequately Priming the Pump for Continual Innovation

Nehemiah Scott

> *"Plans are nothing. Planning is everything."*
>
> Dwight D. Eisenhower
> 34th President of the United States

The dynamic and unpredictable nature of the market has caused many organizations within rapidly changing industries to fail. These failures are, in part, due to a lack of continual and balanced innovation that firms should aim to achieve. That is, although firms may succeed at either refining existing competencies for incremental innovations or exploring new opportunities for radical innovations, many firms have experienced great difficulty in simultaneously pursuing and realizing success in both areas. This innovation imbalance arises when firms stick to traditional strategic notions of competition in fast-moving industries; these firms have not realized that the ability to compete in current and new markets begins with the strategies and priorities that are responsible for the very nature of innovation capabilities. The purpose of this study is to offer a reconceptualization of notions related to organizational strategy that are responsible for driving innovation capabilities. Specifically, this study develops a continual innovation framework that illustrates the impact ambidextrous strategies and priorities have on the firm's ambidextrous innovation capability. It offers a modified concept of ambidexterity (i.e., exploration, exploitation, coordination) to reconceptualize business, marketing, and information-systems strategies as ambidextrous strategy constructs. The article also discusses the relationships between constructs and the implications of this reconceptualization for researchers and managers.

Introduction

It was close to the end of his first term as President of the United States that President Dwight D. Eisenhower addressed the National Defense Executive Reserve Conference, and stated "Plans are nothing. Planning is everything." (Menon et al., 1999). Such a statement emphasizes that environmental volatility will render actual plans useless, but when good planning has been done upfront, plans become dynamic enough to circumvent such volatility. Such planning is necessary for firms wishing to compete within today's rapidly changing business environment. As market swings become more unpredictable, firms must make continual, timely, and appropriate changes to their products and processes (Bourgeois & Eisenhardt, 1988; Chandrasekaran et al., 2012) to combat shorter product lifecycles, unsteady consumer demand, and greater product mix (Liu et al., 2012).

Despite the emphasis that has been placed on the role of innovation in firm competitiveness and survival, many firms have still failed to adapt partially or completely due to their inability to simultaneously pursue and succeed in existing and growth product markets (Davila & Epstein, 2014). Whereas many studies focus on imbalance within the innovation capability itself (He & Wong, 2004; Lin et al., 2013), this study argues that it is the planning activities comprised of strategies and innovation priorities prior to the actuation of the innovation capability that are most critical to ensure successful and timely innovation outputs. For example, a recent report by Accenture finds that manufacturers within the semiconductor industry experience difficulty in competing in traditional and new markets; this challenge is, at least in part, due to misalignments between organizational strategies and innovation priorities (i.e., business, IT and innovation strategies and priorities) that drive central innovation capabilities (Accenture, 2013). IBM also has suffered from lack of innovation planning; although they were the first to commercialize the router and multiple Internet-enhancing technologies, Cisco Systems and Akamai became market leaders in those segments, respectively (O'Reilly III et al., 2009). IBM was unable to capitalize on its head start because of inadequate pre-innovation strategies and innovation priorities, as demonstrated by their preoccupation with satisfying the demands in their current product markets only and a business model that neglected to set innovativeness as a high priority (O'Reilly III et al., 2009).

This article suggests that a firm wishing to succeed in both existing and growth product markets should concentrate on developing their pre-innovation strategies to support ambidextrous business endeavours, which requires firms to modify antiquated strategies and conventional business notions. Without the ability to succeed in current and new markets, a firm risks losing customers and being replaced by rival firms (Schreuders & Legesse, 2012). Thus, the purpose of this study is to reconceptualize those organizational strategies that are responsible for driving innovation. Specifically, this study modifies a concept of ambidexterity to reconceptualize business, marketing, and information systems strategies and innovation priorities necessary to achieve ambidexterity in a firm's innovation capability, and it develops a continual innovation framework that illustrates the impact these ambidextrous strategies and priorities have on the firm's ambidextrous innovation capability.

