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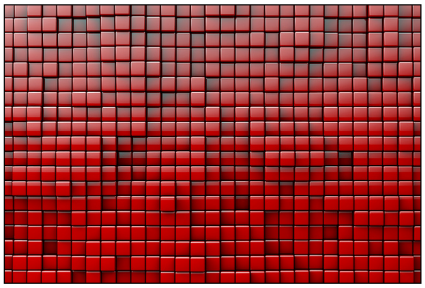
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Insights

Welcome to the May 2015 issue of the *Technology Innovation Management Review*. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

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

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

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

Contribute

Contribute to the TIM Review in the following ways:

- Read and comment on articles.
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- Write an article for a future issue; see the author guidelines and editorial process for details.
- Recommend colleagues as authors or guest editors.
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- Sponsor or advertise in the TIM Review.
- Tell a friend or colleague about the TIM Review.

Please contact the Editor if you have any questions or comments: timreview.ca/contact

About TIM

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

Editorial: Insights

Chris McPhee, Editor-in-Chief

Welcome to the May 2015 issue of the *Technology Innovation Management Review*. In this issue, our authors present insights about patent trolls, service innovations, business ecosystems, open source policies, and cybersecurity in the Internet of Things.

In the first article, **Derek Smith**, Vice President of Intellectual Property at Geotab Inc., argues that a good offense is the best defense against patent trolls. By analyzing the literature on the business models of coercive patent-holding firms, he develops a framework to reveal insights – and strategic countermeasures – to disrupt the profit formula, key resources, and key processes of such firms. His article includes five practical recommendations to help entrepreneurs and executives prepare for involuntary engagements with coercive patent-holding firms.

Next, **Marikka Heikkilä**, **Jouni Saarni**, **Valtteri Kaartemo**, and **Aki Koponen** from the University of Turku in Finland present the "viability radar": a tool to assess the innovation potential of transformative service ideas. The viability radar was developed through an assessment of the innovation potential of three pilot cases of new transformative healthcare services. The tool draws on the service research and innovation literature but is operationalized using questions about an innovation's technology, business model, value network, and related regulations and standards.

Michael Weber and **Michael Hine** from Carleton University's Sprott School of Business in Ottawa, Canada, examine the terms used to describe business ecosystems and their inhabitants with the aim of developing common language and concepts that will remove ambiguity and encourage a clear understanding of the relationships and components of business ecosystems. Through an analysis of the biological and business ecosystem literature, they propose a business ecosystem model anchored around interdependent "technospecies", which are unique entities based on their organizational routines, capabilities, and use of technology.

Then, **Hassib Khanafer**, Chief Technology Officer at Protecode, answers the question, "Does a software development firm need an open source policy?", by highlighting the value of integrating open source management tools into development environments. He describes the key elements of an open source policy and argues that, when used in conjunction with open source management and monitoring tools, such a policy can help software development firms overcome uncertainties relating to the adoption of open source software in terms of licensing issues, security vulnerabilities, and export control regulations.

Finally, this issue includes a summary of a recent TIM Lecture presented by **Jeff Greene**, Director of NAM Government Affairs & Senior Policy Counsel at Symantec. Greene provided an overview of the Internet of Things to compare the hype versus reality and to examine the security implications of connecting myriad physical devices to the Internet and to each other.

In June, we cover the theme of **Critical Infrastructures and Cybersecurity** with guest editors **Dan Craigen**, Science Advisor at Communications Security Establishment Canada, and **Steven Muegge**, Assistant Professor in the Sprott School of Business at Carleton University in Ottawa, Canada.

Along with **Ibrahim Gedeon**, Chief Technology Officer at TELUS, **Dan Craigen** is also the co-editor of our newest title in the "Best of TIM Review" book series (timbooks.ca). The book features 15 of the best articles on cybersecurity published in the TIM Review, selected and introduced by the co-editors, and with a foreword from **Eros Spadotto**, Executive Vice President of Technology Strategy at TELUS. *Cybersecurity: Best of TIM Review* is available for purchase from Amazon in ebook format for Kindle (amazon.com/dp/B00XD3O6L0/). All proceeds support the ongoing operation of the TIM Review.

In July, we welcome professors **Patrick Cohendet** and **Laurent Simon** from HEC Montréal as guest editors for a special issue on the theme of **Creativity in Innovation**.

For our August issue, we are accepting general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions. We hope you enjoy this issue of the TIM Review and will share your comments online.

Chris McPhee
Editor-in-Chief

Editorial: Insights

Chris McPhee

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. He holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. Chris 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.

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Keywords: innovation management, patent trolls, non-practicing entities, social innovation, transformative innovation, business ecosystems, open source software, open source policies, cybersecurity, Internet of Things

Disrupting the Disrupter: Strategic Countermeasures to Attack the Business Model of a Coercive Patent-Holding Firm

Derek Smith

> *" Targeted companies have minimal leverage to do anything save for agreeing to the troll's settlement demands or litigating the matter full-tilt. "*
>
> John F. Luman III and Christopher L. Dodson
> Partner and Associate, Bracewell & Giulani LLP

A coercive patent-holding firm operates a business model that strategically targets firms to force unforeseen patent licensing rents. Coercive patent holders use aggressive litigation tactics to instantaneously create a complicated asymmetrical expensive problem with significant business risk. The strategy creates a dominant position by leveraging legal and business pressure to force the targeted firm into an involuntarily engagement with a coercive patent-holding firm. Such engagements can be quite profitable for the patent holders – and quite devastating for targeted firms. Thus, this article attempts to synthesize a business model framework that reveals insights concerning the profit formula, key resources, and key processes that support the dominant position of coercive patent-holding firms. Based on this framework, we further synthesize countermeasures to disrupt these business model elements and diminish the dominant position. The insights and countermeasures reveal strategic options and tactics that can be leveraged against the business model of a coercive patent-holding firm to alter the dominant position and improve the business situation of the targeted firm.

Introduction

Coercive patent-holding firms assemble an arsenal of patents applicable to specific markets or areas of technology (Fischer & Henkel, 2012). The strategy is to immediately deliver a significant amount of litigation pressure and business risk to a targeted firm and force licensing rents from the firm. A traditional approach to avoid patent infringement against a patent-holding firm is a "freedom to operate" study to identify potentially adverse patents and proactively prepare against potential patent infringement. However, this approach is deficient against coercive patent-holding firms because it is difficult to identify all potentially adverse patents (Pénin, 2012). This difficulty is amplified when dealing with either a strategy of hiding key patents in "thickets" comprising many overlapping patents (Reitzig et al., 2006) or a strategy of continuation patents, where current United States Patent & Trademark Office policy permits a series of patents and additional claims that are re-developed for several years into the future from the filing date of the original patent application. Merges (2009) suggests there is no way to protect against a coercive patent holder, and it is almost impossible to effectively insure against the business risk.

Previous research into coercive patent-holding firms is mixed and discontinuous. Researchers have examined:

1. The financial side and wealth transfer from targeted firms (e.g., Bessen et al., 2012; Lu, 2012)

2. The makeup and quality of the patent arsenal (e.g., Fischer & Henkel, 2012)

3. Firm behaviour and negative labels such as patent trolls, sharks, and non-practicing entities (e.g., Geradin et al., 2011; Layne-Farrar & Schmidt, 2010)

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4. The relationship to innovation (e.g., Luman III & Dodson, 2006; Merges, 2009; Shrestha, 2010)

5. Strategies and business pressure-building tactics (e.g., Columbi & Blasberg, 2006; Tekic & Kukolj, 2013; Togh, 2007)

6. Reforming patent office policy (e.g., Burk, 2013; Cotropia, 2009; Luman III & Dodson, 2006)

Previous research reveals two important gaps. There remains no clear formulation of a business model framework for coercive patent-holding firms as it relates to the business model elements and interdependencies between the value proposition, profit formula, key resources, and processes. There are no clear countermeasures focused on these business model elements and interdependencies for altering the dominant position of the coercive patent holder. Countermeasures could enable targeted firms to effectively disrupt the coercive patent holder's business model and diminish their dominant position.

This article makes two contributions. First, it provides a business model framework for coercive patent-holding firms that reveals insights around the elements and interdependencies that create and support the dominant position and customer value proposition. Second, it provides a number of countermeasures that can be leveraged alone or in combination to disrupt the business model elements and interdependencies in a way that alters the dominant position and improves the business situation of a targeted firm relative to the coercive patent-holding firm.

The remainder of this article includes five sections. The first section reviews the literature on coercive patent-holding firms. The second section provides a business model framework for those firms. The third section provides countermeasures against the business model framework; in particular, it outlines tactics and options directed towards key resources, key processes, and the profit formula of coercive patent-holding firms. The fourth section provides recommendations for entrepreneurs and executives. The fifth and final section offers conclusions.

A Review of the Literature on Coercive Patent-Holding Firms

The objective of this literature review is to examine the current state of knowledge concerning coercive patent-holding firms. The relevant literature was located using a broad keyword search of scholarly journals in the Business Source Complete database (http://www.ebscohost.com/academic/business-source-complete).
The keywords were a combination of: "patent", "troll", "shark", and "non-practicing entity". A close examination of the article abstracts with a focus on coercion revealed a list of 15 articles relevant to coercive patent-holding firms.

The articles covered six different perspectives relating to coercive patent-holding firms:

1. Financial aspects (Bessen et al., 2012; Lu, 2012; Pénin, 2012; Reitzig et al., 2007). These articles included aspects of litigation and the relationship to wealth and the stock price of a firm; licensing fees in relationship to over and under payment of rents; the profitability of the business model; and the consequences of R&D investments.

2. Patent quality and calibre (Fischer & Henkel, 2012).

3. Behaviour of coercive patent-holding firms (Geradin et al.,, 2011; Layne-Farrar & Schmidt (2010)

4. Effects on innovation (Luman III and Dodson, 2006; Merges, 2009; Shrestha, 2010)

5. Classification and attributes of a firm that litigates patents as a sole source of revenue (Abril & Plant, 2007; Pohlmann & Optiz, 2013)

6. Strategies and tactics for and against coercive patent-holding firms (Columbia & Blasberg, 2006; Tekic & Kukolj, 2013; Toth, 2007)

As shown in Figure 1, the general business model framework adapted from Johnson, Christensen, and Kagermann (2008) provides a lens and first perspective to examine the literature from the basic elements of a business model: a customer value proposition, a profit formula, key resources, and processes.

Examining the literature through the lens of the general business model framework revealed a number of factors and key points associated with each business model element that can be further synthesized into a business model framework for coercive patent-holding firms. Tables 1a through 1d summarize the results and list factors and key points relating to each business model element.

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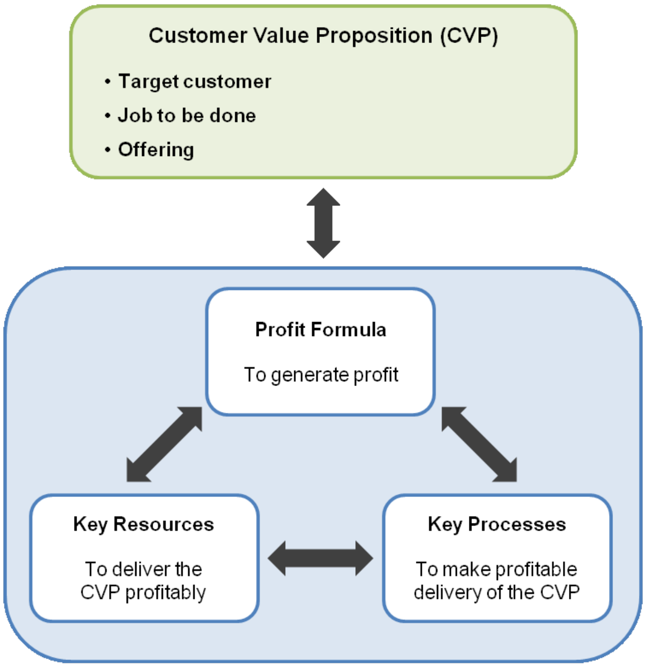

Figure 1. General business model framework (adapted from Johnson et al., 2008)

The literature was also examined from a second perspective: that of targeted firm business practices when dealing with coercive patent-holding firms. Examining the literature from the second perspective revealed key points for deficiencies that can be detrimental to the targeted firm and countermeasures that can interfere with the business model elements and interdependencies of the business model framework for coercive patent-holding firms. Tables 2a and 2b summarize the results and lists factors and key points relating to the patent business practices of the targeted firm and potential countermeasures against the business model of coercive patent-holding firms.

Business Model Framework for Coercive Patent-Holding Firms

The business model framework for coercive patent-holding firms begins with the general business model framework of Johnson, Christensen, and Kagermann (2008). Then, business model factors and key points from the literature on coercive patent holders are synthesized to form a customer value proposition, a profit formula, key processes, and key resources required to deliver the customer value proposition of coercive patent-holding firms, as shown in Table 3. Figure 2 illustrates the overall framework, and the subsections that follow describe each of the elements in greater detail.

Customer value proposition for coercive patent-holding firms
The target customer of a coercive patent-holding firm is another firm, preferably a firm with locked-in or complex technology. These factors increase the business risk for the target customer. The target customer may also be an end user of the technology. The task is to apply graduated patent-litigation pressure and to increase business risk to the technology firm while creating and maintaining a dominant advantage (Luman III & Dodson, 2006). The offering is a licensing fee corresponding to the asserted patents.

Profit formula of coercive patent-holding firms
The revenue model is solely based on patent licensing fees (Layne-Farrar & Schmidt, 2010) such as one-time payments, running royalties, or a combination of both (Fischer & Henkel, 2012; Reitzig et al., 2006; Tekic & Kukolj, 2013; Toth, 2007). The cost structure is primarily determined by time and is preferably based on contingency fees (Abril & Plant, 2007) so that professionals do not receive compensation unless there is a successful license of the patent(s). The margin is based on targeting the upstream value chain, especially with vertically integrated technology, to ensure higher margins for the licensing revenue. Licensing the patent with minimal time, effort, and resources is key to the margin. The licensing revenue can also be proportional to the expense of defending the patent litigation. The resource velocity is preferably fast, with early licensing to minimize the cost structure of time and effort and to enable redeployment of the resources to the next targeted firm.

Key resources
The business model relies upon a blend of litigators, technical experts, and business negotiators. The key asset is the arsenal of patents (Fischer & Henkel, 2012; Merges, 2009) that forms the basis for licensing at least one patent per technology firm. High-level information is initially required concerning the targeted firm's product information. The channels are specific to the technology focus of a coercive patent-holding firm and relate to specific market segments or technologies (Fischer & Henkel, 2012). Partnerships and alliances relate to patent litigation firms to provide a pool of resources on demand. The coercive patent holder's brand varies with the level of success, the total dollar amount of a license, and the business approach to licensing.

