Technology Innovation Management Review

December 2012

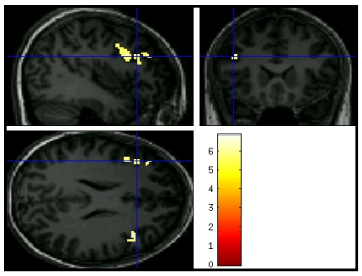

Image from Suomala et al. (2012; timreview.ca/article/634)

Recent Research

Welcome to the December 2012 issue of the *Technology Innovation Management Review*. We invite your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

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

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

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 past articles and blog posts.
- Review the upcoming themes and tell us what topics you would like to see covered.
- Write an article for a future issue; see the author guidelines and editorial process for details.
- Recommend colleagues as authors or guest editors.
- Give feedback on the website or any other aspect of this publication.
- 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

Editorial

Chris McPhee, Editor-in-Chief

Welcome to the December 2012 issue of the *Technology Innovation Management Review*. This month's editorial theme is Recent Research. The articles in this issue come from researchers in the Technology Innovation Management program (TIM; carleton.ca/tim) and the Sprott School of Business (sprott.carleton.co) at Carleton University in Ottawa, Canada.

In the first article, **David Hudson**, PhD candidate in the Sprott School of Business, examines employees who use their own consumer IT (e.g., tablet computers, software programs) to help them do their jobs, and he argues that firms should consider this behaviour as entrepreneurial effort. Creating value by combining personal IT assets with firm assets is consistent with entrepreneurship theory, although this link has not been previously formalized. The article has relevance to other researchers, but the article also highlights the implications of the findings for managers.

Next, **Jyrki Suomala** and five co-authors from Finland – including **Mika Westerlund**, a faculty member appointed to the TIM program and Sprott – present neuromarketing research that examines the subconscious responses of customers to marketing messages presented at various points along a simulated buying process. The study suggest that neuroimaging techniques can help researchers not only further understand the buying process, but also gauge customer responses to new product and service concepts beyond what can be achieved with traditional market research and customer satisfaction surveys.

Derek Smith, a graduate student in the TIM program, highlights the challenges and opportunities presented by an increased use of electric vehicles and the subsequent increases in power demand that will follow. Beyond a simple increase in overall demand, electric utilities have difficulty predicting the timing and location of a mobile demand. Smith provides background on the key dimensions of the problem and then proposes a disruptive and innovative solution that provides real-time mobile communication of the power requirements of electric vehicles and other mobile high-power devices. He argues that the solution would substantially change not only how electric utilities manage their infrastructure and do business with their customers, but it would also open up business opportunities for entrepreneurs.

Aparna Shanker, a recent graduate of the TIM program, presents her research into the value of open source software as perceived by enterprise customers. Through a synthesis of existing literature and interviews with managers and leaders of enterprises, Shanker developed a model of customer value creation. This research identifies the points of value that the suppliers of open source software should focus on, and it points to the need for marketing strategies that can demonstrate this value to enterprise customers.

Ludovico Prattico, another recent graduate of the TIM program, identifies the power centres of open source software foundations using content analysis techniques applied to the foundations' bylaws. Six open source software foundations were examined (Apache, Eclipse, GNOME, Plone, Python, and SPI), and the results show how power is distributed among three groups (Members, Chairman/President/Executive Director, and Board of Directors) in each of these foundations.

This issue also includes a report on a recent TIM Lecture by **Gordon Freedman**, CEO of Power Trip and lawyer at Freedman & Associates. Freedman shared his views on intellectual property paradigms, which are based on his experiences as an entrepreneur, lawyer, and patent and trademark agent. The event was held at Carleton University in Ottawa, Canada, on November 8th, 2012.

In the October issue, we celebrated the one-year anniversary of the TIM Review, and I highlighted the significant growth and diversity of readership we have experienced. The TIM Review is nearing 6,000 unique visitors per month, with substantial readership distributed across the Americas (49%), Europe (23%), and Asia (22%) (McPhee, 2012; timreview.ca/article/613). Here, I would like to recognize some of the articles that have proved particularly popular since October 2011.

Table 1 ranks the most popular articles published in the 12 issues between October 2011 and September 2012, based on traffic to timreview.ca over this period. This method strongly disadvantages more recently published articles, so the table also includes five trending articles that would appear in the main list if only recent traffic were considered. If you missed any of these articles when they first came out, I encourage you to add them to your reading list. Our full archive of articles

Editorial: Recent Research

Chris McPhee

Table 1. Most popular TIM Review articles published from October 2011 to September 2012*

Rank	Article	Author(s)	Issue
1	**Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects** (timreview.ca/article/520)	Bailetti	February 2012
2	**Social Entrepreneurship: Definition and Boundaries** (523)	Abu-Saifan	February 2012
3	**Global from the Start: The Characteristics of Born-Global Firms in the Technology Sector** (532)	Tanev	March 2012
4	**Business Model Discovery by Technology Entrepreneurs** (545)	Muegge	April 2012
5	**Acquisition Integration Models: How Large Companies Successfully Integrate Startups** (490)	Carbone	October 2011
6	**Q&A. What Is the Secret of Red Hat's Success?** (513)	Suehle	January 2012
7	**A Customer Value Creation Framework for Businesses That Generate Revenue with Open Source Software** (534)	Shanker	March 2012
8	**Fostering Student Entrepreneurship and University Spinoff Companies** (485)	Bailetti	October 2011
9	**Developmental Impact Analysis of an ICT-Enabled Scalable Healthcare Model in BRICS Economies** (565)	Saurabh, Bhomick, Amrita, and Biswas	June 2012
10	**Minimum Viable Product and the Importance of Experimentation in Technology Startups** (535)	Rancic Moogk	March 2012
11	**Q&A. What Is Customer Value and How Do You Deliver It?** (525)	Shanker	February 2012
12	**Patent Value: A Business Perspective for Technology Startups** (501)	de Wilton	December 2011
13	**Managing the Challenges of Becoming an Open Innovation Company: Experiences from Living Labs** (489)	Westerlund and Leminen	October 2011
14	**How Open Source Has Changed the Software Industry: Perspectives from Open Source Entrepreneurs** (510)	Lindman and Rajala	January 2012
15	**A New Way of Measuring Openness: The Open Governance Index** (512)	Laffan	January 2012
↑	**The Physical Internet and Business Model Innovation** (566)	Montreuil, Rougès, Cimon, and Poulin	June 2012
↑	**Accelerating a Network Model of Care: Taking a Social Innovation to Scale** (578)	Cammack and Byrne	July 2012
↑	**Living Labs as Open-Innovation Networks** (602)	Leminen, Westerlund, and Nyström	September 2012
↑	**From Stories to Evidence: How Mining Data Can Promote Innovation in the Nonprofit Sector** (575)	Lenczner and Phillips	July 2012
↑	**TIM Lecture Series: Leadership Position in Technology Entrepreneurship and Commercialization** (569)	Bailetti et al.	June 2012

*The rankings are based on website traffic to timreview.ca from October 1, 2011 to September 30, 2012. The list also includes 5 recently published articles (denoted by ↑) that would appear in the main list if only traffic from June 1, 2012 to November 30, 2012 were considered.