Literature Review: Exploration, Exploitation, and Ambidexterity

The concept of ambidexterity was first introduced in Duncan's (1976) seminal study, and it is grounded in the organizational learning literature stream because its functionality is based on two learning mechanisms: exploration and exploitation. Exploration can be defined as the "things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation" (March, 1991). Stated another way, exploration is the search for new external knowledge and opportunities (Kristal et al., 2010) with the focus on producing radical change and enhancing the organization's ability to quickly adapt to market changes (Sarkees et al., 2010). On the other hand, exploitation includes things such as "refinement, choice, production, efficiency, selection, implementation, execution" (March, 1991). That is, exploitation is the employment and refinement of internal firm knowledge (Kristal et al., 2010) and operations that can allow the firm to realize incremental changes and achieve gains from existing markets (Sarkees et al., 2010).

Both exploration and exploitation play vital roles in innovation, which Subramaniam and Youndt (2005) argue are due to the intricacies of knowledge management processes used for distinguishing and using ideas, tools, and favourable circumstances to develop new or improved products or services. Andriopoulos and Lewis (2009) find these innovation processes to be important also for continual renewal of firm capabilities and organizational survival. Tushman and O'Reilly III (1996) support this assertion by stating that balancing exploration and exploitation is important for the enduring success of the organization. However, it is this exploration-exploitation dynamic that has been subject of much debate in the literature. Specifically, some researchers yield to the tradeoff perspective (Levinthal & March, 1993; March, 1991). As the creator of this view, March (1991) believes that an organization cannot be strong in both explorative and exploitative capabilities due to the tensions that originate from their conflicting knowledge-management processes. Levinthal and March (1993) continue this argument by asserting that firms will choose to overinvest resources toward either exploration or exploitation. However, such an overinvestment would be detrimental to the firm; whereas over-exploration causes the firm to enter a cycle of failures due to the uncertainty that comes with new innovations (i.e., a failure trap), over-exploitation causes a firm to neglect new markets due to their continued success in their current markets (i.e., a success trap) (Levinthal & March, 1993).

In contrast, proponents of the complementary perspective state that firms can excel in the pursuit of the both exploration and exploitation (O'Reilly III and Tushman, 2013; Kristal et al., 2010; Nemanich et al., 2007; O'Reilly III & Tushman, 2004). Tushman and O'Reilly III (1996) state that such a balance is necessary in order for firms to survive ambidextrously. From this view, ambidexterity is defined as the simultaneous pursuit and balance of exploration and exploitation activities (Lubatkin et al., 2006) as a means to reap revolutionary and evolutionary change (Tushman & O'Reilly III, 1996).

Ambidextrous Organizational Strategies

Strategy is defined as "the match between what a company *can* do (i.e., organizational strengths and weaknesses) within the universe of what it *might* do (i.e., environmental opportunities and threats)" (Collis &

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Montgomery, 2008). The most successful firms deploy strategies spanning current, emerging, and future product markets (O'Reilly III et al., 2009). However, research purports that many firms have single-market-focused strategies and cannot compete as desired. In other words, "the aggressive pursuit of [only] operational excellence and incremental innovation crowds out the possibility of creating breakthrough innovations [and vice versa]" (Davila & Epstein, 2014). In regard to alleviating this problem, research has implied that strategies should be ambidextrous in nature and that such a strategy can increase innovation efficiency and the firm's protection against strategic rigidities (Beinhocker, 1999) due to its dynamic nature (O'Reilly III & Tushman, 2008).

Innovations are made possible due to the knowledge they are based on, and therefore, attention must be given to those strategies that are responsible for determining how the firm will acquire, integrate, and utilize knowledge to *prime the innovation pump* of the business. These strategies consist of business, marketing, and information-systems strategies. While marketing and information-systems strategies guide a firm's major activities for knowledge processing, they are both driven by the business strategy. Therefore, a firm should adopt business, marketing and information-systems strategies that are balanced by exploratory and exploitative knowledge. Following existing ambidexterity research, the ambidextrous strategies in this study are comprised of both exploration and exploitation. However, contrary to extant research, this study has also introduced *coordination* as a dimension of ambidexterity.