Key processes
A market analysis is required to understand the value chain and potential targets for licensing and the timing of licensing (Fischer & Henkel, 2012; Lu, 2012; Lumann

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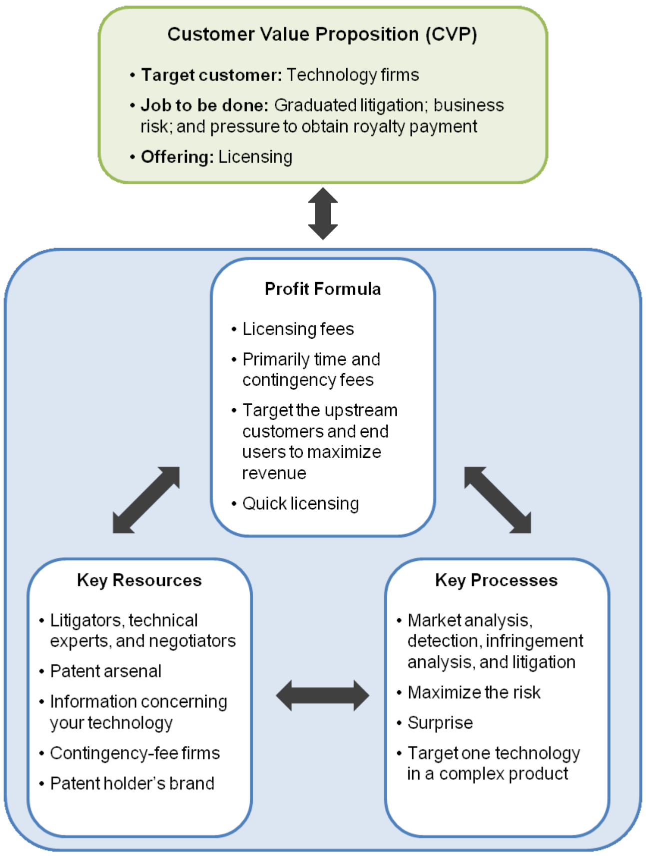

Figure 2. Business model framework for coercive patent-holding firms

III & Dodson, 2006). An analysis is also required to identify and target firms (Lumann III & Dodson, 2006) and any potential for multiple co-defendants (Bessen et al., 2012; Lu, 2012). An initial high-level infringement analysis provides the information required to bring an action for patent infringement. The litigation process is country dependent. A patent reexamination process may be required depending on the response from a targeted firm. Finally, the norms are to maximize litigation pressure and business risk to the targeted firm and to acquire an early dominant position and then maintain it.

Countermeasures That Disrupt the Business Model of Coercive Patent-Holding Firms

In this section, factors and key points from the literature are synthesized and focused around the profit formula, key processes, key resources, and interactions between these business elements. Countermeasures to disrupt the business model of coercive patent-holding firms are illustrated in Figure 3.

Competitive intelligence countermeasures
Targeted firms must proactively develop competitive intelligence to identify and monitor coercive patent-holding firms active in particular technology markets (Fischer & Henkel, 2012; Pénin, 2012; Reitzig et al., 2006) and the competitive patent landscape. Coercive patent-holding firms are identifiable from their behaviour. They tend to file a lawsuit before any discussion with the targeted firm, the lawsuit is typically based on a number of continuation patents, they keep at least one continuation patent application pending before the patent office, and they select a venue favourable to the coercive patent-holding firm business model, such as the Eastern District of Texas or Delaware. Gathering competitive intelligence removes the surprise factor from the coercive patent holder and the potential for inadvertent infringement (Bessen et al., 2012; Fischer & Henkel, 2012; Reitzig et al., 2011). Once a coercive patent-holding firm is identified for a particular technology market, it may be monitored through the Internet to track patent assets (Reitzig et al., 2006) at the patent office and litigation activity (Geradine et al., 2011). Monitoring the litigation activity may provide an early warning and reveal higher-threat patent assets (Tekic & Kukolu, 2013). An evaluation with respect to the history of the litigated patent and the litigation forum (Toth, 2007) can provide useful insight. Firms should also identify and monitor continuation practice in the United States to determine if additional patent claims are being re-developed. Competitive intelligence also permits an early opportunity to identify, collect, and catalog prior art material against the identified patent assets.

Firms should evaluate identified patents to determine the quality (Geradine et al., 2011; Toth, 2007) or a conduct a hazard analysis from the perspective of infringement (Columbia & Blasberg, 2006) to assist with managerial decisions. Higher-quality patents may suggest quick settlement and lower-quality patents may suggest a longer delay to settlement.

Profit formula countermeasures
Targeted firms can focus on a number of areas in the profit formula of coercive patent-holding firms. A early resolution to the issue with the lowest possible license fee can avoid the business and legal risk and financial expense associated with a patent litigation (Fischer & Henkel, 2012; Toth, 2007). An early license fee before the patent holder spends time and money can reduce the cost of a license fee. Alternatively, a targeted firm can also press forward with the patent litigation, driving up the time and expense for the coercive patent-

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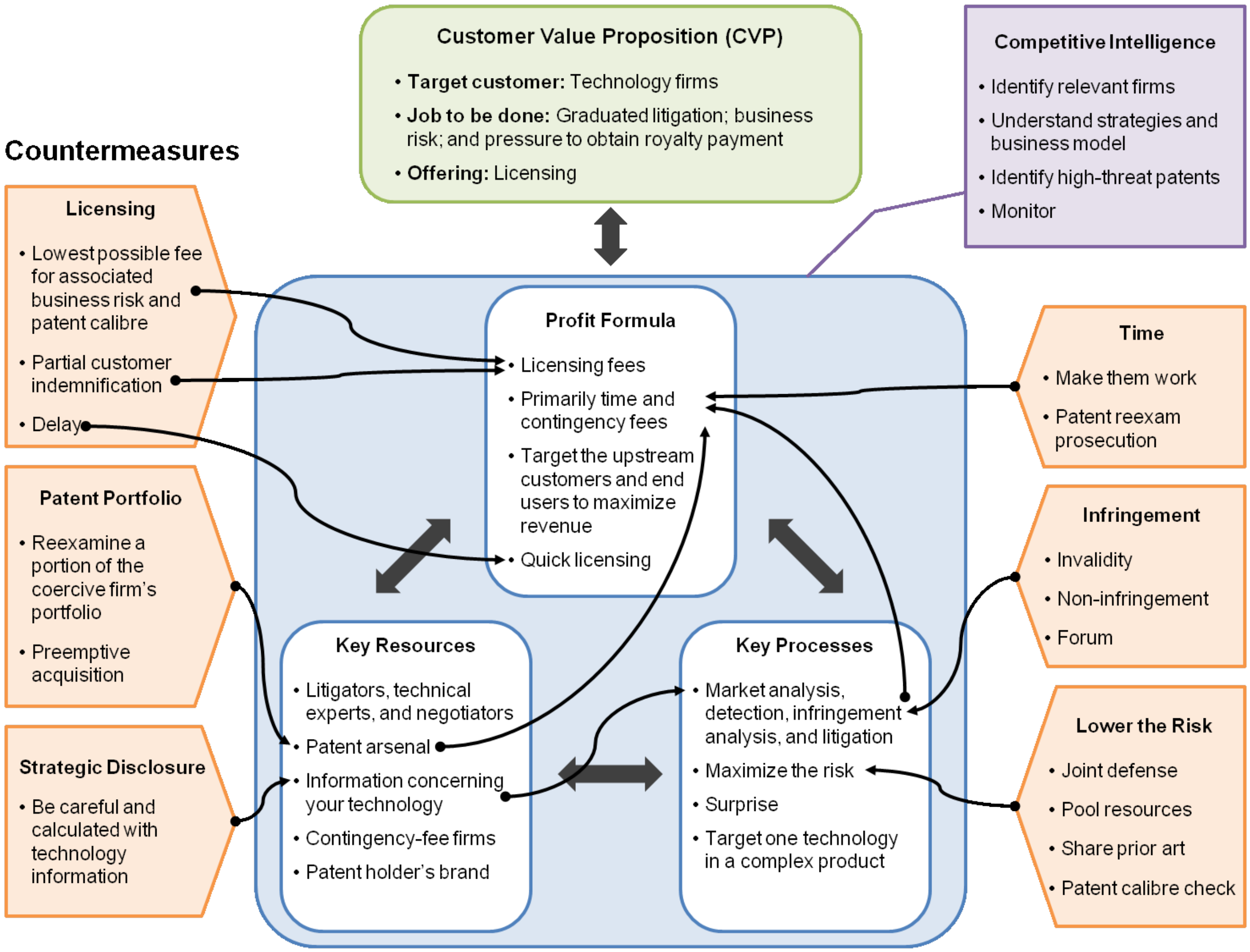

Figure 3. Countermeasures and their impacts on the business model elements of coercive patent-holding firms

holder and delaying any potential license fee (Toth, 2007). Driving up the time and expense impacts the profit margin. If there are concurrent litigations with the same patent, the targeted firm can be open and seek early collaboration and information exchange with other defendants (Pénin, 2012) to weaken the patent holder's position and form defense alliances (Columbia & Blasberg, 2006), driving up time and expense for the patent holder. Partial customer patent indemnification can reduce a license fee in some situations by lowering the litigated party's legal expenses associated with a license fee.

Key resource countermeasures

One of the key resources for a coercive patent-holding firm is the patent or portfolio of patents in a particular technology market. Targeted firms have the option to identify and acquire patents to preventing them from becoming a key resource for the coercive patent-holding firm (Toth, 2007). This approach may be undertaken by a single firm alone or in collaboration with other technology firms. A targeted firm may have the patent or patents reexamined (Toth, 2007), driving up time and expense to the patent-holding firm and interfering with its profit formula. Strategic reexamination applied to a select number of patents can tie up and disrupt these patents for several years into the future. Technology firms should be careful with disclosing or releasing confidential information and details surrounding the technology to make it more difficult for the coercive patent-holding firm to identify any potential patent infringement.

The second key resource is people, for example litigators, technical experts, and business negotiators. To further interfere with the profit formula, targeted firms can drive up the amount of time the coercive patent-holding firm must enlist from these people, especially for

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contingency-fee professionals. The targeted firm can increase the demands for these expensive experts by, for example, delaying the time to achieving a license fee or pressing forward in the patent litigation while continuing to negotiate a license.

Interfering with either or both of these two key resources also interferes with the profit formula in the form of time and expense, especially when contingency fee firms are involved. Litigation can also be disrupted when the patent enters into reexamination.

Key process countermeasures
One of the key processes for a coercive patent-holding firm is the initial infringement analysis and litigation process. The process is designed to maximize the risk to the targeted firm. A targeted firm can assert invalidity of the patent either in the litigation or with the patent office. This assertion also disrupts the profit formula by increasing the amount of time and effort required by the patent holder. A targeted firm can also assert non-infringement of the patent to disrupt the profit formula. Another option is to move the litigation to a more favourable forum (Toth, 2007) and consider a joint defense to pool resources. A more favourable forum is a jurisdiction that historically tends to render decisions in favour of defendant and at the expense of the patent holder.

There are also technology options to lower the risk. One option is to design around the patent (Fischer & Henkel, 2012; Layne-Farrar & Schmidt, 2010; Reitzig et al., 2006) and limit the future risk of licensing fees and infringement. Firms should keep their technology options open (Reitzig et al., 2006; Toth, 2007) to lower the future risk associated with infringement. They can remove dependencies on particular technologies (Reitzig et al., 2006), identify a range of alternate technologies and substitute technologies (Reitzig et al., 2006), and build a modular architecture to permit rapid change (Pénin, 2012). However, firms should exercise caution when using or incorporating third-party technology (Columbia & Blasberg, 2006), especially standards-based technology.

Recommendations for Entrepreneurs and Executives

From a close reading of the published research on coercive patent-holding firms; through induction and synthesis focusing on the targets, revenue stream, patent arsenal, targeted firm oversights, strategies, countermeasures, and calibre of patents from coercive patent-holding firms; and drawing upon the author's practical experience as an intellectual property management consultant and patent agent, five recommendations are offered for entrepreneurs and executives seeking to be prepared and ready to deal with a coercive patent-holder.

1. Proactively gather relevant competitive intelligence about coercive patent-holding firms.
Identify coercive patent-holding firms that are relevant to your technology market and business. This is no different than identifying competitors and customers relating to your technology company. Once you compile a list of relevant patent-holding firms, identify the patents of interest to your technology or business. To gather relevant competitive intelligence, monitor the activities of the patent-holding firms, the patents of interest, and key litigations against competitors or end users. Find and track relevant prior art technology, and make use of Internet information portals relating to coercive patent-holding firms. These activities must be done as early as possible and on an ongoing basis so that you are prepared for any engagement by a patent holder.

2. Be prepared to disrupt the profit formula of a coercive patent-holding firm.
The profit formula may be disrupted directly or indirectly through the key resources and key processes. Take advantage of an early resolution of the litigation with the lowest possible fee before the patent holder spends time and money driving up the license fee. Alternatively, delay the resolution and drive up the time and expense to make a tradeoff with the license fee while lowering the margin of the coercive patent-holding firm.

3. Have a strategy to disrupt the key patent resource.
The key patent resource may be disrupted through a patent reexamination procedure. The larger the number of patents placed into a reexamination procedure, the larger the disruption to the key patent resource. This disruption will continue for several years. Disrupting the key patent resource also indirectly disrupts key processes concerning litigation, infringement, and validity as well as indirectly disrupting the profit formula by increasing time and expense while lowering the margin. A strategy to disrupt one or more patent resources increases the patent holder's time and expense while lowering the profit margin and can be helpful in negotiating a lower licensing fee. Minimal risk with a maximum disruption can occur when you target patents that cannot be asserted against your business or

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technology. Another option is to target patents that cannot be asserted against you and are in active litigation against other firms.

4. Know the calibre of the patent held by the coercive firm.
Assessing the quality or calibre of the asserted patent provides valuable information and insight in support of business decisions. Smith (2014) provides a comprehensive review of citation-based patent evaluation methodologies that may be applied to evaluate a patent. A high-calibre patent suggests a business decision towards seeking an early business solution.

5. Ensure you have a flexible technology architecture.
A flexible and modular technology architecture helps reduce risk and provides options. Identify and keep a range of alternate and substitute technology modules available that may replace portions of the technology architecture. Be careful with integrating or relying upon third-party technology, especially technology based on industry standards.

Conclusion

This article focused on developing a business model framework for coercive patent-holding firms that reveals insight into the business model elements and interdependencies required by the profit formula, key resources, and processes to deliver the customer value proposition. This article also provides a range of countermeasures against the profit formula, key resources, and processes to disrupt the business model of coercive patent-holding firms. Leveraging these countermeasures against a coercive patent holder provides strategic and tactical advantage to disrupt the business model of such a firm and improve the business situation of the targeted firm. Entrepreneurs and executives can leverage these countermeasures to directly raise the adversary's business risk by disrupting a combination of key business elements to alter the dominant position of a coercive patent-holding firm.

Policy makers need to re-think the rules governing continuation practice in the United States and address the inequity of permitting a patentee the opportunistic ability to re-develop patent claims from an old patent application based on direct reference to present day technology. In parallel with this policy issue, firms need to re-think the business practice applied to avoid and defend against patent infringement. A freedom-to-operate approach involves searching databases for relevant patents in a particular area of business or technology. This older approach is limited in that it is very difficult to find all the relevant patents, and coercive patent-holding firms tend to hide patents by assigning patents to many different company names. Firms could transform the behaviour from a freedom-to-operate approach that is limited against coercive patent holders to that of a strategic countermeasure approach that targets the business model of coercive patent holders to alter their dominant position.