Editorial: Recent Research

Chris McPhee

back to July 2007 is available on our website at: timreview.ca/issue-archive

In January, we look forward to the first issue of 2013. The editorial theme is Open Source Sustainability, and the guest editor is **Maha Shaikh**, Assistant Professor of Information Systems at the Warwick Business School in the United Kingdom.

As always, we welcome your feedback, articles, and suggestions for future themes. We hope you enjoy this issue of the TIM Review and will share your comments online. Please also feel free to contact us (timreview.ca/contact) directly with feedback or article submissions.

Chris McPhee
Editor-in-Chief

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. Chris holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa and BScH and MSc degrees in Biology from Queen's University in Kingston. He has over 15 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

Citation: McPhee, C. 2012. Editorial. *Technology Innovation Management Review*. December 2012: 3-5.

Managing Entrepreneurial Employees Who Bring Their Own IT to Work

David Hudson

> *"So I gave them over to their stubborn hearts to follow their own devices."*
>
> Psalm 81:12

Why do some employees invest their own time and money to acquire consumer information technology (IT) for use in the workplace as corporate IT? This behaviour occurs even when their firms already possess considerable IT resources. Moreover, IT governance policies typically oppose the use of unsanctioned IT within the firm. IT governance assumes that the only IT assets that are relevant to the firm are those that are owned by the firm. However, employees can create value for the firm by combining their personal IT assets with the firm's IT assets. Creating novel asset combinations is consistent with entrepreneurship but entrepreneurship theory does not address this type of voluntary employee entrepreneurship using personal IT assets. This article proposes a link between the theory of the firm and entrepreneurship theory to explain why employees act entrepreneurially. This link is significant because it advances the notion that employees of established firms can be entrepreneurial when they use their own consumer IT as corporate IT. This link is also significant because it suggests that managing employee entrepreneurship requires tolerance of value creation that is emergent and can occur within a firm.

Introduction

Employees can be observed using their own consumer IT (e.g., smartphones, touchscreen tablets, software, and Internet services), as corporate IT. Individual employees acquire this technology for their own use, including work done for their employer. Employees who use their own personal IT for work challenge fundamental assumptions about how firms choose, implement, and support tools for knowledge work, and these employees can be perceived as either insubordinate or innovative (Bernoff and Schadler, 2010; tinyurl.com/b2mmxfl). Academic literature on IT governance and entrepreneurship tends to support the view that consumer IT used as corporate IT is a problem. However, it may be that there is significant opportunity arising from this technology trend.

Consumer IT may be used as corporate IT when there is no equivalent corporate IT available (Wang, 2012; tinyurl.com/6xv5o52) or in place of available corporate IT (Moschella, 2009; tinyurl.com/av5mg8y). Consider a situation where customer service employees provide support to customers for firm products by relating symptoms of customer issues to solutions using an online decision tree. One customer service employee, who we will call René, was expected, outside normal working hours, to respond to customer support calls by going to the office or returning home to use secure remote access to company systems. René recognized that the information to perform the support function could be transferred to a personal tablet computer and available wherever that employee happened to be. René found a suitable 'app' and created this mobile support tool on his own time. It is clear that employees such as René no longer see IT departments as the only source for workplace IT (Harris et al., 2012: tinyurl.com/aqqtcuo; The Gartner Group, 2011: tinyurl.com/cg6b66n).

The literature emphasizes the security, support, and cost risks to firms arising from employee use of consumer IT as corporate IT (e.g., Ardoin, 2010: tinyurl.com/aa2uu92; Cane, 2011: tinyurl.com/bqq3e49). The risks arise because employees acquire and support such IT outside traditional firm IT departments and processes. The literature on the benefits of consumer IT

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used as corporate IT is limited and tends to emphasize employee preference but acknowledges that there may also be firm benefits (Bernoff and Schadler, 2010: tinyurl.com/b2mmxfl; Harris et al., 2012: tinyurl.com/aqqtcuo).

The problem addressed by this article is that there is no explanation based on theory for why employees use consumer IT as corporate IT. Furthermore, A theory-based explanation suggests that managing employee use of consumer IT as corporate IT may be about much more than managing the trade-off between employee preferences and IT security. In our example, proprietary information now resides on René's device but René can be more responsive to customers with less personal disruption. How can the firm best manage René's effort to develop a support tool and the violation of company IT policies and practices?

The objectives of this article are to: i) propose that linking the theory of the firm (tinyurl.com/6s8sju) and entrepreneurship theory offers an explanation for employee use of consumer IT as corporate IT and ii) present the implications for managers. This first objective is significant because it argues that employees of established firms can be entrepreneurial and that consumer IT used as corporate IT is an example of such entrepreneurial effort.

This article is organized as follows. First, the consumer IT used as corporate IT phenomenon is briefly described to frame the problem. Second, the link between the theory of the firm and entrepreneurship theory is described as an explanation for employee use of consumer IT as corporate IT. Third, the implications for management practice are presented. Managing employees who use consumer IT as corporate IT is about managing broadly based entrepreneurship and recognizing the need for change in IT governance of the firm.