Here, coordination represents the strategic mechanism that monitors exploration and exploitation activities, making sure that neither one is overemphasized and to ensure that resource allocation is not constrained (March, 1991). This dimension is important for two reasons. First, coordination is necessary for efficient resource utilization for ambidexterity. Regardless of whether a firm decides to implement separated exploration and exploitation into separate business units (O'Reilly III & Tushman, 2004) or pursue ambidexterity within a single business unit (Gibson & Birkinshaw, 2004), exploration and exploitation compete for resources (March, 1991), and these resources must be managed effectively if the firm looks to optimize the benefits of ambidexterity (O'Reilly III & Tushman, 2013). In addition, coordination within and transcending firm boundaries is important. In fact, Raisch and colleagues (2009) contend that "ambidextrous management requires firms to explore new knowledge, exploit existing knowledge, and coordinate these knowledge bases". Thus, ambidextrous innovation performance can be achieved when coordination of knowledge is transpiring between those areas of the firm where exploration and exploitation projects are housed and executed (Raisch et al., 2009; Tushman & O'Reilly III, 1996).

Conceptual Framework and Propositions

As depicted in Figure 1, this study concerns ambidextrous firm strategies, innovation priorities, and subsequent innovation capabilities. It is contended that a firm's ambidextrous business strategy influences its ability to set ambidextrous strategic innovation priorities. Additionally, it is argued that a firm's ambidextrous business strategy and innovation priorities will influence the development of its ambidextrous marketing and information-systems strategies. Once these strategies are in place, the firm can position itself to build an ambidextrous innovation capability.

Ambidextrous business strategy

The business strategy of a firm serves as the competitive game plan that the organization will execute, in which the objective, scope, and goals will be outlined (Collis & Rukstad, 2008). From here, an ambidextrous business strategy can be defined as the visionary and objective-seeking order of actions that details how the organization will simultaneously compete and succeed in current and growth product markets. When we think of traditional business strategy notions, three business strategy types developed by Miles and Snow (1978) can be used: defenders, prospectors, and analyzers. Whereas defenders avoid risk associated with radically innovative products and stress operational efficiency, prospectors seek to initiate industry change, encourage experimentation through heavy R&D investments, and accept greater risk linked to revolutionary products. Analyzers are a balance between prospectors and defenders, except that they are extremely risk averse (Miles & Snow, 1978). In today's business environment, adopting one of these strategies will not allow a firm to keep up with industry competition and changing customer preferences (Markides, 2013). A firm must deploy an ambidextrous business strategy, which borrows concepts from these previously mentioned business strategy concepts. A firm adopting this strategy can develop plans that allows it to adapt to environmental changes and generate continual innovation (He & Wong, 2004; Gupta et al., 2006).

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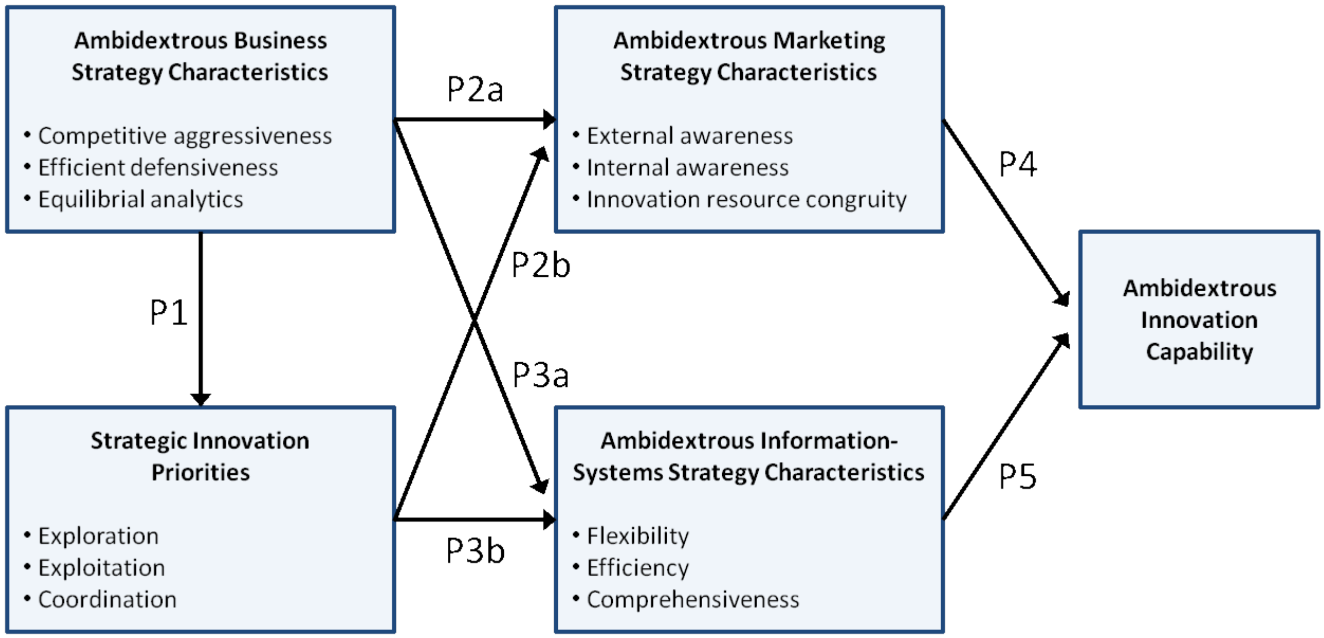