Further research should focus on refining the understanding of the business model of coercive patent-holding firms in the areas of the profit formula, key resources, and processes. Further research should also examine case studies of targeted firms that have successfully disrupted the business model of coercive patent-holding firms, specifically examining how they disrupted the interactions between the profit formula, key resources, and processes.

Entrepreneurs and executives must be ready for the day when they become unwillingly engaged with a coercive patent-holding firm. They must identify and monitor patent holders related to their market and technology segment. By proactively targeting and be prepared to disrupt the business model of a coercive patent-holding firms, firms can overcome the threat they represent.

About the Author

Derek Smith is the founder and principal of Magneto Innovention Management, an intellectual property consulting firm that assists entrepreneurs and small businesses with difficult intellectual property issues. He is also the Vice President of Intellectual Property for Geotab Inc. and a registered patent agent in both Canada and the United States. He has over 25 years of experience working as an intellectual property management consultant and patent agent for IBM Canada, Bell Canada, and Husky Injection Molding Systems, where he was Director of Global Intellectual Property. Prior to entering the field of intellectual property, he was an advisory engineer at IBM Canada, where he was involved in a variety of leading-edge software development projects. Derek holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, for which he was awarded a Senate Medal for Outstanding Academic Achievement. Derek also holds a BEng degree in Systems and Computer Engineering, also from Carleton University.

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Table 1a. Customer value propositions of coercive patent-holding firms: factors and key points

Factors	Key Points
Target Customers	• Technology firms with irreversible capital investment (Lu, 2012) or locked-in technology (Geradin et al., 2011) or unsuspecting firms (Lumann III & Dodson, 2006) • Know which firms will fight and which will settle (Lumann III & Dodson, 2006)
Job to Be Done	• Use litigation tactics to create a complex, expensive, and highly risky business situation (Luman III & Dodson, 2006) to leverage maximum business pressure and risk to the coercive patent-holding firm's benefit (Lumann III & Dodson, 2006)
Offering	• Patent licensing and royalty payment (Abril & Plant, 2007; Fischer & Henkel, 2012; Reitzig et al., 2006; Tekic & Kukolj, 2013;Toth, 2007)

Table 1b. Profit formula of coercive patent-holding firms: factors and key points

Factors	Key Points
Revenue Stream	• Use minor innovations in a powerful approach to seek rents (Merges, 2009) where the strategy and approach enhances an ability for higher royalties (Geradin et al., 2011) • Based on the threat and risk of patent litigation where the revenue is proportional to the threat (Tekic & Kukolj, 2013) and the expense of patent litigation (Bessen et al., 2012) • Sole source of revenue is based on patent licensing (Layne-Farrar & Schmidt, 2010) where litigating a patent is more valuable than not litigating and practicing the patent (Lu, 2012)
Cost Structure	• Cheap, low-cost (patents) raw materials (Pénin, 2012) • Litigation with multiple co-defendants (Bessen et al., 2012; Lu, 2012) • Acquisition (Bessen et al., 2012) from firms poorly positioned to license (Fischer & Henkel, 2012; Merges, 2009), struggling companies, cash strapped or firms in bankruptcy (Luman III & Podson, 2006) as well as technology firms (Pénin, 2012) where the acquired low-cost patents have a high probability of infringement (Pénin, 2012) • Contingency-fee approach to litigation (Abril & Plant, 2007)
Margin Model	• Create a weak position for the target firm to negotiate (Lu, 2012)
Resource Velocity	• "Early bird special" approach to quick settlement and licensing fees (Coumbia & Blasberg, 2006)

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Table 1c. Key resources of coercive patent-holding firms: factors and key points

Factors	Key Points
Patent Arsenal	• Seeking to acquire patents that are enforceable (Abril & Plant, 2007; Columbia & Blasberg, 2006; Fischer & Henkel, 2012; Merges, 2009) • Attributes include patents that may be essential to the technology or applicable to a particular standard (Layne-Farrar & Schmidt, 2010) such as telecommunications, older patents drafted to cover mainstream technology with a higher threat profile (Tekic & Kukolu, 2013) • Inventory includes business-method patents (Columbia & Blasberg, 2006) and bundles of patents in particular technology areas (Abril & Plant, 2006)
Calibre of Patent Arsenal	• Broad claims allowing for vague evidence in litigation (Bessen et al., 2012; Takei & Kukolu, 2013) and hard-to-find patents (Bessen et al., 2012) • Generally low quality and weak patents (Fischer & Henkel, 2012; Layne-Farrar & Schmidt, 2010; Lu, 2012; Pénin, 2012) but can also be high-quality patents (Lu, 2012) with a higher frequency of software-related patents (Bessen et al., 2012; Tekic & Kukolj, 2013.)

Table 1d. Key processes of coercive patent-holding firms: factors and key points

Factors	Key Points
Litigation Analysis	• Litigation mill (Merges, 2009)
Market Analysis	• Wait for a technology market to develop (Fischer & Henkel, 2012; Lu, 2012; Lumann III & Dodson, 2006)
Maximize the Risk	• Use patents more likely to be infringed upon and more difficult to substitute (Fischer & Henkel, 2012) with a higher degree of unpredictable claim interpretation (Bessen et al., 2012) in complex technology (Pénin, 2012) • Lawsuit may be baseless (Lu, 2012)
Strategy	• Hold up approach to manufacturing companies (Layne-Farrar & Schmidt, 2010) after sunk investments (Abril & Plant, 2007; Lu, 2012;Pénin, 2012) • Wait until the technology is fully entrenched (Merges, 2009) • Use litigation tactics to create a complex, expensive and highly risky business situation (Luman III & Dodson, 2006) to leverage maximum business pressure and risk to the coercive patent-holding firm (Lumann III & Dodson, 2006) and drive up the expense of litigation (Abril & Plant, 2007) with a surprise factor to force unexpected rents (Reitzig et al., 2006) • Target one technology in a complex technology product (Fischer & Henkel, 2012; Reitzig et al., 2006) • Hide patent in thickets to make it more difficult to monitor (Pénin, 2012; Reitzig et al., 2006) • Opportunistic and aggressive with infringement to persuade payment of the rent (Tekic & Kukolu, 2013)

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Table 2a. Deficiencies in the business practices of targeted firms that enable the business models of coercive patent-holding firms: factors and key points

Factors	Key Points
Competitive Intelligence	• Negligence and lack of awareness of the competitive patent (Reitzig et al., 2006; Layne-Farrar & Schmidt, 2010) and deficiency in monitoring the competitive patent landscape (Reitzig et al., 2006)
Patents	• Inadvertent infringement (Bessen et al., 2012; Fischer & Henkel, 2012; Reitzig et al., 2011)
Technology Architecture	• Several technologies comprising the final product (Reitzig et al., 2011) • Upstream and downstream technologies (Layne-Farrar & Schmidt, 2010)

Table 2b. Potential countermeasures against the business models of coercive patent-holding firms: factors and key points

Factors	Key Points
Competitive Intelligence	• Identify coercive patent-holding firms that relate to the technology business (Pénin, 2012) and monitor competitive patents (Fischer & Henkel, 2012; Reitzig et al., 2006) and the activities of coercive patent-holding firms (Geradine et al., 2011) and standards-based organizations (Tekic & Kukolj, 2013) • Monitor changes in assignment of a patent (Reitzig et al., 2006) • Understand strategies of coercive patent-holding firms (Reitzig et al., 2006) • Proactively develop a list of patents with a high threat and focus prior art gathering based on the list of high-threat patents (Tekic & Kukolj, 2013) • Monitor internet information portals for prior art information (Abril & Plant, 2007)
Patents	• Options include designing around the patent (Fischer & Henkel, 2012; Layne-Farrar & Schmidt, 2010; Reitzig et al., 2006), targeting and acquiring patents before a coercive patent-holding firm (Toth, 2007), and reexamining the patent (Toth, 2007) • Evaluate the patent to determine its quality to assist with decision making (Geradine et al., 2011; Toth, 2007) and conduct hazard analysis from the perspective of infringement (Columbia & Blasberg, 2006)
Technology Architecture	• Options include: substitute technology (Reitzig et al., 2006); create independence from particular technologies (Reitzig et al., 2006); have a range of alternate technologies (Reitzig et al., 2006); use open source standards to reduce risk of inadvertent infringement and leverage all the open source firms (Reitzig et al., 2006); keep technology options open (Reitzig et. al., 2006; Toth, 2007); use modular technologies (Pénin, 2012) and rapid change (Pénin, 2012); and systematically keep track of your technology (Columbia & Blasberg, 2006) • Be careful with third party vendors and incorporating third-party technology (Columbia & Blasberg, 2006)
Litigation	• Options include: early settlement of a patent litigation (Toth, 2007) and business solution (Toth, 2007) to avoid risky and expensive court proceedings (Fischer & Henkel, 2012); move the litigation to a more favourable forum (Toth, 2007); press forward in the litigation with invalidity and non-infringement arguments (Toth, 2007); evaluate the litigation forum and history of the litigated patent (Geradine et al., 2011); seek early collaboration and information exchange with others (Pénin, 2012); and form defense alliances (Columbia & Blasberg, 2006)

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Table 3. Synthesizing a business model framework for coercive patent-holding firms from a general business model framework

Elements	**General Business Model Framework** (Johnson et al., 2008)	**Business Model Framework for Coercive Patent-Holding Firms**
Customer Value Proposition	• Target Customer • Job to be done • Offering	• Technology firms • Graduated litigation, business risk, and pressure to obtain a royalty payment • Licensing
Profit Formula	• Revenue model • Cost structure • Margin model • Resource velocity	• Licensing fees • Low-cost patents & professional time • Minimize time & maximize license value • Early licensing
Key Resources	• People • Technology; products • Information • Partnerships; alliances • Brand	• Litigators, technical experts & negotiators • Patent arsenal • Information concerning your technology • Partner and alliance with patent litigators and other intellectual property professionals • Brand of coercive patent holder brand
Key Processes	• Processes • Rules and metrics • Norms	• Market analysis, detection, minimal infringement analysis, litigation • Wait or delay • Surprise • Target one technology in a complex product • Target maximum risk

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Viability Radar: A Practical Tool for Assessing the Viability of Transformative Service Innovations in a Healthcare Context

Marikka Heikkilä, Jouni Saarni, Valtteri Kaartemo, and Aki Koponen

> *"All innovation begins with vision. It's what happens next that is critical."*
>
> Eric Ries
> Entrepreneur and author
> in *The Lean Startup*

This article develops and showcases the viability radar, which is designed to assess the innovation potential of transformative service ideas. Based on service research and innovation literature, we highlight the importance of novel simplifying technology, supporting value networks, cost-effective business models, and regulatory environments that enable the renewal of prevailing market practices. We operationalize the radar with a set of questions and assess the innovation potential of three pilot cases of new transformative healthcare services.

Introduction

In healthcare, the need for innovative services is acute (Busse et al. 2010; Currie & Seddon, 2014), especially due to the aging population (Christensen et al., 2009; WHO, 2015a) and increasing incidence of lifestyle diseases (WHO, 2015b). Service science and innovation scholars have identified improving well-being through transformative service as one of the top research priorities (Ostrom et al., 2010). Transformative services aim at changes in society and the economy, not only changes in science and technology (Sen, 2013). By transformative, we mean innovations that make a marked change in the well-being of the service ecosystem. Such change may be radical (disruptive) or it may comprise a series of incremental changes. We acknowledge that there is an abundance of seemingly good ideas that suggest how technology or process reconfigurations could be employed to increase well-being in the health care context. Nevertheless, before these ideas can be referred to as innovations, they need to be accepted and adopted in parallel by multiple stakeholders in the ecosystem, such as the service provider's management and employees, service purchasers, authorities, and consumers (Heikkilä & Kuivaniemi, 2012). And, they then need to be diffused through market practices by institutionally embedded actors. Many actors could benefit from an approach that would help predict an idea's value and potential. This article attempts to provide one such approach.

The objective of this study is to increase understanding of institutionalization in transformative service innovation processes in the context of healthcare. The major contribution of our article is that it operationalizes the model of four innovation elements, inspired by the work of Clayton Christensen and colleagues (2007, 2009) to analyze the different extents of viability in real-life service transformations. The study introduces a simple template for viability evaluation – the viability radar – consisting of metrics on: i) the novelty and simplicity of the technology, ii) the feasibility of the business models to the partners, iii) the supporting value networks, and iv) the regulatory environment, enabling renewal of the prevailing market practices. By viability, we refer to a service innovation that includes a novel idea that can be deployed into practices that increase well-being in the service ecosystem; is accepted and adopted by different stakeholders; and has suitable features to attract diffusion in its innovation and stakeholder networks. The usage of the radar is showcased through three healthcare cases assessing the viability of the innovations.

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This article is organized as follows. First, we describe the relevant innovation literature and institutionalization processes to understand how innovations spread and advance consumer and societal well-being. Thereafter, we operationalize a viability radar template that can be employed to assess the viability of potential disruptive service innovations. In the empirical part, we showcase the developed viability radar by assessing three potential healthcare innovations that aim at improving well-being through increased efficiency and empowerment of patients. In addition to showing how the template was used in evaluating the viability of these cases, we discuss how the template could be developed further.

Theoretical Background

The literature characterizes innovation as a multi-stage activity whereby organizations transform ideas into new or improved products, services, or processes and bring them to market (Thompson, 1965; Hauser et al. 2006). It is also a way for organizations to advance, compete, and differentiate themselves successfully in their marketplace (Baregheh et al., 2009). The key matter is that innovation is expected to substitute existing solutions. Some researchers (e.g., King & Anderson, 2002; Kraus et al., 2011) state that innovation should pose novelty and tangible, recognizable qualities as something other than just a change to the typical routines.

There is rich literature following Rogers' (1995) innovation diffusion model comprehending the adoption processes across several individuals over time (Robert et al., 2010). For example, Caldwell and Kleppe (2010) underscore that public demonstration by early adopters reduces consumer resistance to HIV/AIDS public health innovations. Also the readiness of both health service providers (Okazaki & Castañeda, 2013) and early-adopting patients (Lanseng & Andreassen, 2007) in adopting new technologies has been studied. Similarly, Okazaki and colleagues (2013) focus on perceptions of the technology as well as personal characteristics of the physicians.

Information and communication technology (ICT) is considered a main driver of innovation, because its transformational effects spread to several sectors of the ecosystem and society (Dutta & Bilbao-Osorio, 2012). Also, in healthcare, ICT solutions are expanding rapidly (Currie & Seddon, 2014, Dobrev et al., 2010; Ho, 2007). Healthcare is shifting towards personalized services (Seppälä et al., 2012) and eHealthcare with a wide range of ICT solutions from remote medical monitoring to emergency alarm services (Oh et al., 2005).

However, innovation scholars point out that ICT is not sufficient alone, but should be accompanied by innovative business models that release the value potential of the new technical invention by commercializing it to markets (Chesbrough & Rosenbloom, 2002; Rayna & Striukova, 2014; Shin, 2014). The business model describes the general logic of business, including customer segment(s), service, organization, technology, and financing (Bouwman et al., 2008). That is, a business model can be seen as a representation of the strategy and as the starting point for planning operative business processes in selected markets (eFactors, 2002). The markets are especially complex in closely regulated economic sectors, such as in healthcare, where we are expecting innovations to simultaneously create economic and societal value (Rohrbeck et al., 2013).