Consumer IT Used as Corporate IT

Consumer IT used as corporate IT is a consequence of the fact that, in 2004, the consumer market for IT products became larger than the enterprise market (Ginsburgh and Alvarez, 2009; tinyurl.com/b6lwt6k). In increasing numbers, consumers bring to work the IT that they have personally acquired (Harris et al., 2012; tinyurl.com/aqqtcuo). A survey of information workers in 2009 indicates that over one third bring devices, applications, or services originally acquired for personal use to work without approval from the IT department (Bernoff and Schadler, 2010; tinyurl.com/b2mmxfl). By 2015, it is estimated that IT assets and services worth the equivalent of 35 percent of the enterprise IT budget will be managed outside the IT department, and this includes a rapidly growing component that is consumer IT used as corporate IT (The Gartner Group, 2011; tinyurl.com/cg6b66n).

Consumer IT used as corporate IT is distinguished from "BYOD" (Bring Your Own Device), and similar labels, to emphasize that the IT of interest includes not only devices but software applications and Internet-based services as well (e.g., Citrix, 2010; tinyurl.com/cxhg6dt). It is also distinguished from "IT consumerization", a term that has been used to describe instances where the consumer IT is acquired by the firm through traditional IT governance processes (e.g., Harris et al., 2012; tinyurl.com/aqqtcuo). Consumer IT used as corporate IT is chiefly distinguished by the fact that an individual employee acquires it and then uses it for work, such as when René decided to use his own tablet with software that he found on the Internet. René asked for nothing from the firm or its IT department to create a portable support tool.

Because of the importance of IT to firms in most industries, there is a body of literature that describes best practices for IT governance. IT governance includes practices encompassing IT strategy, selection, implementation, and operation (Weill and Ross, 2005; tinyurl.com/btkugmt). IT governance assumes that IT is owned by the firm, not the employee, and emphasizes the virtues of top-down IT standardization. In fact, this literature describes situations where employees individually obtain their own IT as "anarchy" (Weill and Ross, 2005).

There is limited academic literature addressing consumer IT used as corporate IT. Bernoff and Schadler (2010; tinyurl.com/b2mmxfl) and Harris, Ives, and Junglas (2012; tinyurl.com/aqqtcuo) both describe the trend as growing and such use by employees as inevitable because of the pervasiveness of the technology in everyday life. Bernoff and Schadler emphasize that encouraging use of consumer IT as corporate IT is a form of empowerment by firms of their employees but offer no theoretical support for their argument. Harris, Ives, and Junglas describe how IT governance might accommodate consumer IT used as corporate IT but, again, offer no theoretical explanation for why firms ought to do so other than to address the need to maximize employee and firm benefits.

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Governance

Governance is the formal allocation of decision rights in a firm and arises as a consequence of a rich body of economic theory that explains why firms exist and how they ought to be managed given why they exist (Foss, 2012: tinyurl.com/76h2xzq; Williamson, 1996: tinyurl.com/ahoqdr8). The theory of the firm argues that firms are collections of contracts for employment, ownership, equity investment, sales, supply, goods, service, warranty, and so on (Coase, 1937: tinyurl.com/796acxx; Foss, 1996: tinyurl.com/7kfsluj). In our customer support example, the firm's ownership of certain IT assets, support obligations to its customers, the 1-800 call centre service, and René's employment would all be contractual relationships. Contracts document all forms of such economic exchange and, therefore, contracts are the essence of a firm (Jensen and Meckling, 1976; tinyurl.com/6uw7flt).

Because it is impossible to capture all possible eventualities in a contract and because people may interpret what contracts do say to their own advantage, contracts must be overseen by managers (Aghion and Holden, 2011: tinyurl.com/85j3bge; Williamson and Winter, 1993: tinyurl.com/7qgdwjr). In the theory of the firm, managers exist to mitigate opportunistic bad behaviour and to ensure that agents deliver as expected and in unforeseen situations (Nee, 2005; tinyurl.com/7waf4y7). Managers do so by using tools such as process, monitoring, incentives, and allocation of decision rights – who can decide what – that are collectively referred to as firm governance (Foss, 2012; tinyurl.com/76h2xzq).

IT governance is one type of firm governance and includes a large body of literature and standards encompassing decision-making for IT strategy, architecture, technology, platforms, applications, investment, and ongoing operations (Weill and Ross, 2005; tinyurl.com/btkugmt). IT governance builds on a specific assumption that a goal of governance is to minimize shirking by agents, including employees (Jensen and Meckling, 1976; tinyurl.com/6uw7flt) and an implicit assumption that the only assets that are relevant to the firm are those owned by the firm (Penrose, 1959; tinyurl.com/a38orc9). The fact that René owns certain IT is irrelevant to the firm in this traditional view of governance.

Employees as Entrepreneurs

It is possible that some employees who use consumer IT as corporate IT are playing Angry Birds or watching last night's "Walking Dead" episode and therefore are shirking using assets that are irrelevant to the firm. However, employees do indicate that their own IT provides "better results" when they do their jobs than IT provided by the firm, that they use their own IT "to do my job to the best of my abilities," that "the software and applications I use are integral for accomplishing my job," and so on (Bernoff and Schadler, 2010; tinyurl.com/b2mmxfl). One quarter of the employees in another survey indicated that they often use their own IT to solve a business problem in their jobs for the firm (Harris et al., 2012; tinyurl.com/aqqtcuo).

Shane and Venkataraman (2000; tinyurl.com/bkgee99) provide one of the most widely referenced definitions of entrepreneurship in management journals. They define the field of entrepreneurship as how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited. Where employees use their consumer IT as corporate IT and create value for the firm, possibly in combination with firm assets, then that use would appear to meet the definition of entrepreneurship.

However, entrepreneurship theory emphasizes founders who are motivated by profit and the use of firm assets (Penrose, 1959: tinyurl.com/a38orc9; Shane, 2012: tinyurl.com/aznwf4n). Entrepreneurship theory does not focus on entrepreneurial effort by employees except within formally sanctioned corporate venturing or intrapreneurship initiatives (Amit et al., 1993; tinyurl.com/ax3yya4). Employee use of consumer IT as corporate IT is not led by management. For example, René created his portable customer-support tool without either instruction or approval from a manager.

Linking the Theory of the Firm and Entrepreneurship Theory

A link between the theory of the firm and entrepreneurship theory is proposed to explain a phenomenon that neither theory can explain on its own: employee use of consumer IT as corporate IT. The link advances that employees who act entrepreneurially combine their own consumer IT with firm IT to create value for their firms and to benefit themselves. Below, three key concepts are used to develop the link between the theory of the firm and entrepreneurship theory.