Figure 1. A continual innovation framework, with propositions about how a firm's ambidextrous strategies and priorities influence each other and the firm's ambidextrous innovation capability

In this study, an ambidextrous business strategy is characterized by competitive aggressiveness, efficient defensiveness, and equilibrial analytics. Competitive aggressiveness enables the firm to pursue exploration as a strategic innovation priority. Specifically, competitive aggressiveness demonstrates a firm's desire to invent new products, improve new product market returns, increase proactiveness via increased market scanning, and be adaptive through industry turbulence. On the other hand, exploitation can simultaneously be an innovation priority due to efficient defensiveness. Efficient defensiveness means the firm desires to achieve operational efficiency through economies of scale and cost-effective technology investments, while minimizing sales uncertainty by making incremental improvements to their current products (Sabherwal & Chan, 2001). Lastly, coordination can be actuated due to equilibrial analytics. As an internally and externally driven characteristic, equilibrial analytics is concerned with how the firm makes use of analytical competencies to solve resource allocation tensions generated in balancing efforts related to competitive aggressiveness and efficient defensiveness. For example, a firm can use novel technologies, such as predictive analytics, to make proactive strategic decisions with regard to dividing future investments in long-term and short-term innovations (Venkatraman, 1989; Sabherwal & Chan, 2001), thereby seeking to pursue exploration, exploitation, and coordination as key innovation priorities. As a result of the ambidextrous business strategy, these priorities mean that the firm intends to pursue ambidexterity throughout the innovation-management process. Thus, strategic innovation priorities should reflect this intention and should be comprised of exploration, exploitation, and coordination. Thus, the following is proposed:

> **Proposition 1:** *An ambidextrous business strategy characterized by competitive aggressiveness, efficient defensiveness, and equilibrial analytics will enable a firm to successfully pursue exploration, exploitation, and coordination as key strategic innovation priorities.*

Ambidextrous marketing strategy

An ambidextrous marketing strategy outlines the sequence of activities that will allow the firm to extend and exploit its resources for the exploration and attainment of the most significant market opportunities. Following traditional business logic, ambidextrous marketing strategy is driven by an ambidextrous business strategy, and is pertinent because dynamic markets are calling for a novel marketing approach to deal with the increasing levels of turbulence within the market (Matthyssens et al., 2005).