Many practitioners point out that it is rather easy to come up with new ideas, but the real challenge is putting them into practice. Designing a business model and institutionalizing it is especially demanding when innovations occur outside the exclusive control of traditional firm boundaries (de Reuver et al., 2013; Muegge, 2011). Research shows that diffusion of innovations in healthcare in particular requires a credible evidence base (Barnett et al., 2011), observability, strong leadership and trust (Berwick, 2003), and it also requires strong social interactions between professional groups and suitable organizational contexts (Barnett et al., 2011; Fitzgerald et al., 2002). Often, the needed changes are of a systemic nature (Dubosson-Torbay et al., 2002) and require a business ecosystem (Moore, 1993) where multiple organizations act in collaboration (Rohrbeck et al., 2013), mixing the traditional boundaries of business sectors and of companies, and involving users in co-creation (Heikkilä & Kuivaniemi, 2012; Lettl et al., 2006; McColl-Kennedy et al., 2012). For instance, Heikkilä and colleagues (2014) evaluate the feasibility of a networked business model designed jointly by several partners for an innovative health service concerning physical activity prescriptions, and Nikayin, Heikkilä, de Reuver, and Solaimani (2014) discuss its social implications. Although these studies increase our understanding of the behaviour of pioneers in adapting healthcare innovations, they are limited in terms of raising awareness of the institutionalization of healthcare innovations into market practices.

Christensen and colleagues (2009), in their book on disruptive innovations in the healthcare sector, summarize the innovation literature discussion into four elements of innovation: i) sophisticated and simplifying technology, ii) innovative business models, iii) an economically coherent value network, and iv) regulations and standards. According to Christensen, traditionally, new solutions are typically first adopted only by the top level of users. In the healthcare sector this means, for example, that university hospitals are the first adopters of new technologies, often with heavy costs. Thereafter, the innovation is slowly diffused to other healthcare actors. His theory of disruptive innovations emphasizes that some technologies are able to simplify and routinize such processes, which have previously been more complex or intuitive. Moreover, disruptive innovations also require business model innovations that deliver value to customers profitably and an ecosystem with a commercial infrastructure that supports diffusion. Prevailing regulations and standards within the ecosystem can either ease or restrict the needed reconfigurations.

The work of Christensen and colleagues (2009) is often referred to and most of these articles describe a specific innovation, arguing that it has the potential to become disruptive (e.g., Hahn et. al, 2014; Rapoport et al., 2011; Wessel & Christensen, 2012). For instance, several articles identify healthcare clinics within retail establishments as a disruptive innovation (e.g., Burns et al., 2011; Grady, 2014, Kissinger, 2008). Also genomics, personalized medicine, and pharmacogenomics are identified as being disruptive (e.g., Carlson, 2009; Schulman et al., 2009; Wade et al., 2014). Other articles are typically general commentaries or conceptual papers attempting to extend, modify, or supplement the Christensen analytical framework (Rapoport et al., 2011). Criticism has grown in the literature, especially towards its strong ex-post perspective (Danneels, 2004; Govindarajan & Kopalle, 2006; Keller & Hüsig, 2009; Klenner et al., 2013). For example, Tellis (2006) questions the predictive value of the concept if one must wait until the disruption has occurred. Even though there are already a number of approaches proposed for ex-ante analysis, such as differing classification analyses, economic models, and scenario methods (Klenner et al., 2013), they are mostly focusing on macro-level analysis of transformative or disruptive innovations. We believe that Christensen and colleagues (2009) provide a suitable framework for micro-level ex-ante analysis of innovation pilots and proposals. We therefore developed an ex-ante viability template for organizations and funding institutes to evaluate the innovations, and to spot specific dimensions requiring further development if they wish to further advance the diffusion and institutionalization of the innovation.

Research Approach and Methodology

This study follows a design science approach, which has its roots in the pragmatist research philosophy (Hevner, 2007; Iivari, 2007). This approach is used especially by information systems researchers studying creation, transfer, and diffusion of innovation in organizations and society (Anderson et al., 2012; Leung et al., 2013; Venable et al., 2010). It is considered as a new means for improving the relevance of research as it focuses on building artefacts (in this article the viability template), using the artefacts to solve relevant problems, and learning from the use of the artifacts (Venable et al., 2010). Design science is solution-oriented, linking interventions to outcomes (Van Aken & Romme, 2009), and solutions follow the logical statement "If you want to achieve Y in situation Z, then you perform something like X". X can be an act or a sequence of acts, but it can also be the design and implementation of some process or system. In this article, we formulated the statement as follows: *If managers want to select and advance the most viable innovations, then the viability radar will help them to identify and measure the viability of innovations and to analyze which innovation element(s) affect(s) viability.*

Even though almost any type of research method can be applied in design science research, studies are typically case-based, collaborative, and interventionist (Van Aken & Romme, 2009). Our study is an interventionist multiple case study where researchers were collaborating with the organization in developing actual solutions to problems and contributing both to theory and practice (Dumay, 2010; Lukka & Suomala, 2014). Typically, design cases are different from ordinary case-study research, which is focused on generating in-depth knowledge of a certain phenomenon with a given context. Design cases aim at knowledge on how unique artefacts are created in the context and how the artefact and design process can be reused and theorized.

Our empirical study was commissioned by Sitra (www.sitra.fi/en), a national innovation fund institute that promotes projects aiming for sustainable well-being in Finland (www.sitra). One of its divisions aims to contribute to the development of user-friendly electronic services for health promotion and to create conditions for Finland to become a pioneer in electronic welfare. The division has executed its mission by sponsoring research in the theme, influencing opinions, and launching and funding experimental projects where new innovative ideas are put into practice and evaluated. After running several pilot projects in health and well-being, the institute recruited the researchers to help analyze the viability of their ongoing and future pilots. The aim was to generate practices for the funding institute to estimate the potential viability of innovation pilots (i.e., its strengths and weaknesses) and to focus their efforts on advancing the diffusion of healthcare innovations. In collaboration with Sitra, three pilot services were selected as interesting examples of potential transformative health care reforms:

1. An electronic maternity card

2. An electronic tool for assessing the need for medical care for birth control, eating disorders, and cracked teeth

3. An electronic service to motivate senior citizens to do physical exercises

Research Process and Data Collection

Table 1 shows the process, tasks, and data produced or collected in the project. The process consists of six steps adapted from Verschuren and Hartogh (2005).

Our assessment of the cases is based on 12 interviews of the service providers, system providers, and responsible project leaders at the funding institute (Table 2). Prior to the interviews, a case study protocol and an interview protocol were developed to guarantee research reliability (Yin, 2004). During the interviews, we followed a semi-structured format to discuss differing aspects of the innovation. Each interview took from one hour to two and a half hours, and all interviews were recorded. During the interviews, several memos were made regarding meta-information, including the emphasis, reactions, and expressions of the interviewees, and the key concepts being discussed. After the interviews, essential topics that were discussed during the interview were collected in table format. In order to triangulate (Yin, 2004), multiple data sources were used, including company websites, documents regarding stakeholder analysis, business and market analysis reports, and other relevant documentation such as material provided by the institute (e.g., contracts, minutes of a board meeting, and final reports when available) to justify our assessment.

Our interview data is solely based on the viewpoints of service and system providers. However, to overcome the absence of the end-customer view, we had access to consumer satisfaction survey results conducted in two of the cases, and we tested all services ourselves as well. With this data, we could estimate the acceptance of the service by the end users.

The Result: Viability Radar

As a foremost outcome of the interviews, we recognized some key similarities in the factors affecting the viability of the pilots. Given that these factors could be linked with relevant themes in the innovation literature, we decided to present the key elements with a graphical template – the viability radar – covering the essential elements for viability of a healthcare innovation. It should be noted that we did not have the viability radar construct ready when we started the empirical study, but it was created during the process. Building on the previous literature and discussions with the funding institute, it became clear that the degree of technological innovation has to be estimated in combination with the business models. Moreover, because the service providers and services in healthcare are largely interconnected through joint processes and ICT, the business models have to be feasible to all partners. Furthermore, the diffusion of healthcare innovations is strongly regulated by laws and practices of the trade.

We operationalized the template by assigning a few fundamental questions to each of the four elements. As a practical tool, the simple viability radar is designed for assessing the innovation potential of transformative service ideas in at least three scenarios. First, it may be used for funding decisions to cherry-pick which innovation proposals have the most diffusion potential. Second, it may be used to focus attention on the elements of viability that are lagging the furthest behind. Third, it can be utilized in business development by increasing the overall understanding of the potential barriers for diffusion in the wider institutional setting.

Next we describe and justify the set of questions for each element.

Technology (T)
To assess whether solutions enable some processes to be carried out in a simpler or more effective way, we focus on value-in-use-in context (Vargo & Lusch, 2008). The new technology enables value creation either by reaching a new performance level in some respect or by simplifying previously used methods. When renewing healthcare services, the substitution is a very important feature. If the innovation does not replace any older functions, its adoption would only increase the service

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Table 1. The research process

Phase	Tasks	Research Data Sources
Idea	• Discussing the need for evaluation of the innovation pilots, experiences of viability evaluations carried out in earlier programmes • Contract with Sitra for carrying out the research	• Memos from meetings with the director and the division head • Evaluation reports of previous programmes
Requirements and assumptions	• Presentation and acceptance of the research plan in the division meetings • Initial list of cases selected in the division meeting; final decision was made by the head of the division • Contacting and agreeing with the partners to be interviewed	• Memos from division meetings • Lists of past/ongoing/planned pilots
Identifying the solution	• Recognizing challenges and indicators for the viability of innovations • Collecting additional data • Case study protocol consisting of a semi-structured interview template covering four main topics of transformative innovation	• Memos from discussions with the head of division • Company websites, business and market analysis reports, and other relevant documentation such as material from the funding institute (contracts, minutes of board meeting, and final reports when available)
Prototype of the template	• For each case, interviews of the service provider, the IT provider, and the responsible project leaders within the division • Presentation of initial results in division meeting • Creating viability template	• Interviews (12) and notes from three cases • Hands-on testing of three case services • Survey results on pilot customers' attitudes, experiences, and feedback from using the pilot service collected by the service providers in two cases • Feedback from the director and from the division on the template
Evaluation	• Analysis of case innovations with the template and suggestions for focus of further actions to increase adoption of the innovations • Internal report on the viability of the cases presented and accepted in the division meeting	• Notes from the division meeting where the viability template was presented and accepted
Implementation	• Viability template was utilised in the division to evaluate the innovation pilots both ex ante (as a basis of selecting new pilots that will be funded) and ex post (assessment of pilots carried out providing basis for decision over additional funding or other means of support • The division head also suggested that it could be deployed in other divisions as well; viability report was distributed to other divisions	• Mail conversation on the usage of the viability radar with the division head nine months later

Table 2. Details of interviewees

Case	Stakeholder	Interviewees By Position
Electronic maternity card	Service provider	Head Nurse, Maternity Clinic
		Executive Medical Director, Maternity Clinic
		Coordinator, IT Management of City T
	System provider	Chief Executive Officer, IT Company A
		Project Manager, IT Company A
	Funding Institute	Senior Lead
Medical care need assessment	Service provider	Director of Development, Medical Care Organisation
	System provider	Project Manager, IT Company B
Senior tablet computer service	Service provider	Director of Development, City J
	System provider	Project Manager, University
		Researcher, University
	Funding Institute	Specialist, Systems

system's size unless it enables a very novel and radical value increase (Baker et al., 2003). Overlapping information systems and double bookkeeping of health information entries is a typical example of uncompleted substitution (Miller & Sim, 2004). Therefore, the elemental questions are:

• Is the innovation a substitute for existing services or functions?

• Is the innovation significantly more novel and better performing than previously used practices?

Business model (BM)
The service provider needs to have a functional business model that will provide added value to the end customers. We also extend the business model to cover the incentives of different stakeholders to change their behaviour in accordance with the innovation. Thus, we expand the view to value co-creation opportunities with users (Tanev et. al, 2014) and within the network of partners (i.e., collaborative business model innovation: Heikkilä & Heikkilä, 2013). Willingness of these key stakeholders to adopt the use of reform is crucial for its viability. Decision making often becomes monetized, requiring calculations and a proof of concept to show that that the innovation's adoption will lead to a positive surplus compared to the existing situation (Heikkilä et al., 2005).

• Does the current service provider see the opportunity for benefits to overcome the costs?

• Do the suppliers see opportunities to generate business growth?

• Are the consumers and end users adopting and committing to use the innovation?

Value network (VN)
If the innovation does not diffuse to other organizations, it can easily be seen only as an experiment and it will not reach its full coverage. Here, it is emphasized that support for innovation diffusion can only be expected when multiple stakeholders experience mutually beneficial outcomes (Maglio & Spohrer, 2013). Viable

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innovation requires that there are no major conflicts of interest among different stakeholders around the innovation. Mutual understanding of the goals and motives of each partner helps innovation adoption and diffusion considerably. Low need for modifications and customization implies a greater simplicity of innovation and therefore greater chances for diffusion (Rayna & Striukova, 2014).

• Are there supportive partners and interest groups for the innovation and its implementation?

• Do the goals and objectives of the participating organizations support each other?

• Can the innovation also be utilized in other contexts (with only slight customizations)?

Regulation and standards (R)
Rules determine what kinds of changes are allowed and what are not. Thus, the viability radar takes into account not only various stakeholders but also the influence of institutions, enabling and constraining value co-creation, and the diffusion of market practices (Akaka et al., 2013). Rules, standards, and legislation are society's formal means to ensure fair, safe, and ethical courses of action. Naturally, they are drawn up only after the emergence of an innovation. Informal routines and practices are rooted in the organisation's culture, and changing them requires recurrent communication and demonstrations.

• Does the realization of the innovation have any legal or regulative obstacles?

• Does the innovation fit into existing practices or are the practices changeable?

The questions may be developed further but, as such, they synthesize the important themes raised in transformative service research and in the innovation literature, as well as from institutional theories. To keep it simple, the measurements can be subjective red-yellow-green status estimates or more elaborate quantitative values. If there is a need to perform an in-depth analysis of the viability of the innovation, the template helps to focus additional studies or pilots, etc. to provide more information for the basis of the evaluation. In Figure 1, we present the viability radar using data from a hypothetical innovation. The further away from the centre the values reside, the better the chances that the innovation has to become widely adopted and eventually institutionalized into the practices in the healthcare sector.

Evaluation of the Cases with the Viability Radar

We applied the viability radar to assess the case innovations, which were selected together with Sitra. The results presented in Figure 2 describe our interpretation of the status of the pilot regarding viability questions. In general, our analysis shows that the first two pilots performed well in the majority of viability issues. Below, we analyze each innovation pilot in greater depth.

Electronic maternity card
The first case, an electronic maternity card, is currently piloted in one city and surrounding region in Finland. It involves replacing the traditional paper-based information storage procedures with an electronic health record service that allows expectant mothers online access all information relating to their pregnancy (Sitra, 2014). The objective is to improve the exchange of information among maternity clinics, expectant mothers, and hospitals to reduce the likelihood of mistakes, to improve customer service, and to make monitoring high-risk pregnancies more efficient. Besides self-monitoring their health, expectant mothers can use the electronic service to share information from their pregnancy with their family and friends if they so choose. The first innovation pilot passed all questions with the highest marks, except for concerns over adaptability of the innovation in other contexts with differing information systems and interoperability requirements. Adoption of the innovation may require heavy investments in electronic patient records by the service provider and can thus face challenges in wider diffusion at a time when public health care is looking for ways to cut spending, not increase it.