First, managers in firms exist because contracts are incomplete and agents may shirk (Jensen and Meckling, 1976; tinyurl.com/6uw7flt). However, while the theory of the firm emphasizes that agents, such as employees, may perform below the spirit of their contract even if

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they meet the strict letter of the contract, it is also possible for agents to do the opposite. An agent may use care, materials, or techniques that exceed what a contract specifies without the principal's knowledge. This is "consummate performance, that is, … performance within the spirit of the contract" (Hart and Moore, 2008; tinyurl.com/c56xtnb). Employees who acquire IT on their own to perform their jobs better than strictly required or possible with the IT provided by the firm can be said to be performing consummately. René voluntarily created a tool to serve customers that, initially, was not visible to his manager because it was used outside of normal working hours. Creation of a tool was not part of René's job description but addressed a desire to provide superior customer service within a healthy working environment, which is consistent with the spirit of René's employment.

Second, employees may also make investments when they work to the spirit of their contracts. If there is an investment made in expectation of an uncertain return then the effort is not only consummate, it is also entrepreneurial (Shane and Venkataraman, 2000; tinyurl.com/bkgee99). The creation of value from novel combinations of employee IT assets with firm IT assets is entrepreneurial (Foss et al., 2007; tinyurl.com/d77uotf). Employees may invest through the financial cost of their IT. Employees may see benefit to themselves in terms of future advancement in position or salary, and the firm may see benefit through productivity gains or new products and services. Although René already owned the tablet, he acquired software and invested time to make the tablet usable as a remote support tool. Moreover, he later improved the tool to allow co-workers to use the tool on their personal devices.

Third, the investment and return for employee entrepreneurship can be more than monetary given that entrepreneurs calculate the cost-benefit relationship of their actions in more than financial terms (Aldrich, 2005; tinyurl.com/7waf4y7). Employees may invest time through search, learning, and acquisition efforts. The benefits realized by employees may include the choice of workplace, co-workers, or tools (Jensen and Meckling, 1976; tinyurl.com/6uw7flt). Employees using consumer IT as corporate IT may also perceive benefit through their "human capital tied to particular technologies … with which they are familiar" (Hart and Holmstrom, 2010; tinyurl.com/bver2xy).

This non-monetary employee benefit can be more generally described as emancipation. Where technology change increases uncertainty by threatening the firm's environment (Dosi et al., 2005; tinyurl.com/7waf4y7), then emancipation can be understood as a reaction by individuals who are uncomfortable with leaving the response to change to others (Alvesson and Willmott, 1992; tinyurl.com/cntmnks). Emancipation includes efforts by employees to take control over their environment and satisfies an entrepreneur's "moral obligation to act" rather than being directed towards personal monetary gain (Courpasson et al., 2011; tinyurl.com/a2ajotv). René's actions were initially a response to his desire to respond to customers while minimizing disruption to his own life. Customers likely perceived some improvement in responsiveness while René, and later his co-workers, found that they could perform their jobs with more control over where and when work was done.

Therefore, consummate performance by employees using consumer IT as corporate IT would be demonstrated by use of IT to do more than strictly required to perform assigned tasks. Such effort is entrepreneurial if it requires some investment and creates value for the employee or for the firm from new asset combinations. Investment could be monetary, such as the purchase of a tablet or smartphone for use at work, or it could be non-monetary, such as personal time René spent finding and acquiring the software for his support tool. Benefit to the employee that includes rearranging the employee's environment, such as when, where, with whom, and how work is performed, would be a consistent with emancipation. The firm benefits through improved performance from its employees and possibly from new products or services. The linked theories then explain consumer IT used as corporate IT as an instance of how employees of established firms can be entrepreneurial.

Implications for Managers

Different approaches to managing employees affect entrepreneurial effort. For example, some research argues for having responsibility for entrepreneurship widely held in established firms rather than centralizing it, if managers wish to increase entrepreneurship: "More innovation will occur if the decision to innovate is dispersed among many diverse individuals than if it is concentrated in the hands of a few" (Bewley, 1989; tinyurl.com/ar2c3y6). Dispersion does not mean isolation, because entrepreneurial effort by one person can stimulate another.

The theory of the firm supports this view. For example, Foss (2012; tinyurl.com/76h2xzq) argues that distributing responsibility for entrepreneurship and tolerating am-

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biguity may be associated with increased entrepreneurship. The ambiguity here is about who has the right to the benefit from the entrepreneurial effort. Individuals invest effort to take advantage of what they uniquely know where they perceive potential rewards for themselves as well as for the organizations (Jensen and Meckling, 1976; tinyurl.com/6uw7flt). In other words, the potential for private employee benefit must exist to encourage entrepreneurial risk-taking. In creating an IT tool, René invested his own time doing something that was, strictly speaking, not his job because he saw the opportunity and had a sense that he could do it easily. By allowing coworkers to use the tool, he took on a further support responsibility because they could realize similar benefits. Again, IT support was beyond René's job description.

Facilitation of employee entrepreneurship within firms may also include supporting appropriate norms and reward systems (Ireland et al., 2009; tinyurl.com/b6g9r4k). Interestingly, others argue that "resistance activities – such as resisting oppression and breaking free from constraints – can actually foster entrepreneurial processes" (Courpasson et al., 2011; tinyurl.com/a2ajotv). It is possible, therefore, that entrepreneurial effort responds to both supportive management acts as well as to certain organizational constraints. Employees react to the opportunity to reshape their environment using IT that they choose themselves, for example, to improve how they perform their jobs. Management at René's firm became aware of the support tool, which by then had been augmented with photographs and other information by the customer support employees to improve the usefulness of the portable support tool. At this point, management recognized that benefits clearly outweighed the IT policy violations and sanctioned the activity.

Therefore, management support for employee entrepreneurship must recognize the potential to exist broadly within an organization and that employees may tend to respond to very locally perceived opportunities where they can realize certain personal benefits. René's customer-support tool had reached a point where it worked on a wide range of devices and was sufficiently easy to use, and so it was productized as a customer self-service tool and added to the firm's portfolio. The key point is that the firm may also see product, service or business process innovation (Bernoff and Schadler, 2010: tinyurl.com/b2mmxfl; Harris et al., 2012: tinyurl.com/aqqtcuo). As with any entrepreneurial activity, outcomes are often uncertain and surprising (Baker and Nelson, 2005: tinyurl.com/c6svx2e; Foss, 2012: tinyurl.com/76h2xzq). Consequently, managers must allow that value creation through employee entrepreneurship such as this may require oversight that is tolerant of both risk and emergence.