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In this study, an ambidextrous marketing strategy is characterized by external awareness, internal awareness, and innovation resource congruity. External awareness is concerned with the rational and methodological consideration of the firm's external opportunities and threats, so that radically innovative outputs are adequately matched with environmental shifts (Bourgeois & Eisenhardt, 1988). Thus, external awareness matches the external nature of exploration priority and seeks competitive aggressiveness business goals, such as greater new-product market returns and firm adaptability. On the other hand, internal awareness means that the firm will look to harness their internal strengths, minimize weaknesses, and incrementally modify the firm's marketing-related capabilities so that incrementally innovative outputs are adequate to handle minor external threats (Menon et al., 1999). Thus, internal awareness matches the internal nature of exploitation and exudes great focus on meeting efficient and defensive business goals, such as minimizing uncertainty in current product return and maximizing production efficiency. Lastly, innovation resource congruity can circumvent the issues that too much exploration and exploitation may cause. Resource congruity balances external and internal analytical decisions through cross-unit resource commitment meetings, where appropriate levels of human capital, time, and financial resources are allocated toward marketing activities, such as setting market performance goals and assessing the scale and scope of innovation (Menon et al., 1999), market experimentation, and product development. Resource congruity is driven by the coordination priority and equilibrial analytics, as it seeks to balance exploration and exploitation in innovation-related marketing efforts. Thus, the following are proposed:

> **Proposition 2a:** *A firm can successfully develop an ambidextrous marketing strategy characterized by external awareness, internal awareness, and innovation resource congruity if their ambidextrous business strategy is characterized by competitive aggressiveness, efficient defensiveness, and equilibrial analytics.*

> **Proposition 2b:** *A firm can successfully develop an ambidextrous marketing strategy characterized by external awareness, internal awareness, and innovation resource congruity if exploration, exploitation, and coordination are their key strategic innovation priorities.*

Ambidextrous information-systems strategy

One of the most pervasive aspects of information-systems research is to ensure that systems are aligned with the business strategy. In fact, relevant literature has firmly established the importance of strategic alignment (Tallon & Pinsonneault, 2011; Tallon, 2007). Thus, following traditional business logic, an ambidextrous information-systems strategy is driven by an ambidextrous business strategy. Consequently, information-systems strategies are also critical to innovation, because they seek to develop the knowledge-handling capability of the firm (Zahra & George, 2002) and ensure that knowledge can be fed to production and supply chain operations that support innovative efforts (Frohlich & Westbrook, 2001).

An ambidextrous information-systems strategy is necessary to ensure that business demands spurred by radical and incremental innovation goals can be met by IT supply (Bot & Renaud, 2012), and that the firm has the technology to acquire, store, analyze, integrate, and utilize knowledge in a way that is conducive to meeting such goals; such a strategy is characterized by flexibility, efficiency, and comprehensiveness (Sabherwal & Chan, 2001). Flexibility means that the firm should be able to use their system for acquiring and analyzing externally-generated knowledge related to future innovations from external stakeholders. Although this notion seems like "old news", many established firms still use out-of-date systems and face challenges in gearing up for future product innovations. For example, whether a firm can collect data from active consumers by integrating their system with technologies such as smartphone location and video feed applications can help determine their success or lack thereof in radical innovations (Rao, 2009). On the other hand, efficiency means that the firm can use their operational support systems to monitor daily operations with regard to current products, assess operational efficiency (Sabherwal & Chan, 2001), and analyze ways of increasing productivity and profitability via incremental process innovation. An example of such efficiency benefits comes from the manufacturing industry, with firms such as General Electric and Siemens installing sensors to help them predict when machine maintenance is needed so that unplanned maintenance costs can be minimized (Buytendijk, 2013). This approach satisfies exploitation as an innovation priority and efficient defensiveness as part of the business strategy.

Lastly, comprehensiveness means that the external and internal technology structures can easily be integrated so that the firm can balance short-term incremental and long-term radical innovations across their partnership network. For example, technology manufacturers adopting enterprise resource-planning systems alongside predictive analytics software are positioned to realize greater operational and strategic performance because their strategic partners are aligned with their innovation needs. Thus, comprehensiveness balances flexibility and efficiency, and it also facilitates planning for current and future product innovations at the firm and strategic-partnership levels, satisfying the equilibrial analytics goal of the business strategy. Thus, the following are proposed:

> **Proposition 3a:** *A firm can successfully develop an ambidextrous information-systems strategy characterized by flexibility, efficiency, and comprehensiveness if their ambidextrous business strategy is characterized by competitive aggressiveness, efficient defensiveness, and equilibrial analytics.*

> **Proposition 3b:** *A firm can successfully develop an ambidextrous information-systems strategy characterized by flexibility, efficiency, and comprehensiveness if exploration, exploitation, and coordination are their key strategic innovation priorities.*