Medical care need assessment
In the second service pilot, the service provider's management team had a strong vision to speed up the triage process by replacing the phone interview with an electronic process in selected patient groups. This approach freed nurse resources for other tasks and encouraged some customers to seek care, which they would not have otherwise done so. It was demonstrated that carefully planned electronic procedures can be created, but a traditional phone interview was still required in some situations. The expansion of the innovation to new contexts requires integration and tailoring. Furthermore, the system provider of Case 2 needs to put forth more effort if it desires to expand adoption of the reform. The new practice has been accepted within its current special clientele. However, more efforts are expected if the innovation is to have wider societal consequences.

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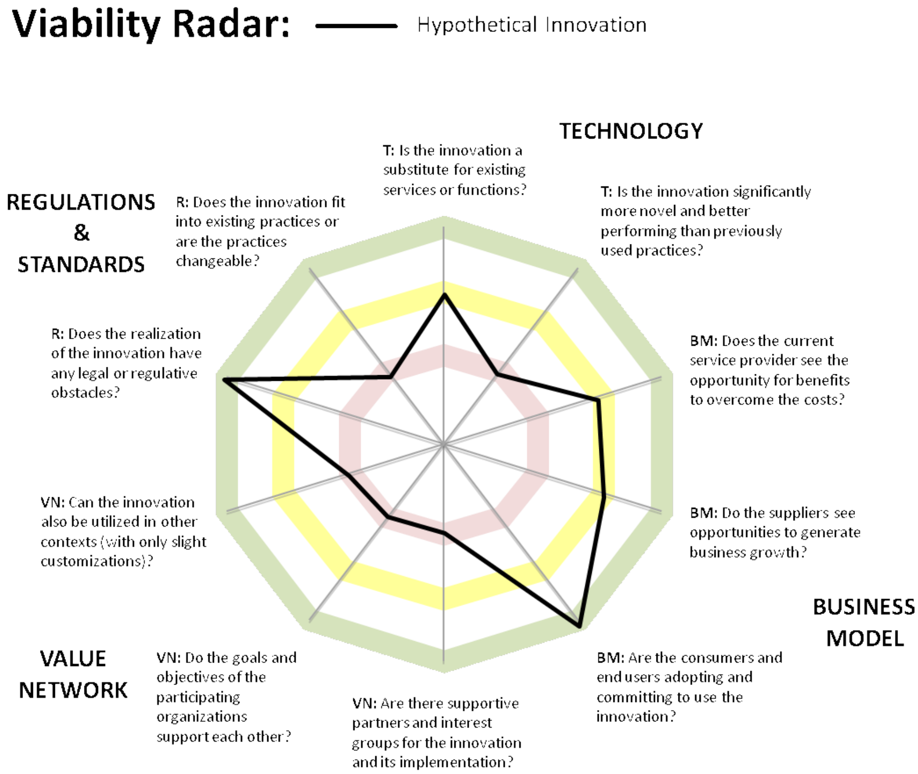

Figure 1. Viability radar of transformative service innovations with a hypothetical example of an innovation. The outer circle represents the most successful premises for viability, and the innermost circle refers to the situation, which demands considerable attention for problem solving.

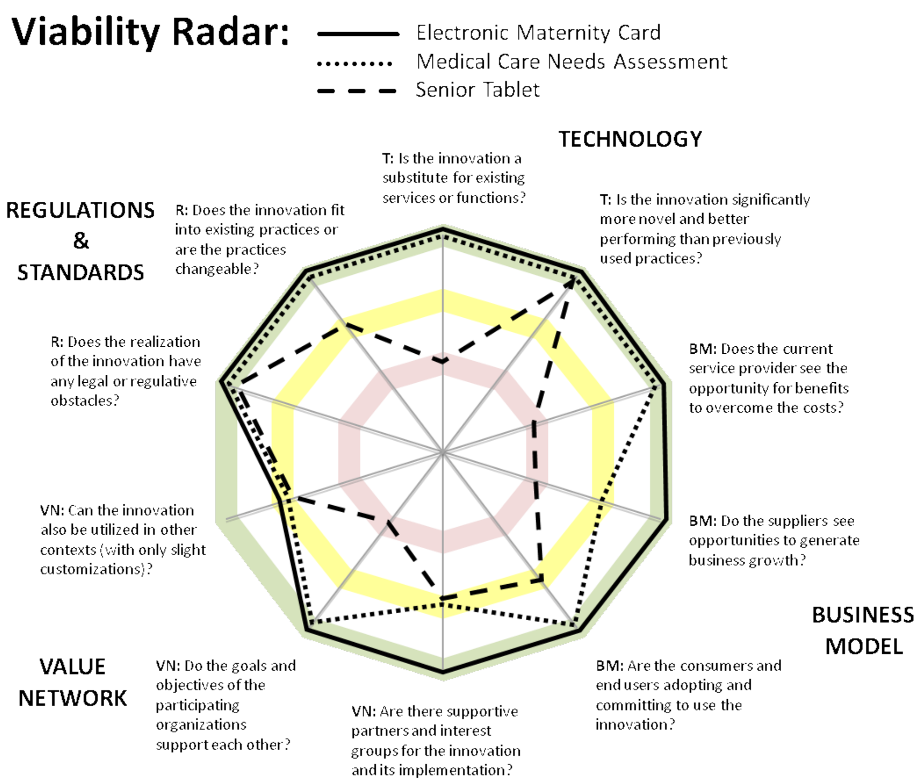

Figure 2. Three pilot cases assessed with the viability radar

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Senior tablet computer services

The third pilot focused on senior services. It demonstrated that a tablet computer is an acceptable and engaging platform for elderly people to receive health-related information and instructions – if the right content is provided. Technological execution was considered to be suitable for a wider adoption of the innovation, but the content and user guidance are the areas needing the most development efforts. The pilot had many severe issues to tackle, predicting failure of the reform. The business model especially was not successful and the parties did not see prospects for profitability or business growth. These challenges are crucial when the innovation is not substituting existing services. The participating organizations are not committed to the wider diffusion of innovation, as they lack mutual goals. Also, the current funding system is not supporting the idea becoming a market practices, as public and private partners are not interested in investing in preventive healthcare technology.

Discussion

This study focuses on representing a practical tool for assessing the viability of service innovations in the healthcare context. Assessment of the cases indicates how the viability radar can be employed to understand the rich context of new technology. The template combines important issues that need to be considered in assessing the innovation's diffusion potential. The radar is thus helpful in making funding decisions and in pivoting transformative service ideas.

This practical tool enabled us to focus on the most crucial questions relating to the institutionalization setting that surrounds the potential innovation analyzed in the empirical study. Thus, we were able to provide the funding institute with important information that often remains overlooked in decision making and ex-post analysis. Moreover, according to the discussion with the division head, nine months after the creation of the tool and first assessments, the template is now applied in the division: first, ex-ante in evaluating all potential innovation pilots to provide a basis for selecting the pilots that will be awarded funding, and then ex-post to give a final assessment of the pilots and to provide a basis for deciding on additional funding or other means of support. To conclude from the above, the empirical evidence validates our proposition: *If managers want to select and advance the most viable innovations, then the viability radar will help them to identify and measure the viability of innovations and to analyze which innovation element(s) affect(s) viability.*

It should be emphasized that a low rating of an innovation pilot in some parts of the viability radar does not simply translate as a "no go". Instead, these ratings indicate the action points that require further attention from the managers if they want to push the innovation forward. If a new simplifying technology does not benefit from wide support, it is possible to influence other stakeholders in various ways. For instance, a demonstration can be developed to showcase the benefits of new technology. Second, opinions of authorities and other key stakeholders can be changed with active lobbying. Third, stakeholders may become more committed to the innovation diffusion if they participate in the development process.

As a scientific contribution, we continue the discussion on assessing the role of business models and value networks in the diffusion of innovations. Our study is an approach to operationalize the disruptive innovation (Christensen et al., 2009) template in healthcare, but it can also be contrasted with the discussion on "disruptive susceptibility" (Klenner et al., 2013), which focuses on the readiness of innovation networks to adopt new solutions. Similar to the study by Klenner and colleagues (2013), we extend the view of the value network from the service providers, customers, and competitors to more general market characteristics. Readiness for change is important, as regulations and institutions strongly affect not only private market characteristics but public service innovations. For instance, non-profit organizations always engage in maintenance or transformation of dominant institutional logic depending on whether it fits the actor's aims or not. In line with Coule and Patmore (2013), we conclude that, in order to engage in deinstitutionalization or transformation of existing institutions, the service provider needs to have a viable business model with a value proposition that resonates with the aims of potential network partners.

The practical development and scientific approval of the developed template require further evidence. And, there is a need for a theoretically valid set of questions. The questions represented in this article are selected intuitively by consulting the related literature and the national funding institute whose main objective is promoting innovative projects aiming for sustainable well-being in Finland. Before the viability template is adopted into wider use, there is a need to ensure that all important questions are asked. Despite these remaining shortcomings, we believe that our study advances the assessment of the institutional setting that is still often overlooked in the general innovation literature.

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Particularly, our study emphasizes the role of business models in networked environments in the healthcare context. The context is characterised by a separation of buyers (or financers) and users of innovations. This is an important notice that should be taken into account in assessing the generalizability of the template in other contexts. Therefore, we invite other scholars to test the tool, not only in the context of healthcare, but in institutional settings that represent more traditional business markets. We also invite them to enhance understanding of the quasi-market context in healthcare.

Conclusions

In the institutionalization process of transformative service innovations, we identify the importance of novel technology that outperforms existing solutions, innovative business models that are feasible to the partners, and an ecosystem consisting of supporting partners as well as regulations and standards supporting the diffusion of the innovation. We propose that, in order to transcend from service ideas to transformative service innovations, all or most of these elements need to be aligned during the innovation process.

We contribute to the service innovation and business model innovation research by explicating how to assess the viability of innovations. For practitioners (e.g., funding agencies, system providers, and business developers), we provide a set of concrete questions that may be addressed in evaluating and enhancing transformative service ideas. They are operationalized in the viability radar, which, in our empirical study, was shown to be usable in decisions over funding of innovation proposals, in recognizing elements of viability of an innovation demanding more attention, and in business development by increasing overall understanding of the potential barriers for diffusion in the wider institutional setting.

Last, we acknowledge that the development work of the practical template remains in its early stages. We intend to develop it further towards a practical business model innovation analysis tool, especially for small and medium-sized enterprises (SMEs). We also invite other scholars and practitioners to advance our understanding on how to assess the influence of institutional settings on the viability of transformative service innovations.

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Viability Radar: Assessing the Viability of Transformative Service Innovations

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Who Inhabits a Business Ecosystem? The Technospecies as a Unifying Concept

Michael L. Weber and Michael J. Hine

> *“For evolution is not only substitution of independent components; it is also integration of the components to form adaptively coherent systems.”*
>
> Theodosius Dobzhansky (1900–1975)
> Evolutionary biologist
> In "Mendelism, Darwinism, and Evolutionism" (1965)

Currently, many terms are used to describe business ecosystems and their inhabitants. These terms have meanings that can cause definitional confusion and an ambiguous level of analysis as to what constitutes a business ecosystem. To understand business ecosystem relationships, an unambiguous understanding of the ecosystem components is required. The importance of standardized terminology and clear definitions of these components has been recognized in the literature. From a managerial perspective, identifying the relationships a firm is situated in is valuable and useful information that can be practically applied. We propose a business ecosystem model anchored around interdependent technospecies similar to the biological model that many of the existing concepts are drawn from. Technospecies are unique entities based on their organizational routines, capabilities, and use of technology. This article will present an alternative formulation of the business ecosystem model with the aim of synthesizing the diverse terminology presently in use into a concise, common language.

Introduction

Natural ecosystems provide a powerful metaphor to aid in understanding business ecosystems given that both consist of inhabitants with different characteristics and interests, joined together by diverse mutual relationships (Corallo & Protopapa, 2007). Analogous to the supply chain concept, business ecosystems focus on the connections and interrelationships between firms (Moore, 1993; Bailetti, 2008; Carbone, 2009; Hurley, 2009; Adner, 2012; Muegge, 2013; Muegge & Haw, 2013) because organizations do not exist in isolation but depend upon the capabilities and resources of their ecosystem (Hakansson & Snehota, 1995). Unless a company is completely vertically integrated, it cannot successfully compete alone and thus requires relationships, interactions, and resources provided by the ecosystem (Rice & Hoppe, 2001).

Most previous research on business networks examines dyadic (or triadic) connections of network inhabitants and the consequences of particular network positions (Anderson et al., 1994). This focus does not identify or control for higher-order dependencies and influences that are typically present with inter-organizational systems (Moore, 1993, 2006; Peltoniemi & Vuori, 2005). Although research has made important contributions toward the understanding of business connections and structures (Hakansson & Ford, 2002; Iansiti & Levien, 2004a, 2004b; Kambil, 2008; Henneberg et al., 2010), a holistic understanding of business ecosystems is absent (Corallo & Protopapa, 2007; Li, 2009; Satsangi, 2012). Business ecosystems have been conceptualized as platforms (Muegge, 2013), multi-sided platforms (Iyer & Davenport, 2008; Bailetti & Bot, 2013), communities (Carbone, 2009; Muegge, 2011), networks (Iansiti & Levien, 2004b; Corallo & Protopapa, 2007; Basole, 2009), value blueprints (Adner, 2012), and institutions and resource flows (Hearn & Pace, 2006; Muegge, 2011, 2013; Bailetti et al., 2013); these models are often viewed separately and studied independently even though a holistic view is required. Firms, government and regulatory agencies, non-governmental organizations, and open source platforms, among others, all in-

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teract (Hurley, 2009) and create value (Basole, 2009). It is thus important to understand and chart these interrelationships as each firm engages in an ongoing exchange with its environment, including other ecosystem inhabitants (Marin et al., 2008). In order to interact and engage effectively, a firm must be able to identify the members of the ecosystem(s) with which it interacts. Where a firm is situated in the ecosystem and the connections within that ecosystem are of primary concern to each business ecosystem inhabitant (Chesbrough, 2006; Moller & Rajala, 2007; Basole, 2009) and hence are of practical relevance to the managers of those firms.

Although business ecosystem research has matured and proliferated, advancement has been limited by different terminology and nomenclature and inconsistent usage of said terminology. To move forward in both academia and industry, the field requires standardized terminology so academic literature can be synthesized, compared, and applied to real managerial situations. This standardization would allow managers to make improved decisions and apply research findings based on a common understanding of the structure and organization of the business ecosystem (Bardawil, 2011). In turn, this standardization would allow managerial situations to more tightly link and thus influence academic undertakings (Astley & Zammuto, 1992). Without common terminology, research progress is difficult or impossible (Astley & Zammuto, 1992; Shoemaker et al., 2004) and whatever results are derived are difficult to transmit to management as message content degrades as it is passed from the business to academic realms and vice versa (Ortenblad, 2005). This article proposes a new model of business ecosystems with the potential to unify the multiple current business ecosystem perspectives using standardized and consistent terminology.