Employee use of consumer IT as corporate IT will not always be entrepreneurial and entrepreneurial use will not always necessarily be constructive for the firm. However, managers can distinguish constructive entrepreneurial use and further distinguish where this creates the potential for positive change in the firm or IT governance. While the sourcing and support relationships implied by consumer IT used as corporate IT may conflict with how IT governance has been understood, the value created by entrepreneurial employees may be significant. Restricting employees from using consumer IT as corporate IT may not only impinge on employee preferences, it may deny new value creation in many areas of firm operation. Firms depend on innovation for differentiation and therefore must recognize and encourage constructive entrepreneurship by employees. As a practical contribution, the link suggests that managing consumer IT used as corporate IT is about more than how employee preferences affect IT security and other policies.

The IT that is of value to the firm may now include IT that happens to belong to employees. This IT presents an opportunity to entrepreneurs. Some entrepreneurs may take advantage of this opportunity by starting new firms. However, employee entrepreneurs may use this technology to change the firm from within by discovering novel sources and uses for IT and creating a case for change in IT governance to permit, and even encourage, appropriate use of consumer IT as corporate IT.

Conclusion

Managing employee entrepreneurship requires tolerance of value creation that is emergent and possibly disruptive. Employees may not see what they are doing as particularly innovative and may even emphasize the personal benefit of their effort. However, outcomes that provide significant benefit to the firm can arise. Such outcomes are only possible if governance practices do not drive employee entrepreneurial effort underground or out of the firm. Managers must allow for and encourage efforts by employees to work to the spirit of their contract in this manner as a source of competitive advantage.

Managing Entrepreneurial Employees Who Bring Their Own IT to Work

David Hudson

About the Author

David Hudson is pursuing doctoral studies and is a lecturer in the MBA program at Carleton University's Sprott School of Business in Ottawa, Canada. His research focus considers entrepreneurial effort by employees and changes arising from consumer technology use in industry. Previously, David was the Vice President for Advanced Research and Technology at a large technology firm and has had an extensive career in technology development and product line management. He received Bachelor's and Master's degrees in Systems Design Engineering from the University of Waterloo.

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Neuromarketing: Understanding Customers' Subconscious Responses to Marketing

Jyrki Suomala, Lauri Palokangas, Seppo Leminen,
Mika Westerlund, Jarmo Heinonen, and Jussi Numminen

> *"Executives love the idea of using brain scans. As brain imaging and neuroscience develop, neuromarketing companies will be able to pull out more sophisticated data about what makes people want to buy or avoid certain items. The big question is whether neuromarketing can push a 'buy button' in your brain."*
>
> Nick Lee
> Professor of Marketing
> Aston University

This article presents neuromarketing as a way to detect brain activation during customer engagement. Neuromarketing is a field of marketing research that studies consumers' sensorimotor, cognitive, and affective response to marketing stimuli. We established a Virtual Customer Journey model based on the consultative selling process to study customer engagement by using brain scans. Consultative selling suggests that a customer's shopping experience is managed by the salesperson's behaviour and in-store marketing assets, and that the customer gets engaged step by step. A total of 16 test subjects were shown video clips and still pictures from a consultative sales process at Nokia's flagship stores, and their brain activity was scanned. The results show that test subjects were able to associate themselves with people and events on the video and they felt safe and comfortable during the consultative selling process. The study implies that laboratories can build virtual environments that resemble real shopping environments where customers can participate in the buying process and respond to events displayed on the screen, and that neuroimaging is useful in providing valuable information on customer behaviour that is not achievable otherwise.

Introduction

Whereas traditional marketing has concentrated on the value and competitive advantages of a product or service, contemporary marketing takes a holistic approach by also considering the purchasing process and the retail store atmosphere to evoke a positive shopping experience (Levy and Weitz, 2009; tinyurl.com/adshuo3). Neuromarketing has surfaced as a new branch of marketing that studies the consumer's subliminal reactions to marketing material, brands, products, and product groups. It has been described as a way to apply the methods of the neurology lab to the questions of the advertising world (Wilson et al., 2008; tinyurl.com/aeo5zvn). Neuromarketing has revealed significant new information about human preferences and emotional responses by measuring the brain activation when customers view and evaluate different products or advertisements (Plassmann et al., 2012; tinyurl.com/bezoeyb).

In 2007, neuroscientists at the University of California Los Angeles scanned the brains of people watching commercials during the Super Bowl, the annual championship game in professional American football. Large advertisers paid up to $85,000 per second to connect with viewers during the game. While people watched the advertisements, a functional magnetic resonance imaging (fMRI) machine scanned neural activity in

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areas of the brain responsible for everything from language to emotion. The results showed that, whereas a Doritos spot stimulated empathy and connection, many of the other expensive ads provoked anxiety and fear. Nationwide Insurance's ad, which featured Kevin Federline as a failed rap star stuck in a job in a fast-food restaurant, generated anxiety and feelings of insecurity that were quite opposite to the company's goals. Researchers noticed that the amygdala, which is a kind of a threat-detector region of the brain, was much more active compared to other brain regions. (Sherman, 2007; tinyurl.com/bhm2qc3)

This article uses neuromarketing to study how customer engagement is managed by salesperson behaviour and in-store marketing assets. The reason for the study is that most neuromarketing studies focus on simple product and brand preferences or reactions to advertising (Chessa and Murre, 2007; tinyurl.com/c46737m). However, marketing scholars argue that neuromarketing is still in its infancy and will likely provoke a vast amount of research that goes beyond the current emphases (cf. Lee et al., 2007; tinyurl.com/chbboqo). We argue that neuromarketing can be applied to understanding complex marketing problems, such as customer engagement processes, by showing selected marketing material to the test subjects.

We start by establishing a Virtual Customer Journey model based on the consultative selling process. The model is needed for structuring the data-collection process and for analyzing the neuroimaging data. We then describe the study, in which brain activation was measured in 16 test subjects while they participated in trials that were organized according to the phases of consultative selling. Finally, we discuss the results and implications of the study.