As a result of pre-innovation ambidextrous marketing and information-systems strategies, the firm is in position to build appropriate strategic innovation capabilities. Specifically, it is contended that these strategies can enable a firm to build an ambidextrous innovation capability (Lin et al., 2013), which will enable the firm to stay competitive and survive the dynamic business environment on the basis of exploration, exploitation, and coordination. External awareness paired with flexibility in information systems can help the firm build a superior exploratory innovation capability that enables them to increase their flexibility and competitiveness in new product markets, thereby increasing revenues (Bot, 2012) and market share (Jansen, 2005). Internal awareness paired with efficient utilization of information systems enables the firm to build strong exploitative innovation capability, resulting in the firm performing well in their existing businesses and increasing profitability through greater operational efficiency (Cao et al., 2009; He & Wong, 2004). Finally, innovation resource congruity paired with comprehensive information systems will allow the firm to control investment-allocation decisions in new product development with their strategic partners, allowing for continual innovations in both current and growth product markets. Thus, the following are proposed:

> **Proposition 4:** *A firm can successfully develop an ambidextrous innovation capability if its ambidextrous marketing strategy is characterized by external awareness, internal awareness, and innovation resource congruity.*

> **Proposition 5:** *A firm can successfully develop an ambidextrous innovation capability if its ambidextrous information systems strategy is characterized by flexibility, efficiency, and comprehensiveness.*

Implications and Conclusion

There are a number of research and managerial implications that spur from this study. First, this study has developed concepts at a high level. Therefore, researchers can further develop them into concepts that can be operationalized and conduct an empirical investigation to test the propositions that have been posited in this study. From a practitioner standpoint, company leaders can utilize Figure 1 and the discussion of its concepts to assess whether their current firm strategies and priorities are geared toward ambidexterity and continual innovation. Thus, this study and its framework can be used to help firms reposition themselves if necessary and cultivate their innovation capabilities to withstand unforeseen industry changes, especially for firms operating in fast-moving industries.

This study concentrated on the development of those strategies and priorities that are critical for a firm pursing ambidexterity. This study contends that building ambidexterity into the pre-innovation business, marketing, and information-systems strategies from the outset, and setting ambidexterity as a key strategic priority, can enable the firm to build an ambidextrous innovation capability and position it to continually succeed in incremental and radical innovation product markets. As a result, this study makes several contributions to extant innovation research. First, this study modifies the concept of ambidexterity by adding coordination as a mechanism that balances exploration and exploitation. Secondly, this research reconceptualizes three organizational strategies as ambidextrous strategies necessary for innovation: i) a business strategy that emphasizes competitive aggressiveness, efficient defensiveness, and equilibrial analytics; ii) a marketing strategy that emphasizes external awareness, internal awareness, and innovation resource congruity; and iii) an information-systems strategy that emphasizes flexibility, efficiency, and comprehensiveness.

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Altogether, this study emphasizes that a firm desiring the simultaneous accomplishments of incremental and radical innovations must be ambidextrous in business, marketing, and information-systems strategies and strategic priorities, and that failure to do so will render the firm unsuccessful.

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Nehemiah Scott is a PhD student in the Manufacturing & Technology Management program in the College of Business and Innovation at the University of Toledo, USA. He holds a BS in Computer Science and Engineering Technology and an MBA specializing in Information Systems from the University of Toledo. He also has corporate experience in the field of information systems working as a database programmer, and he has research and consulting experience in the area of process improvement. Nehemiah's main research interests include innovation and technology management, and supply chain management. His past research focused on innovation in bottom-of-pyramid societies and the supply chain. His current research focuses on ambidexterity for firm innovation and adaptation.