The remainder of this article is organized as follows. First, current views of business ecosystems are presented. Next, we expand on the biological species metaphor to introduce the new technospecies construct that forms the foundation of our business ecosystem model presented in the third section. The description of the model is followed by conclusions, research and managerial implications, and future research directions.

Business Ecosystems

Moore (1996) defined a business ecosystem as: "…a foundation of interacting organizations and individuals – the organisms of the business world." To date, there is no clear definition for these organisms with the literature focusing on dyadic, triadic, or limited network interactions when discussing business ecosystems. Although widespread interaction and resource sharing are recognized as existing in a business ecosystem (Bailetti, 2008), the terminology describing these interactions continues to be drawn, primarily, from the industrial and organizational behaviour literatures and resource-based views (Wernerfelt, 1984). A common theme in that literature is goal-directed behaviour, that a business ecosystem can be "organized" around a platform (keystone) and managed based on the limited interactions arising from the resulting connections (Holling, 2001; Gunderson & Holling, 2002). For example, keystones such as Microsoft, Apple, Wal-Mart, and Mozilla provide platforms to their ecosystems allowing value creation both for themselves and for other ecosystem members (Moore, 1993, 2006; Cusumano & Gower, 2002, Iansiti & Levien, 2004b, Tiwana et al., 2010).

Peltoniemi and Vuori (2005) state that a business ecosystem is a socioeconomic system where its population develops through coevolution with the environment resulting in self-organization and emergence (i.e., the ability and process to create new order), and adaptation to the environment. An ecosystem is therefore a complex adaptive system that is more than the sum of its parts and cannot be understood except by considering the entirety of the ecosystem rather than a limited number of connections. The concept of the Internet of Things represents a network of connections including people–people, people–things, and things–things via the Internet allowing virtually unlimited connections (Morgan, 2014; Westerlund et al., 2014) between all inhabitants of a business ecosystem, resulting in connections that may or may not be accessed.

Much of the business ecosystems literature is based on Moore's (1993, 1996, 2006) ecosystem perspective and has advanced definitions and operationalizations for limited domains. There has been much in the literature concerning platform architecture (Cusumano & Gower, 2002; Milinkovich, 2008), keystones (Heikkilä & Kuivaniemi, 2012), networks (Iansiti & Levien, 2004b; Greve et al., 2014), communities (Moore, 2011; Muegge, 2013) and ecosystems (Moore, 2006; Carbone, 2009). However, these bodies of knowledge are not well integrated, tend to be studied in isolation, and often diverge in approach depending upon the level of analysis (Muegge, 2011). The focus is frequently on a single actor, feature, or platform that, while providing depth of coverage, does not adequately address holistic ecosystem complexity. For example, Bailetti (2008) applied the ecosystem approach to the commercialization of technology products and services. Bailetti and Hudson (2009) adapted Moore's definition to include the use of a "community oriented out-of-the-box platform", and describe the Lead To Win ecosystem designed to create technology jobs and attract technology investment in a similar manner as keystones described by Iansiti and Levien (2004). Bailetti (2010a) recognized that any firm that is unable to envisage and understand the ecosystem in which it operates is at a significant disadvantage and uses the analogy of courtship to distinguish between a firm in an ecosystem as compared to a traditional setting (Bailetti, 2010b). Muegge (2011) further advances the concept by defining business ecosystems and resolving various existing perspectives in the literature by applying an institutional theory frame of reference to describe distributed innovation. Although the aforementioned works have been insightful and important in moving forward the concept and application of business ecosystems, the scope of this literature is primarily oriented toward technology and entrepreneurs, and the platform (or keystone) in a business ecosystem. A more general perspective would benefit this area specifically and the blossoming field of business ecosystems in general. Toward this goal, we adopt a more general view of business ecosystems by further connecting the business and biological perspectives.

Other work in business ecosystems has focused on ecosystem leaders (Moore, 1993), platform leaders (Cusumano & Gawer, 2002), or keystones (Iansiti & Levien, 2004a, 2004b) coexisting with other communities and individuals (Milinkovich, 2008; Muegge, 2013). These views follow on the description of a business ecosystem oriented around a hub or keystone by Iansiti and Levien (2004a, 2004b). Using this perspective, a business ecosystem does not necessarily align with a particular industry but may span different industries (e.g., Apple encompasses computer technology, consumer electronics, and information and communication technologies). The crucial factor driving the success of each business ecosystem is the ability of the keystone to provide a platform (i.e., tools, technologies, manufacturing processes, services, etc.) that other members of that ecosystem can leverage to add value to their product or service in a co-evolutionary process. Interactions may be either cooperative, competitive, or coopetive (Smith, 2013). In a business ecosystem, the capabilities of a firm co-evolve around innovations unique to that ecosystem.

Tian and colleagues (2008) define a business ecosystem as a: "…configuration of people, technology, shared information, and value propositions connecting internal and external service systems". This definition is closely related to the value chain and value network concept describing the tangible (e.g., goods, services, and revenue) and intangible (e.g., knowledge and intangible value) transactions between different organizations (Porter, 1980, 1985; Allee, 2000; Walters & Lancaster, 2000) and between organizations and customers (Prahalad & Ramaswamy, 2004). As such, there is reciprocal interdependence where "each node depends on adjoining nodes to perform its role…" (Hult et al., 2004). The implication of this statement is that each node (inhabitant) is connected to adjoining nodes in a network configuration, forming a business ecosystem. Currently, business ecosystems are considered to consist of platforms and communities having a multi-level, hierarchical system and an architecture of participation (Muegge, 2013). As ecosystems are considered to be self-organizing and scale-free, they consist of an interconnected, complex, assemblage of members having resource and information flows and some level of productivity where each ecosystem affects and is affected by the inhabitants of that ecosystem resulting in evolution or adaptation with emergence or emergent features.

However, the conceptualization of the ecosystem inhabitants varies with the area of research and individual researcher, especially concerning how the inhabitants are defined. This tendency is particularly apparent with the species concept borrowed from biology (Prendergast & Berthon, 2000), where the conceptualization within the business literature is quite different than the intention of the original and definitive intention of species. To date, most of the work on business ecosystems has resulted in definitions that vary by researcher, and thus there are differing levels of consistency with the biological definition. For example, multi-sided platforms are considered to bring together distinct but interdependent groups (Bailetti, 2010b; Evans et al., 2011) although exactly where the platform exists remains undefined (Haigu & Wright, 2011).

The Technospecies Construct

Species is a biological term used in many areas of the business literature, including: platforms (Kang & Downing, 2014), keystones species (Iansiti & Levien, 2004a, 2004b), organizational species (Gundlach, 2006; Lemos, 2009; Pagano, 2013), non-profit organizational species (Potter & Crawford, 2008), organizational species barrier (Gaba & Meyer, 2008), flagship species (Kim et al., 2010), leading species (Knight & Cavugil, 2004), ecosystem species (Guegen & Isckia, 2011), business owner species (Bruhn, 2013), business species diversity (Wright et al., 2009), and endangered (business) species (Cooke, 2000). Although the word is used in the business literature with similar connotation to the biological term (Prendergast & Berthon, 2000) – that of a distinct population of organisms – business species and biological species are very different. In biology, species is the main natural taxonomic unit and is defined as a group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding (Lawrence, 2005), and is usually based on genetic (DNA) similarity (Mayr, 1963). For business ecosystem usage, the biological definition of species is restrictive because a species may only mate with members of its own species. Although firms and organizations do not have DNA or genes, it has been argued that organizational routines are the equivalent of genes (Nelson & Winter, 1982).

Nelson and Winter (1982) adopted Darwinian concepts (e.g., variation, replication, and selection) and proposed that evolution occurred at a higher level than individual genes and involved the replication and selection of routines. Organizational routines may be viewed from an evolutionary perspective based on these general Darwinian principles (Hodgson & Knudsen, 2004). This perspective implies that routines are collective-level (i.e., organization-level) constructs that embody prior learning and are selected for by some mechanism. In evolutionary economics, organizational routines and capabilities are of central importance (Felin & Foss, 2004) because they provide the fundamental unit of analysis (Becker, 2004) in the sense of their being the micro-unit of analysis and that they directly link with the evolutionary triad of variation (of routines across a population of firms), selection (based on routine fitness relative to the environment), and heredity (routines being the social equivalent of genes) (Nelson & Winter, 1982). However, routines have also been viewed as generative and as a source of continuous change (Feldman, 2000; Pentland et al., 2011). Feldman and Pentland (2003) suggest the generation of endogenous change as a result of carrying out the organizational routine. By definition, routines involve repetitive or recurrent patterns of action, although each repetition will have observable differences. This observation has been referred to as the "paradox of the (n)ever changing world" (Birnholtz et al., 2007). Each repetition of a routine varies due to improvisation or error; increasing numbers of repetitions create more variation and opportunity for change (Tsoukas & Chia, 2002) similar to the manner in which mutation occurs in DNA. Routines may be considered a particular firm's way of doing things, for example the business model of a firm (Westerlund et al., 2014).

Routines and capabilities differ (Teece et al., 1997; Teece, 2011). Nelson and Winter (1982) see capabilities as at a higher level than routines, although there is some overlap (Dosi et al., 2000). A capability has a recognizable purpose expressed in terms of the outcome that capability enables due to conscious strategic deployment (Felin & Foss, 2004). Capabilities, or processes, are sets of actions that repeat over time and are used to accomplish some business purpose (e.g., product development, acquisition, marketing) (Pentland & Rueter, 1994; Teece et al., 1997; Miner et al., 2001; Ray et al., 2004; Teece, 2011). Organizational routines are a key independent variable in organizational performance research and are the foundation for organizational capabilities (Becker, 2004) bridging the economics and evolutionary literature for organizations (Felin & Foss, 2004; 2009). Organizational routines and capabilities therefore relate to strategic management performance and firm heterogeneity (Nelson & Winter, 1982; Barney, 1991), specifically the core competencies of the organization (Prahalad & Hamel, 1990; Helfat et al., 2007). Organizational routines can be considered as the equivalent of genes with the totality of capabilities representing the genome (Bruderer & Singh, 1996); ultimately, both characterize the phenotype (Figure 1).

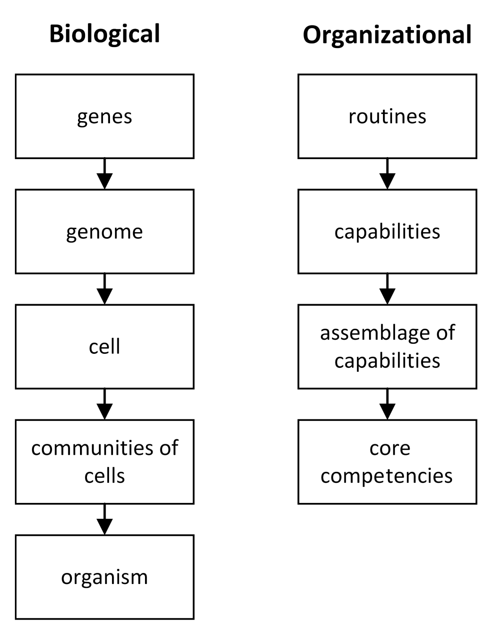

Figure 1. Comparison of biological and organizational entities

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Different organizations may have similar routines but unique interactions of routines, capabilities, and technology. Routines may be similar in outcome but expressed in a completely different way due to the facilitating technology. For example, consider the difference between a manual billing system using paper invoices mailed to the customer and the electronic billing system used by PayPal. Each routine enables a billing capability that has the same goal and outcome but is accomplished differently.

The nature of organizational evolution differs from that of biological organisms due to learning for routines (Nelson & Winter, 1982; Zollo & Winter, 2002). The attempt to adapt evolutionary theory as a metaphor for explaining the business perspective is limited by the lack of unit analysis for the evolutionary process, similar to the gene in biological evolution (Corallo & Protopapa, 2007). For biological organisms, evolution is fundamentally genealogical and based ultimately on the propagation of genes and, for a few species, social learning along lines of descent (Heyes, 1994; Whiten et al., 1999; Laland, 2004).

As with biological organisms, the appearance of novel organizational forms requires an innovation; for business organizations, this innovation is often technological, and disruptive, in nature (Christensen, 1997; Markides, 2005), affecting the routines and capabilities of the firm. However, organizations do not reproduce in the same manner as biological organisms; organizational evolution is thought to begin with the appearance of a new form and end with the disappearance, or transformation to another form, of that variant (Corallo & Protopapa, 2007). This view has created a problem in the application of evolutionary theory to business processes, and some confusion as to the usage of the word "species". Given that there are significant differences between biological species and business species, a distinction would be helpful in order to distinguish between the two forms and to properly define species in the business context.

To distinguish the meaning of species between the biology and business domains, we suggest the addition of the prefix "techno" to differentiate a business species from a biological species. The prefix "techno" is from the Greek *techne*, meaning art, science, or skill and is related to the Greek *technikos,* meaning art, artifice and weave, build, or join. The most common form of this word is "technology", meaning:

> *"The purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities" (Business Dictionary, 2015).*

Given that "techno" relates to the use of technology by humans or social organizations, this prefix can be applied to the root word "species", yielding technospecies, referring to an organizational, human construct rather than the biological species describing an extinct or extant biological organism. Only one use of the word technospecies occurs in the literature. Kurylowicz and Gyllenberg (1989) use the term in reference to a genetically engineered, man-made species of *Streptomycetes.* Thus, there is unlikely to be any definitional confusion in the use of the word technospecies, unlike the current situation for species, which requires an adjective to indicate a business species.

Replacing the word species with technospecies for business usage would benefit two areas in business research. First, it will distinguish a business species from a biological species and hence reduce the current definitional confusion in the literature concerning the use of the word species. Second, given that the species definition in biology is restrictive in terms of reproductive and evolutionary processes, – a species may only mate with members of its own species – using technospecies will remove this constraint as it does not hold for business species able to recombine into diverse hybrid forms (Nelson, 2007; Reydon & Scholz, 2009). In a manner similar to biological species, technospecies could exchange routines resulting in genetically different offspring. This view would permit a unique evolutionary assessment of organizations following on the combination of organizational routines and capabilities (Nelson & Winter, 1982; Becker, 2004) and technology that would more resemble the gene-based Darwinian evolutionary model acting on populations of organisms.

Each technospecies is uniquely defined by its routines, which enable capabilities. A technospecies evolves in response to interactions with other technospecies, each of which is also affected by the set of technospecies they interact with. This process is known as diffuse co-evolution (Thompson, 1999) and is also expected to be true for social ecosystems such as a business ecosystem. Analogous to the natural unit of classification in biology (species), technospecies could form the unit of classification for business ecosystems. This would allow technospecies to be typed according to routines and capabilities in a similar manner to genome sequencing for biological organisms. In summary, we define technospecies as:

> *An organizational form consisting of a distinct combination of routines expressed as capabilities that combined with technology encompass the core competencies of that technospecies.*

Technospecies would have the capability of exchanging (mating) the organizational equivalent of DNA (routines) with other technospecies. As with biological organisms, this exchange would result in a novel genome and a new (evolved) technospecies.