The Need for a Virtual Customer Journey Model

Neuromarketing is a new application of the neuroscientific approach to human behaviour in the market context. Rather than simply trying to use science to better understand the decision-making processes of individuals, neuromarketing studies test subjects' reactions to certain stimuli, which are then recorded with the aim of revealing consumer preferences. The results of these trials can potentially predict differences in thought processes being deployed by consumers that might not necessarily be observable with behaviour (Venkatraman et al., 2012; tinyurl.com/a5atyx6). The trials are aimed at building targeted advertising campaigns, designing new consumer products and shopping environments, and even determining the reasoning behind subjects' preferences for certain brands (Belden, 2008; tinyurl.com/ayfwvpb).

Previous neuromarketing studies help marketers to understand customers' emotional, cognitive, and neural activity at the moment of the purchase decision. However, the in-store shopping experience starts outside the store and continues beyond the purchase and after departing the store. The consultative selling approach suggests that marketers should understand the shopping experience from the moment the customer steps into the store until the moment they walk out, because it affects the customer-engagement process, which has long-term effects. When a customer enters a retail store, they see many different stimuli, including people, advertisements, products, and the whole marketing environment.

Marketing stimuli can be simulated and customer reaction and behaviour can be observed in the laboratory. Virtual store research (tinyurl.com/bd3gzze) is an extension of the traditional methods of marketing research. Although marketing research employs techniques such as focus groups, surveys, and observation to better understand consumer decision-making, virtual store research uses these standard research techniques within a simulated store setting. Virtual store research uses computer simulation technology to create 2D and 3D retail contexts that are deemed close to the real shopping experience. Test consumers within the virtual environment can interact with store merchandise and make purchase decisions in a way that closely resembles real, in-store behaviour.

Building on this foundation, we developed a Virtual Customer Journey model based on consultative selling. The model reflects customer engagement through a step-by-step process and provides a structure for organizing marketing material required for a neuroimaging analysis. In other words, a Virtual Customer Journey model allows researchers to study customer perceptions and feelings throughout the customer-engagement process based on test subjects' perceptions of simulated events. The study constructs a Virtual Customer Journey using video clips and still pictures gathered from the high-technology sector. In the study, both marketing assets and the behaviour of salespeople are organized by the phases of consultative selling.

There are two fundamental assumptions that enable this type of a study. First, every human has mirror neur-

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ons (tinyurl.com/2d69gx) that are associated with social behaviours such as imitation and empathy. Due to the mirror neuron system, which is the neural basis of the human capacity for emotions such as empathy, the test subjects are able to associate themselves with the people and behaviour seen on the screen. Second, the activation of valuation circuitry in the forebrain during the exposure to these marketing stimuli would indicate that the test subject has an intention to buy products displayed on the screen. Valuation activation is an important precondition for test subjects' purchase decisions, and mirror neuron activation implies that they associated themselves with events taking place during the consultative sales process seen on the video.

The Consultative Selling Process

Consultative selling is the process of professionally providing information to help customers take intelligent actions to achieve their objectives (Liu and Leach, 2001; tinyurl.com/bl2apz6). It is a type of personal selling in which a salesperson plays the role of a consultant who assists the buyer in identifying customer needs and then suggesting products that satisfy those needs. Consultative selling is about finding out the prospects' needs and gaining a greater understanding of those needs. The sales professional is a valued advisor and problem-solver rather than persuader or someone merely promoting a particular product (Sharma, 2007; tinyurl.com/bzz2fdg). During the process, the salesperson needs to ensure that the customer feels satisfied with the whole purchase experience.

In addition, marketing assets – including the store environment – are often converted into a consultative selling environment to support the sales process. Typical marketing assets include an optimized product mix, branded shopping bags, and physical store components. Furthermore, displays, banners, and product information sheets support the customers' decision-making process. These assets play an important role during consultative selling, because customers are led through the path of discovery using light, motion, and visuals to strengthen the positive experience. Many high-technology companies establish flagship stores with a distinctive store location, decor, or merchandise mix to promote and attract customers. The marketing material used in this study consisted of video clips and still pictures derived from Nokia's flagship retail stores (Figure 1).

Figure 1. Nokia's flagship retail store

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Customer engagement can refer to the stages consumers travel through as they interact with a particular brand or company. This customer-engagement cycle, also known as the customer journey, has been described using a myriad of terms but most often consists of five different phases. In the context of consultative selling, we regard these phases as: i) create a connection to the customer, ii) understand customer needs, iii) address customer needs, iv) close the sale, and v) establish a sustainable customer relationship. The sales management literature suggests variations of consultative sales process and argues there is not a single model that would have become the most widely accepted process model (DeCormier and Jobber, 1993; tinyurl.com/bm9q4ba). We established the phases for the purposes of our study, and we presented and organized video and photo material in our empirical research in accordance with these phases.

The five diverse phases of consultative selling are illustrated in Figure 2 and are described below:

Figure 2. The five phases of consultative selling

Phase 1: Create a connection to the customer. The purpose of the first phase is to acknowledge the presence of the customer and make them feel welcome.

Phase 2: Understand customer needs. The second phase emphasizes listening to the customer and understanding their needs, experiences, and feedback. If the salesperson does not understand customer needs adequately, the likeliness that the proposed solution will address their needs is probably not high enough to support closing the sale (Chakrabarty et al., 2010; tinyurl.com/dxslxo7).

Phase 3: Address customer needs. This phase includes determining the customer's problem, identifying a suitable solution, and proposing a solution alternative. Although the customer may have learned of the providers' product range previously, the customer often needs professional help to identify the most suitable solution for the problem, especially in the high-tech industries. An in-store demonstration of the solution should help clarify the customer's needs. As the retail salesperson performs a product demonstration, the marketing activities are concentrated on lowering the customer's purchase barrier for a particular product that is identified as a potential solution to the customer's problem (Liu and Leach, 2001; tinyurl.com/bl2apz6).

Phase 4: Close the sale. The goal of the fourth phase is to close the deal. Meeting the customer's needs and adding value to their daily life increases the likelihood of a repeat purchase and customer loyalty. When a mutually beneficial result has been achieved, the act of closing a deal can be anticlimactic: it does not necessarily require a specific technique if the customer has already received value in the previous phases of the selling process (Moncrief and Marshall, 2005; tinyurl.com/c4kaoqt).