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Keywords: ambidexterity, exploration, exploitation, innovation, strategy

TIM Lecture Series The Laboratory for Analytic Sciences: Developing the Art and Science of Analysis

J. David Harris

> “*Our goal is to combine tradecraft and technology. We are examining not only the methodologies and the tools – the systems and the machinery – that we can create in hardware and software, but also the critical-thinking skills and structured analytic techniques that we can bring to bear when thinking about what the key questions are, what the data means to us, and how to make sense of it.*”
>
> J. David Harris
> Director, Laboratory for Analytic Sciences (LAS)

Overview

The TIM Lecture Series is hosted by the Technology Innovation Management program (TIM; carleton.ca/tim) at Carleton University in Ottawa, Canada. The lectures provide a forum to promote the transfer of knowledge between university research to technology company executives and entrepreneurs as well as research and development personnel. Readers are encouraged to share related insights or provide feedback on the presentation or the TIM Lecture Series, including recommendations of future speakers.

The fifth TIM lecture of 2014 was held at Carleton University on July 8th and was presented by David Harris, Director of the Laboratory for Analytic Sciences (LAS; ncsu-las.org), a government, academic, and industry collaboration whose mission is to imagine, investigate, and implement innovative classified and unclassified solutions for a variety of tactical and strategic analytic challenges, including those related to cybersecurity.

Summary

The goal of the lecture was to share the early experiences and lessons learned in the Laboratory for Analytic Sciences and gather feedback from those who may have similar experiences or have faced analogous challenges. In the first part of the lecture, Harris provided a brief introduction to the laboratory and its analysis framework. In the second part of the lecture, he discussed the lab's current work and demonstrated a collaboration tool they are using to both help improve the lab's efficiency and enhance its analytic approach.

About the laboratory

The activities of the laboratory are centred on the development of a science of analysis to address both near-term problems and long-term strategic challenges of critical importance. Thus, the lab's work includes a strong research dimension, but it is also tasked with solving real-world problems that are affecting the community today. Cybersecurity is an area of focus, but the research and methodologies are applicable to a wide range of analogous domains, including healthcare, financial services, energy, agriculture, and retail, among many others.

Although the laboratory is based on a campus of North Carolina State University (Figure 1), it is the physical working space for a consortium of members from government, academia, and industry who bring a diversity of educational backgrounds, work roles, and experiences. Only about half of the people have backgrounds in science, technology, engineering, or math (STEM) in recognition of the broad dimensions of the challenges that need to be addressed, which extend well beyond the STEM fields and which will require non-technical innovation and input. Co-locating diverse staff from the various consortium members encourages interaction

TIM Lecture Series – The Laboratory for Analytic Sciences

J. David Harris

Figure 1. The Laboratory for Analytic Science on the campus of North Carolina State University

and collaboration between individuals who may bring their own unique and innovative approaches to problems. Working groups can be easily assembled and disassembled as work on particular challenges progresses.

Having completed its "ideation" phase, the laboratory is approximately one year through its initial three-year timeline and is currently in its "commit" phase. The laboratory currently houses 17 staff, with plans to expand to around 100 once it reaches its "validation" and "scale" phases.

The LAS analysis framework

The analysis framework under development at the LAS is based on the simultaneous need to look backwards with global awareness (i.e., making sense off a massive amount of "big data" from many sources) and to look forwards with strategic foresight (i.e., trying to anticipate where the currents within the stream of data will be going next). The framework depends on three ongoing activities:

1. **Reflecting on the past:** taking into account what we know about the data based on hindsight; saving and structuring past events

2. **Observing the present:** identifying events of interest, deciding which are more or less important, focusing efforts on specific areas within the sea of data

3. **Imagining the future:** making predictions, prioritizing where to look for future events that may form part of a potential narrative of events, developing "devil's advocate" predictions interpretations or assumptions are flawed

These activities are not only performed with past-to-future direction in mind; later events can inform our interpretations and activities about past events. For example, looking back at what actually happened can highlight missing pieces of the story about which we failed to collect data or about which we need to refine our interpretation. And ongoing back-and-forth between our interpretations of past, present, and future is the only way to fill in the picture and improve our capabilities for predicting events based on massive amounts of unstructured data. The overall goal is to improve both narrative processing (i.e., the telling of the story in a compelling and meaningful way) and analytic workflow (i.e., improving our ability to take meaningful actions in response to the data).