Technospecies in a Business Ecosystem

The prevailing view of business ecosystems is that they are dominated by one or more keystones (Iansiti & Levien, 2004a, 2004b; Bailetti, 2010c; Weiss, 2010) utilizing a unique technology or platform to create value in a connected network with distinct boundaries and based on a single product, service, or technology. However, ecosystem boundaries often transcend a single industry (Makinen & Dedehayir, 2012). Examples of boundary spanning ecosystems are: the mobile phone ecosystem (Basole, 2009), the Internet ecosystem (Zacharakis et al., 2003, Nehf, 2007, Javalgi et al. 2005), the microprocessor ecosystem (Garnsey et al., 2008), the biopharmaceutical ecosystem (Garnsey & Leong, 2008), Amazon's web service ecosystem (Isckia, 2009), Google's ecosystem (Iyer & Davenport, 2008), Cisco's business ecosystem (Li, 2009), and the rental car ecosystem (Pierce, 2009). Taking the mobile phone ecosystem as an example, current superphone products by Samsung, Sony, Apple, etc. now span multiple industries including cable, Internet, gaming, media, entertainment, photography, and fitness with integrated and complementary products and services. Value is created across boundaries that are increasingly indistinct but tied to a central platform in a business ecosystem.

With the escalating use of information technology (IT) forming a digital business ecosystem emphasizing technological connectedness (e.g., Alibaba.com) what constitutes a business ecosystem should be reconsidered (Tan et al., 2009; Bharadwaj et al., 2013). The current view is of a group of cooperating or competing firms; our conception is that a business ecosystem consists of an interconnected assemblage of technospecies and additional members (Heikkilä & Kuivaniemi, 2012; Makinen & Dedehayir, 2012). This view requires that the boundaries of a business ecosystem be reassessed because they are less distinct than is suggested by the current literature.

The boundaries of the firm cross a variety of industry boundaries (Moore, 1993, 2006) and extend into multiple ecosystems (Iansiti & Levien, 2004b). However, the common conception is that a firm exists in a single business ecosystem, a model that is poorly understood and conceptualized. What constitutes the boundaries of a business ecosystem should be extended in order to account for all technospecies and other inhabitants of that ecosystem. Synthesizing the features of such a system from Muegge (2013), and using the technospecies and business perspective, results in the proposed definition:

> *A business ecosystem is an adaptive system positioned around a platform encompassing the totality of co-evolved interactions between technospecies and other inhabitants, required to design, improve, produce, deliver, or market a product or service.*

Although in most instances the processes required to produce, market, and deliver a product or service are similar, the interactions will be specific to each business ecosystem for that product or service. For example, the process differences between the manufacturing of a landline telephone and a cellular telephone are immediately evident. Thus, the ecosystem for these two firms would also be noticeably different. More similar products would be expected to have more similar ecosystems, although different firms manufacturing the same product would also be expected to have different relationships, resulting in different ecosystem boundaries even though they exist in a business ecosystem centred around the same platform or keystone.

We propose that a business ecosystem is predominantly comprised of a population of technospecies (with each having a unique combination of routines, capabilities, and access to resources). A technospecies may control (i.e., as a keystone) or utilize (i.e., as a complementor) a technology with value creation arising from a combination of the technology and the other resources available in the business ecosystem environment. The focal firm (keystone technospecies) controls the platform technology that is shared within that ecosystem supporting the value chain. Each uses this technology in a complementary manner to create value across the ecosystem (Iansiti & Levien, 2004b; Adner, 2006; Muegge, 2013). An example instantiation of a business ecosystem model in the context of the Adobe Flash platform is presented in Figure 2. Although there may be more than one keystone in a business ecosystem (Weiss, 2010), only one is presented here for simplicity. In our example, we have listed some of the complementary technospecies for the Adobe Flash ecosystem but the list is not comprehensive.

Adobe is a keystone technospecies based on control of the Flash technology platform. Flash was originally developed by Macromedia using the routines and capabilities of that firm. Other technospecies in this ecosystem (e.g., Google, Mozilla) will assemble a unique set of routines, capabilities, and resources enabling those firms to leverage the platform technology in the ecosystem. External and internal resources, including other forms of technology, may be available to members of the ecosystem (Conner & Prahalad, 1996). Google and Mozilla incorporate Adobe Flash Player for web browsers to enable clients and customers to view content based on their business models and capabilities, search engine, and web browser, respectively. Ecosystem resources (e.g., wireless technology infrastructure, web services, cloud technology) enable interaction throughout this ecosystem. The unique combination of individual routines, capabilities, and the platform technology define each technospecies in the same way that DNA is unique to organismal species. This unique combination for each technospecies could be considered to be the internal platform of that technospecies that is comparable, and complementary, to the external (keystone) platform central to that ecosystem (Gawer & Cusumano, 2014).

A technospecies that is a keystone in one ecosystem may play a different role in a different ecosystem by simultaneously having multiple relationships within and between ecosystems (Bengtsson & Kock, 1999). For example, in Figure 3, Adobe is a complementary technospecies in the Microsoft Office technology business ecosystem via its Portable Document Format (PDF) technology that allows documents to be consistently rendered regardless of application software, operating system, or hardware. Microsoft Office is the most widely used suite of office/productivity software worldwide. In this ecosystem, Adobe is a complementor tied to the Microsoft platform. Therefore, Adobe exists sim-

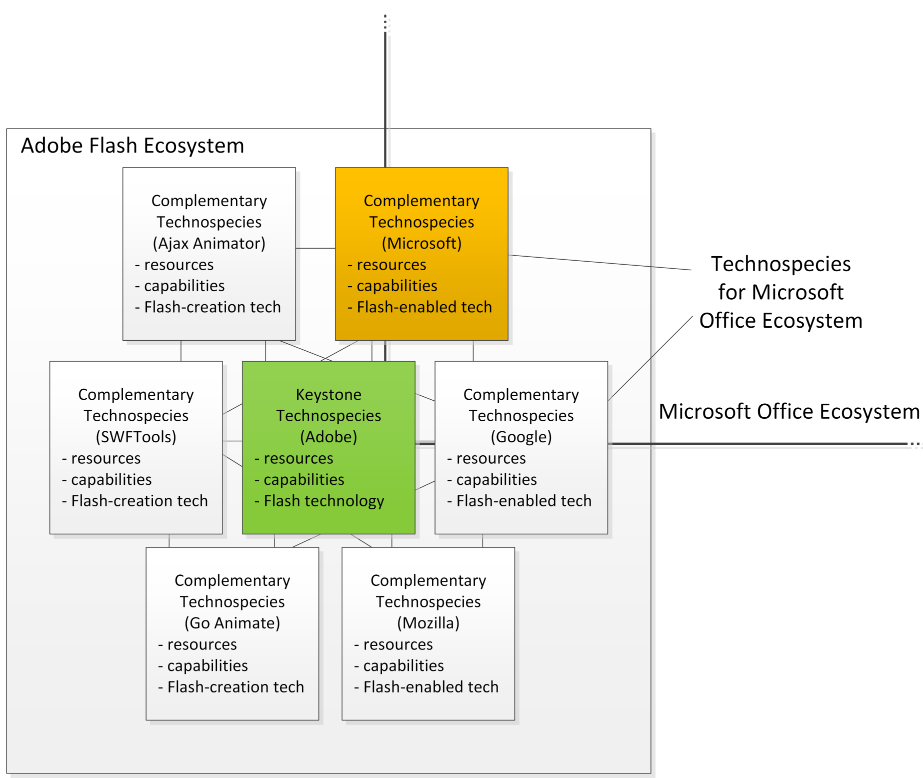

Figure 2. Adobe Flash ecosystem with Abode Flash as the platform technology and examples of complementary technospecies leveraging this technology

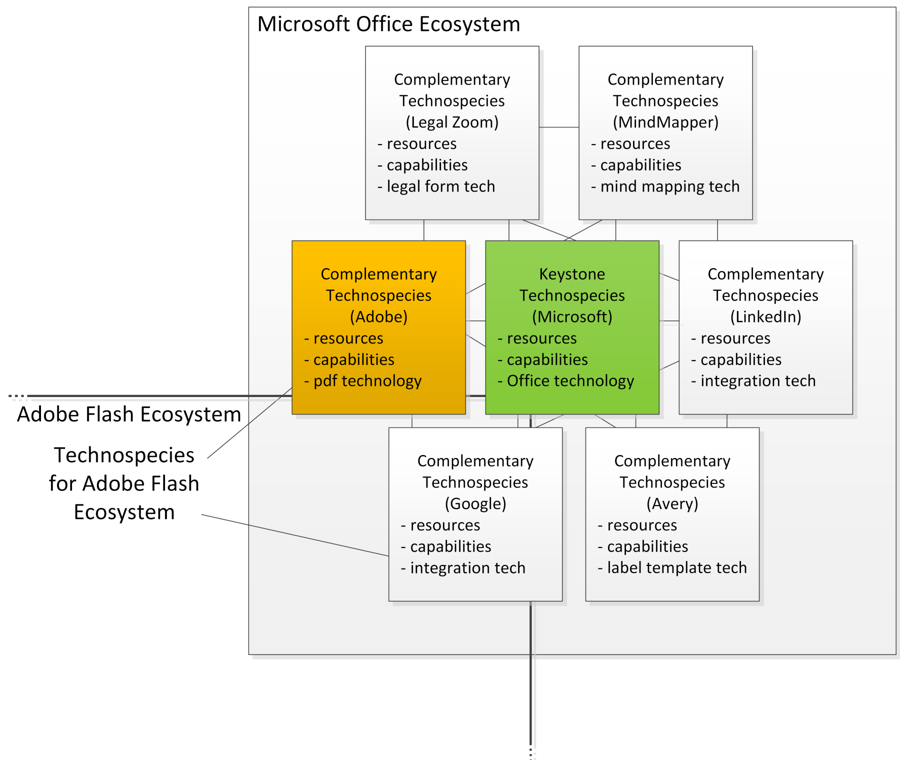

Figure 3. Microsoft Office ecosystem with Adobe acting as a complementor

ultaneously in multiple ecosystems, via the Flash platform in its own ecosystem where it acts as a hub and in the Microsoft ecosystem where it acts as a complementor (Weiss, 2010).

Business ecosystems also include, but are not limited to: suppliers, system integrators, distributors, advertisers, financiers (venture capitalists, corporate investors, investment bankers, angel investors), universities, research institutions, regulatory authorities, standard-setting bodies, the judiciary (Makinen & Dedehayir, 2012), individuals (e.g., customers, open source contributors) (Baldwin & von Hippel, 2011), crowdsourcing and crowdfunding participants (Vukovic, 2009; Kahtan, 2013; Kannangara & Uguccioni, 2013), and not-for-profit organizations such as Mozilla, the Apache Software Foundation, and the Eclipse Foundation (Hurley, 2009). We have not included these additional ecosystem members in the figures because the added detail would render the figures unreadable. These additional members may or may not be considered to be technospecies but are additional resource sources existing in the ecosystem. Thus, relationships between ecosystem members are more complex than simply between the technospecies providing the platform and complementors, and this complexity is not generally recognized (one exception being Heikkilä & Kuivaniemi, 2012). Recognizing the full extent of these connections, and what constitutes a technospecies either controlling or exploiting the focal technology in that ecosystem, is important both in defining the boundaries of a business ecosystem and determining the different ecosystems a technospecies resides in. A firm may exist simultaneously in multiple business ecosystems; the ecosystem boundaries of a firm such as Adobe are not limited to a single ecosystem. Combining this knowledge with the defining features of each technospecies (i.e., routines, capabilities, and resources utilized to create value in that ecosystem) should provide both managers and academics with a much clearer picture of the complex interrelationships in a business ecosystem. For example, software vendors require insight into software ecosystems and relationships (Jansen et al., 2009), because a software enterprise may abolish some, or all, of the barriers surrounding its intellectual property by becoming a keystone or complementor in multiple ecosystems (e.g., the Eclipse Foundation or the Apache Foundation).

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Conclusions and Future Research

Following from biology, we propose a business ecosystem model structured as a population of interacting technospecies. This perspective is in contrast to the current assortment of views including: platforms (Muegge, 2013), multi-sided platforms (Iyer & Davenport, 2008; Bailetti & Bot, 2013), communities (Muegge, 2011; Carbone, 2009), networks (Iansiti & Levien, 2004b; Corallo & Protopapa, 2007; Basole, 2009), value blueprints (Adner, 2012), and institutions and resource flows (Hearn & Pace, 2006; Muegge, 2011, 2013; Bailetti et al., 2013). Adopting this common terminology would allow communication about business ecosystems with reduced ambiguity, especially concerning the biological species concept used in business, and it would enable higher-level learning. These are necessary antecedents to the comprehensive study of business ecosystems involving mapping relationships between technospecies populating multiple, diverse business ecosystems and will allow progress toward describing a holistic view of the business environment.

A broader view of the ecosystem is required, encompassing the platform provider, complementary technospecies, and a variety of other participants. This view requires defining the technological capabilities and the ecosystem relationships for each technospecies. Recognizing technological capabilities would allow a technospecies to extend its connections beyond a single business ecosystem. Close monitoring of the capabilities of other technospecies in an ecosystem would also allow detection of threats and opportunities related to platforms that could displace the incumbent (Christensen, 1997) or could allow the technology to be assimilated and the possible competitor become a cooperator or coopetitor (Zineldin, 2004; Gueguen & Isckia, 2011; Heikkilä & Kuivaniemi, 2012). This approach would extend the value creation confines of the business ecosystem beyond the current view of that created by the technospecies providing the ecosystem platform or a complementor (Bailetti, 2010c).

The business ecosystem conceptualization presented in this article provides several managerial insights. Our model facilitates managerial identification of business ecosystem inhabitants, their interrelationships, and associated boundaries using consistent and semantic terminology. A manager, and thus organization, that is able to more clearly envision and articulate their own business ecosystem, and others that they may interact with, could potentially have a competitive advantage within their industry. A clear understanding of one's business ecosystem may allow an organization to move quicker and more fluidly than their competitors and also leverage resources from other technospecies and inhabitants that may be currently unrecognized. Additionally, understanding inter-ecosystem technology flows has implications for technological standards (Rohlfs, 2001; Laakso & Nyman, 2014), industry consolidation (Puranam et al., 2006; Carbone, 2011) and the emergence of new technologies (Weiss et al., 2013). Given that the number of different entities in a business ecosystem is quite diverse, ranging from competitors to open source contributors, being able to identify and utilize these valuable resources would benefit both the focal firm and the health of the entire ecosystem. Business ecosystems are likely to have quite different populations of technospecies and other participants that vary with different value chains; therefore research in this area based on a common language and definitions would provide deep insight into better management of these ecosystems.

Future research should focus on determining technospecies relationships in a business ecosystem beyond the limited primary relationships currently described in the literature. Similar to the concept of a keystone technospecies providing the platform in a single ecosystem, it may be that the interrelationships of a single technospecies provide unique technology or capabilities that would, if unavailable, result in a trophic extinction cascade in that ecosystem (Eklof & Ebenman, 2006; Nichols et al., 2009). Species diversity is directly implicated in biological ecosystem health (Lundberg et al., 2000; Nichols et al., 2009; Naeem et al., 2012); therefore, monitoring business ecosystem relationships and technospecies population numbers (i.e., if a dominator is present diminishing the critical mass of the ecosystem such that it becomes unsustainable) would seem equally important in terms of operationalizing the business ecosystem health concept of Iansiti and Levien (2004b).