Phase 5: Establish a sustainable customer relationship. In the fifth phase, sellers acknowledge that the process is about building a business relationship that may later result in a repurchase (Moncrief and Marshall, 2005; tinyurl.com/c4kaoqt). Therefore, marketing focuses on ensuring that the newly founded relationship with the customer will continue after the customer walks out of the store.

Research Method

Although there are several techniques for scanning the brain, the two most important for neuromarketing are electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). Whilst EEG is the recording of electrical activity outside of the brain using scale electrodes, fMRI measures changes in blood flow and oxygen levels according to mental activity and enables researchers to isolate systems of neurons associated

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with functions of the brain. The method highlights relevant networks of neurons by coloring the image of a brain in the locations of significant increases in blood flow. Using fMRI, researchers are able to image the neural activity associated with vision along with the cognitive and affective responses to stimuli (Wilson et al., 2008; tinyurl.com/aeo5zvn). Many universities use fMRI for neuroeconomics research, which uses brain-scanning technology to study how people make decisions, calculate risks and evaluate rewards, evaluate personal choices, and decide which products to buy. We used fMRI to record the brain activation of 16 test subjects at the Advanced Magnetic Imaging (AMI) Center at Aalto University (ami.aalto.fi/en/) in Finland (Figure 3).

The research process followed the suggested outline of an fMRI study for social sciences (cf. Dimona, 2012; tinyurl.com/ccqympr). The video clips shown during the trial were organized chronologically by the five phases of consultative selling. The video was presented first, and then a customer was shown six still pictures captured from the video. The test subjects' brains were scanned and brain activation data were monitored while they viewed the pictures. After each still picture, customer behaviour was evaluated by asking test subject's about their intention to purchase the product and measuring their responses on a six-point scale. Each test subject was shown 30 pictures and we stored a total of 3,240 functional magnetic image pictures per person. Therefore, the test data includes 51,840 functional brain images (16 test subjects x 3,240 images).

However, it is important to understand that the unit of analysis is not a single magnetic slice scan from a test subject's brain, but the change of the BOLD (Blood-Oxygen-Level-Dependent) signal per specific time unit. All fMRI data is based on the changes of the BOLD-signal, which essentially measures the ratio of oxyhemoglobin and deoxyhemoglobin (tinyurl.com/l8uox) in the subject. The fMRI scan of each test subject's brain was performed every 1,800 milliseconds (TR), during which the image was acquired in 27 slices with a voxel size (tinyurl.com/d9ssnf) of 3 mm by 3 mm. In the study, the BOLD signal analysis unit was 2 TR, equaling to a 3,600 ms interval. Figure 4 illustrates a trial protocol from a specific selling phase.

After showing the introductory video, each test subject was displayed a blank baseline. The purpose of baseline stimulus was to help the test subject to relax and to allow the BOLD signal to decrease and normalize after the expected hemodynamic response to the stimulus. After viewing a baseline, the test subjects were shown still pictures selected from the introductory video, and they were provided with a valuation stimulus in terms of a question on the test subject's willingness to purchase on scale from one to six. Each picture was shown for a duration that covered a representation of feasible actions (3.6 seconds), valuation of each action (3.6 seconds), and action selection based on the valuation (3.6 seconds) in concordance with the framework for

Figure 3. A test subject being prepared for fMRI at Aalto University's AMI Center

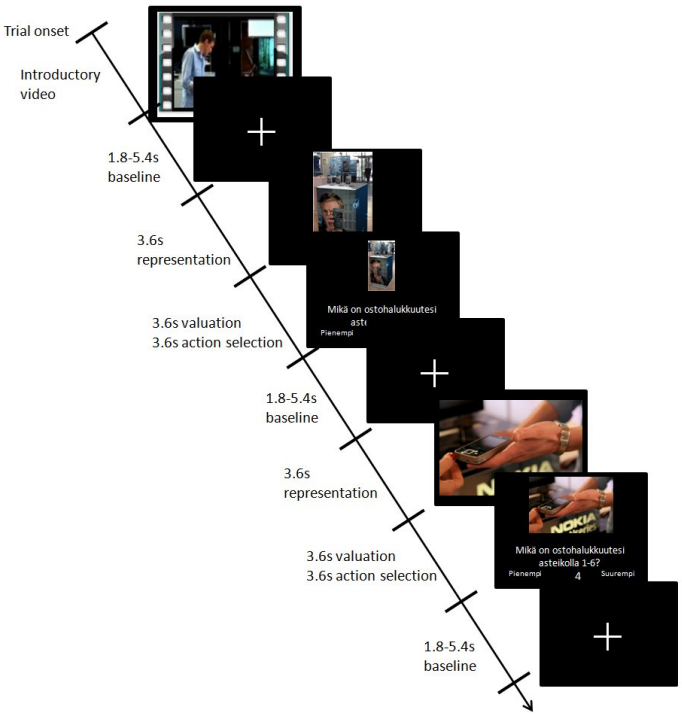

Figure 4. Example of a phase in the scan illustrating the use of video clip and still pictures

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studying the neurobiology of value-based decision making suggested by Rangel and colleagues (2008; tinyurl.com/bz57n2r). Figure 5 shows examples of the still pictures used in the trial.

Steps in the Data Analysis

Because the amount of brain data in fMRI studies is typically ample, the data analysis process is a critical step in the study. The outputs of fMRI scan events were stored as images with time stamps. The time stamps were later used to align variations in the BOLD signal with the events shown during the trial. The fMRI data was analyzed in three steps: i) preprocessing, ii) formulating a design matrix, and iii) performing statistical tests. These steps are described below:

Step 1: Preprocessing. Each test subject's brain data were preprocessed, which means that the collected data were corrected and organized to be comparable with the rest of the data from the same test subject. First, the movement of the subject during the scan was corrected. The natural movement of the brain causes displacement of several millimeters, which can be corrected by alignment. Second, a process of co-registration enabled a positioning of BOLD signal on the anatomical image of the test subject. The images had to be further processed to apply temporal and spatial comparison of data between the test subjects. Third, after a normalization process, test subjects' functionally homogenous brain sections became spatially comparable and it was possible to use standard coordinates to refer to one part of a brain among the test subjects. Fourth, a spatial smoothing with a Gaussian kernel was applied to the data in the study to increase the signal-to-noise ratio and the validity of inferences in the analysis (Henriksson, 2009; tinyurl.com/bzq9glo). With preprocessing, it was possible to apply within-subject and between-subject statistical analyses for the neurophysiological data.