Demonstration: Collaboration tools in the laboratory

Finally, Harris demonstrated an online collaboration tool that is currently in use within the laboratory. Based in part on Yammer (yammer.com), a "private enterprise social network", the collaboration tool helps lab members interact, build relationships, and take advantage of the multidisciplinary approach. All of the entries about the activities of individuals are tagged so the data can be mined later, and the overall platform integrates various other tools (e.g., 4square, OSX, Google Glass), including automated event recording and interpretation, and other inputs. Thus, the tool not only contributes to the efficiency of the lab, but through its use, the lab is assembling a large and structured dataset with which it can test and refine its analytic framework and approach. The goal is to collect and mine data, then build stories (both imagined and observed), that can enable meaningful actions.

TIM Lecture Series – The Laboratory for Analytic Sciences

J. David Harris

About the Speaker

J. David Harris is the inaugural Director of the Laboratory for Analytic Sciences in Raleigh, North Carolina, where the aim is to develop a science of analysis and analytic methodology. During nearly 25 years service with the U. S. Department of Defense, David has worked in a variety of technical and leadership positions in areas of research and development, technology transfer, and operations.

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This report was written by Chris McPhee.

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Topic

Start by asking yourself:

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- Do I often find myself having to explain this topic when I meet people as they are unaware of its relevance?
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- Emphasize the practical application of your insights or research.
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- Demonstrate your depth of understanding for the topic, and that you have considered its benefits, possible outcomes, and applicability.
- Write in a formal, analytical style. Third-person voice is recommended; first-person voice may also be acceptable depending on the perspective of your article.

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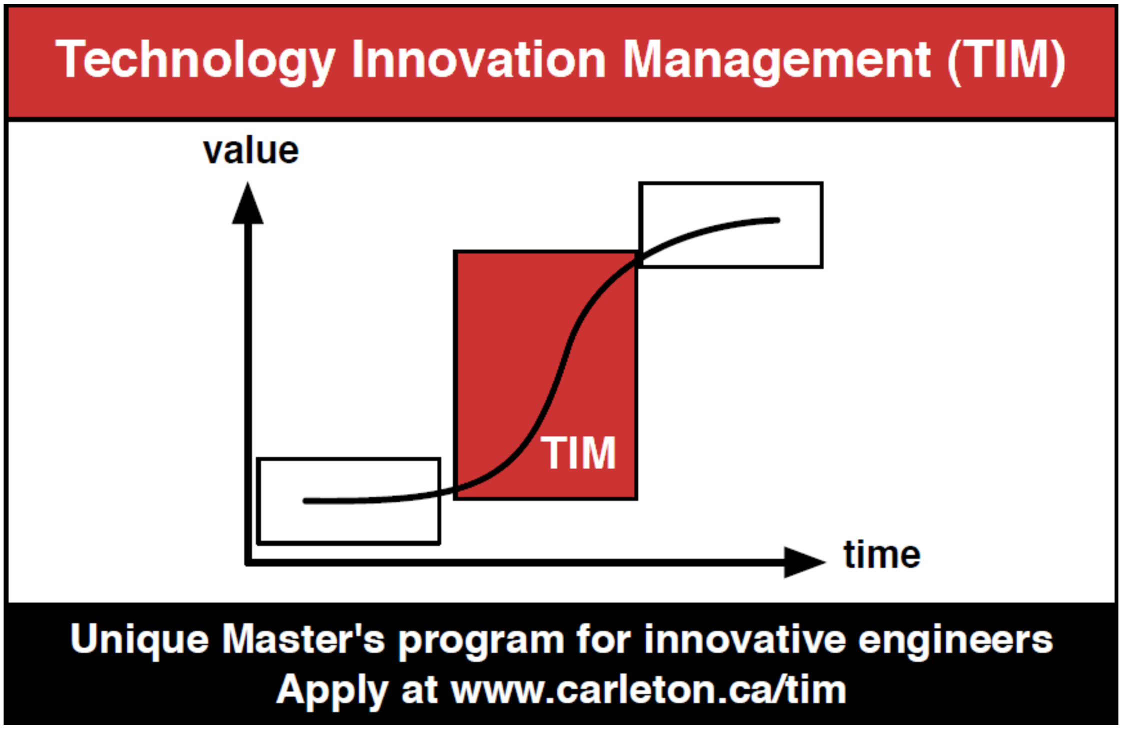

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