Researchers in technology management and in business could contribute to this area of research by studying the multiple ecosystems technospecies are situated in, either as a keystone or a complementor. The interactions between business ecosystems in this regard is currently an unexplored area. Another research opportunity would be to consider business ecosystems from the perspective of the individual technospecies; this approach would also frame the research questions and results around managerially relevant problems that would be applicable for technology entrepreneurs. Additionally, the unexplored technospecies construct proposed in this article requires further refinement and development. Specific areas include a better understanding as to the characteristics of this new form and the inter-relationships of technospecies themselves and with other inhabitants in a business ecosystem. The latter concept is a particularly neglected area in research (e.g., the interaction of technospecies with non-technospecies in a business ecosystem). How ecosystem relationships are modified through the lifecycle of the platform technology is a related area of research. As relationships and interactions become more important in value creation (Ritter et al., 2004), a holistic view of business ecosystems and relationships becomes more important.

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Q&A

Hassib Khanafer

Q. Does a software development firm need an open source policy?

A. Software development has evolved from the guarded approach of building commercial products entirely in-house to building them by piecing together proprietary, third-party, open source, and contractor code. The wide availability of open source software (OSS) spares developers from having to reinvent the wheel, while accelerating development and reducing costs. Indeed, the wide availability, ease of access, and lack of financial cost of OSS lead many developers to believe that it is a risk-free solution to many of their pressing development problems. However, similar to any third-party commercial software, developers need to respect the licensing and copyright terms that govern how the OSS code can be used, address the security vulnerabilities that may be associated with the software, and abide by export control regulations if the used software contains implementations of encryption algorithms.

Licensing can be a particularly complex issue for organizations wishing to leverage OSS as part of their software products. Although there are many different types of OSS licenses, they generally fall under the categories of copyleft or permissive licenses. Copyleft licenses, such as the GNU General Public License (GPL), generally require that products containing GPL-licensed code be released under the same license. In contrast, permissive licenses, such as the MIT License, grant the user more flexibility in terms of how the software can be used. For example, the MIT License allows users to do whatever they want with the software as long as a copy of the license accompanies the copied software. The onus is on the user of an OSS component to make sure that they are abiding by the obligations of the license.

Similar to its proprietary counterparts, OSS is not immune to security vulnerabilities. Developers need to make sure that the specific versions of the OSS component they are using are not associated with known security impairments that could expose their clients. Developers are required to take the appropriate actions, for example, to upgrade to new versions that are free from the vulnerabilities or replace the vulnerable component with another open source component. Lastly, software vendors who plan to export their software should be aware that many jurisdictions, including the United States, the United Kingdom, and Canada, among many others, place stringent regulations on the export of software that contains encryption algorithms or cryptography. These restrictions apply regardless of whether the encryption algorithms form part of an open source module integrated into a software product or are part of the proprietary code.

In all but the smallest of code portfolios, managing the aforementioned risks can be daunting. These challenges may discourage organizations from leveraging OSS in their products. Thus, to make sure that license and copyright obligations are addressed, minimal interruption to the product development cycle is incurred, and the opportunity to use available high-quality OSS is exploited, software development firms should implement an internal open source policy.

An open source policy clearly defines the objectives of using OSS in the enterprise, and it describes how those objectives tie into the overall business strategy. As an example, using OSS components may allow the company to focus its software efforts solely on areas of technology that truly differentiate the company's offering. Or, deployment of OSS may expedite the development of a product, which may tie in to an overreaching enterprise strategy of reducing time to market. The policy also defines the rules that govern the internal and external use of open source software. As an example, while the policy could be lenient in terms of open source licenses used internally for building and testing the product, it could be very stringent in terms of limiting what components can be shipped as part of the product (e.g., the policy could state that no GPL-licensed software should be part of the distributed product).

Furthermore, the policy should clearly define the team that is responsible for its development, evolution, and implementation. Representatives from both the business team (e.g., product line managers) and the devel-

Q&A. Does a software development firm need an open source policy?

Hassib Khanafer

opment team (e.g., architects) could be responsible for the development and evolution of the policy, while the development team could be responsible for its execution.

Other aspects defined by the policy should include:

- the sources from which OSS components may be obtained (e.g., main project websites versus forked sites)
- the forms in which the components may be downloaded (i.e., source files or binaries)
- the ongoing maintenance of the OSS components used (e.g., the processes for applying regular updates of the components and emergency patches such as fixes for security vulnerabilities)
- the steps that should be taken if a policy violation is detected

In support of its open source policy, a company can employ open source compliance tools, which can be integrated into any or all stages of the development cycle. These tools are similar to static code analysis tools that developers employ as part of their quality assurance testing. Whereas the latter are used to check software for potential coding issues, the former are used to check the code for presence of open source components and report on associated licenses and copyrights, known security vulnerabilities, and encryption content. Both static code analysis tools and open source management tools have similar usage patterns, although the user community for the latter is larger and could include legal and licensing teams. Some development organizations deploy these tools at the end of their development cycle, while others prefer to integrate the tools throughout the development cycle, which decreases remedial efforts that may be needed prior to a product release.

Open source management tools can be integrated into the development environment, where they can continuously monitor the use of OSS in real time and help developers with the early detection and remediation of potential policy violations as they arise. Additionally, these tools can be integrated with the build infrastructure of products; as an example, the nightly build could trigger the tool to check the code base for any newly used OSS and their licenses, security vulnerabilities, and other attributes. This approach is similar to how companies use unit test frameworks (e.g., Junit), where the execution of test suites is triggered by the software build process.

Hence, the growing adoption of OSS components in the production of software products mandates that the users of such software establish and implement internal open source policies that govern and manage the use of such software. The introduction and implementation of such policies is best supported by the use of open source management tools that automate the analysis of software code portfolios and aid the removal of any uncertainty around adopting open source software.

About the Author

Hassib Khanafer is the Chief Technology Officer at Protecode, a provider of open source license and security management solutions that can be used throughout the software development lifecycle to ensure license compliance. Hassib is a technology enthusiast who has been in the software industry for more than 25 years. His experience spans the domains of network management, OSS license management, financial applications, human resource applications, enterprise collaboration tools, oil and gas maintenance planning applications, e-commerce systems, and software management tools. Prior to joining Protecode, he worked in different positions in Nortel Networks, Siemens, Avaya Inc., and Kuwait Gulf Oil Company. Hassib holds a Bachelor's degree in Electrical Engineering from the University of North Carolina at Charlotte, United States, and a Master's degree in Computer Engineering (Software Systems) from Kuwait University.

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TIM Lecture Series

The Internet of Everything: Fridgebots, Smart Sneakers, and Connected Cars

Jeff Greene

> *"Cybersecurity considerations need to be at the forefront of our minds as the Internet of Things moves from expectation to reality."*
>
> Jeff Greene
> Director of NAM Government Affairs & Senior Policy Counsel
> Symantec

Overview

The TIM Lecture Series is hosted by the Technology Innovation Management program (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 second TIM lecture of 2015 was held at Carleton University on March 18th, and was presented by Jeff Greene, Director of NAM Government Affairs & Senior Policy Counsel at Symantec (symantec.com). Greene provided an overview of the Internet of Things to compare the hype versus reality and to examine the security implications of connecting myriad physical devices to the Internet and to each other.

Summary

Greene began by sharing examples of new technologies in which privacy concerns, vulnerabilities, and even intrusions that increasingly come from unexpected places, such as trash cans that track pedestrians via smartphones (Satter, 2013), Smart TVs with security gaps through which hackers could view and record users through their webcams (Fink & Segall, 2013), and camera-enabled baby monitors that hackers have been able to control remotely (Hill, 2013). Technologies such as these will become familiar components of the Internet of Things (IoT), or the Internet of Everything, although Greene cautions against defining these terms too closely:

> *"There is no hard and fast definition of the Internet of Things, in part, because it is so new and continues to evolve. Even five or ten years from now, we will likely be calling the IoT something different."*

In the context of the lecture, Greene's view of the Internet of Things is quite broad, and it includes "a whole host of connected endpoints that in some way interact with the physical world, whether sensing, acting, or reacting". This view extends beyond computers and handheld devices – it includes factories, water treatment plants, fitness devices, toys, and so on. And, generally, he finds that it can be helpful to distinguish between the industrial Internet of Things (e.g., heavy machinery, manufacturing, critical infrastructure) and the consumer Internet of things (e.g., appliances, toys, home devices).

Greene argued that, although we see current technologies that will likely contribute to the Internet of Things, we are likely still five to ten years a from realizing it, meaning that we still have a window of opportunity to shape it and ensure that it is as secure as possible. In particular, we must recognize the clash of cultures between the physical world and the IT world that the Internet of Things brings about. For example, manufacturers and critical infrastructure utilities depend on having their systems up and running 24 hours per day, whereas the IT culture assumes systems will be taken down on a regular basis for patching and other maintenance.

TIM Lecture Series – The Internet of Everything

Jeff Greene

Greene's presentation included examples of the intersections between vulnerabilities in the physical and IT worlds and the poor practices that are increasing creating cyber-risks as the Internet of Things evolves. Notably, many of the underlying vulnerabilities do not represent a shortcoming in technical development, but rather point to poor security practices that can be remedied, such as re-using or sharing passwords, hard-coding passwords, and having (or not changing) default passwords. Thus, there are basic steps that can be taken to improve security through behavioural changes, without requiring innovative technological solutions. Equally, there can be greater consideration paid to human behaviour when designing and implementing technical solutions. For greater cybersecurity, this human-behaviour element should also factor into our expectations of how devices will be used. Increasingly, devices are being used in ways or for purposes not intended by their designers. As users, Greene encourages us to focus less on the question "can it be connected?" and ask instead "should it be connected?"

In closing, Greene examined what is being done to assess the risks of the Internet of Things and to develop appropriate policies for its cybersecurity so that we can all enjoy the tremendous benefits that it may bring. As identified by the National Security Telecommunications Security Advisory Committee (NSTAC, 2014) in the United States, there is "a small – and rapidly closing – window to ensure that IoT is adopted in a way that maximizes security and minimizes risk. If the country fails to do so, it will be coping with the consequences for generations." Greene reports that this small and rapidly closing window is likely on the scale of two to four years:

> *"Based on our experience with the Internet itself, and its key lesson that security should be part of design, we have only a short time to avoid making the same mistake with the Internet of Things. Cybersecurity considerations need to be at the forefront of our minds as the Internet of Things moves from expectation to reality."*

About the Speaker

Jeff Greene is the Director of Government Affairs for North America and Senior Policy Counsel at Symantec, where he focuses on issues including cybersecurity, the Internet of Things, and privacy. In this role, he monitors executive and legislative branch activity and works extensively with industry and government organizations. Prior to joining Symantec, Jeff was Senior Counsel with the U.S. Senate Homeland Security and Governmental Affairs Committee, where he focused on cybersecurity and Homeland Defense issues. He has also worked in the House of Representatives, where he was a subcommittee staff director on the House Committee on Homeland Security. Previously, he was an attorney with a Washington, D.C. law firm, where his practice focused on government contracts and contract fraud, as well as general civil and criminal investigations. Jeff recently served as the staff co-chair of the "Internet of Things" research subcommittee of the President's National Security Telecommunications Advisory Committee. He is also a Senior Advisor at the Truman National Security Project, where he is on the Steering Committee for the Cyberspace and Security Program. He is co-chair of the Homeland Security Committee of the American Bar Association's Section of Science & Technology Law and is on the Executive Committee of the Information Technology Sector Coordinating Council. He has a BA in International Relations from Boston University in the United States and a JD with Honors from the University of Maryland, also in the United States, where he has taught classes in Homeland Security law and policy.

This report was written by Chris McPhee.

TIM Lecture Series – The Internet of Everything

Jeff Greene

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Keywords: cybersecurity, Internet of Things, IoT, Internet of Everything, Industrial Internet, Consumer Internet of Things, hackers, cyber-attacks

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These guidelines should assist in the process of translating your expertise into a focused article that adds to the knowledge resources available through the *Technology Innovation Management Review*. Prior to writing an article, we recommend that you contact the Editor to discuss your article topic, the author guidelines, upcoming editorial themes, and the submission process: timreview.ca/contact

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Start by asking yourself:

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If your answer is "yes" to any of these questions, your topic is likely of interest to readers of the TIM Review.

When writing your article, keep the following points in mind:

- Emphasize the practical application of your insights or research.
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- 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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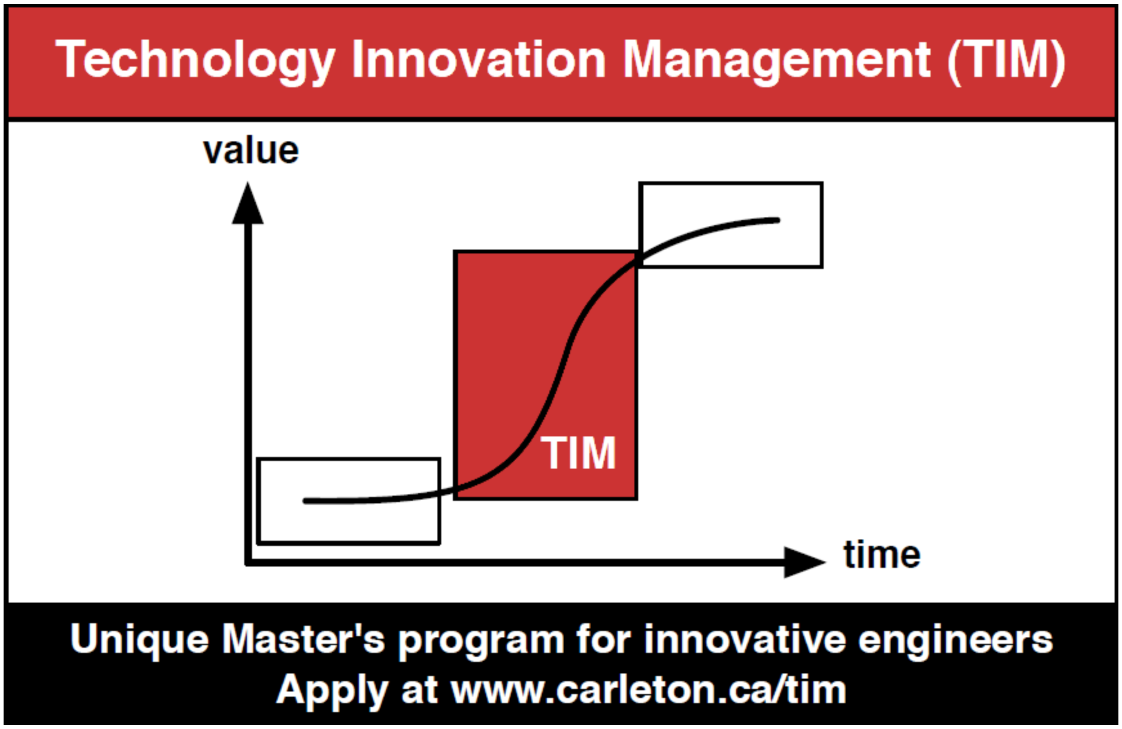
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