Step 2: Formulation of a design matrix. The expected intensity of brain activity (BOLD signal) was modeled to a design matrix (Friston, 2004; tinyurl.com/bjm82vw). The design matrix is a specific table, where rows represent points in time and columns represent test variables. The matrix serves as a template for further statistical analyses. In this study, each of the columns in the design matrix depicts one of the five phases in the consultative selling process, as illustrated in Figure 2.

Step 3: Performing statistical tests. The analysis of the data was performed by applying a statistical test on

Figure 5. Examples of still pictures from the video shown to test subjects during the trial

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each voxel. First, the statistical parametric maps of individual test subjects were analysed using a t-test with respective t-contrasts. The results were modelled into the statistical parametric map based on the common anatomical brain image. Secondly, the group analysis was performed for the statistical parametric maps including the results of the t-tests from the individual analyses. With this approach, it was possible to test the assumption that particular differences between conditions account for the variance in physiology. This study applied the method to analyze the differences in neurophysiological responses between the phases of consultative selling. The between-subject analysis was performed by using one-way t-test. This test compared the statistical parametric maps of individual test subjects in order to drive inferences in the group level. The between-subject analysis was used to test which brain areas are active during a specific consultative selling phase. The results were counted as mean brain activation of the group.

Results of the Analysis

Different components of the brain's valuation circuits were active at each phase of the Virtual Customer Journey. First, dorsolateral prefrontal cortex (DLPFC) activation was found at each five phases of the consultative selling process. DLPFC is an area in the primate brain that serves as the highest cortical area responsible for motor planning, organization, and regulation. It plays an important role in the integration of sensory and mnemonic information and the regulation of intellectual function and action, and it is involved in working memory. Figure 6 shows the brain activation of DLPFC (above left: sagittal view, above right: coronal view, and below: axial view of the brain).

The test subjects' fMRI showed significant correlation to the consultative selling process in DLPFC. The Family Wise Error (FWE) correction was applied to the inter-subject analysis to address the variance in the location of the neural activity. The statistical threshold was set at $p<0.05$ voxel level (FWE-corrected) and only clusters with at least 10 activated voxels were reported. DLPFC activation indicates that the Virtual Customer Journey organized by the phases of consultative selling activates the general valuation system of the brain. Previous research shows that this activation is an important prerequisite for purchase decisions (Glimcher, 2010; tinyurl.com/37mnmow). DLPFC activation tends to increase when a familiar brand is shown (McClure et al., 2004; tinyurl.com/cyvpt6l) and when customers intend to buy the products displayed on the screen (Plassmann et al., 2007; tinyurl.com/d3lqkdt).

Second, the inferior frontal gyrus (IFG) was active during most phases of the consultative selling process. The test subjects showed significant correlation with phases 1, 2, 3 and 5 in IFG; the threshold was set at $p<0.05$ voxel level (FWE-corrected) with a minimum cluster size of 10 voxels. Figure 7 illustrates the activation of the IFG (above left: sagittal view, above right: coronal view, and below: axial view of the brains).

Previous studies suggest that response in the IFG acts as a safety signal, because it shows a higher response to safer options than unsafe option (Christopoulos et al., 2009; tinyurl.com/ac4t6am). Therefore, the IFG activation

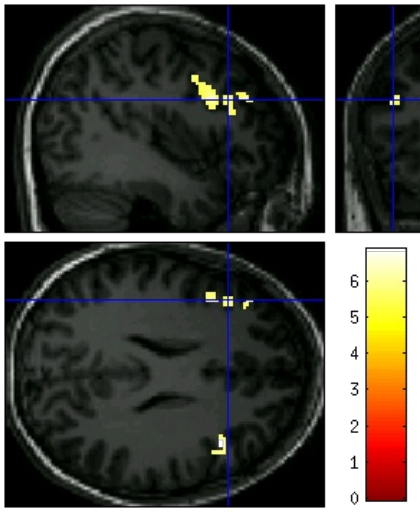

Figure 6. Brain activation of the dorsolateral prefrontal cortex (DLPFC)

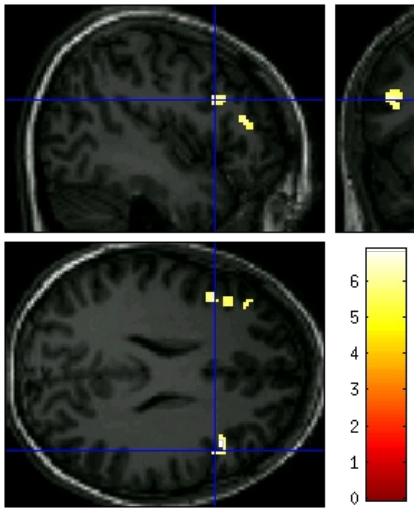

Figure 7. Activation of the inferior frontal gyrus (IFG)

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in our trials indicates that test subjects perceived the shopping environment as safe, and they did not feel fear or risk. The IFG activation was absent only in phase 4 (closing the sale); however, the activation increased again in the final phase. It has been shown that the IFG is active when an individual performs an action or sees another person performing an action (Iacoboni and Dapretto, 2006; tinyurl.com/c8hckl3). Therefore, the IFG activation in our trials shows test subjects were not only seeing the people on the screen but also associating themselves with those people and mirroring their behaviour and feelings during the consultative selling process (Keysers and Gazzola, 2006; tinyurl.com/bwkwv3s). This finding supports the idea that, by using an artificial environment (i.e., by creating virtual reality in the laboratory), it is possible to establish a realistic shopping environment where customers can participate in the buying process displayed on the screen.

Finally, hippocampus activation was found at phases 1 and 2, as well as 4 and 5, during the consultative selling process; the threshold was set $p < 0.05$ (FWE) at voxel level and a minimum cluster size of 10 voxels. Hippocampus activation indicates that the test subject's memory was active during the process. The activation of the memory system was expected, because the information shown during the process likely triggers an individual's memories. Figure 8 shows the hippocampus activation (above left: the sagittal view, above right: coronal view, and below left: axial view of the brain).

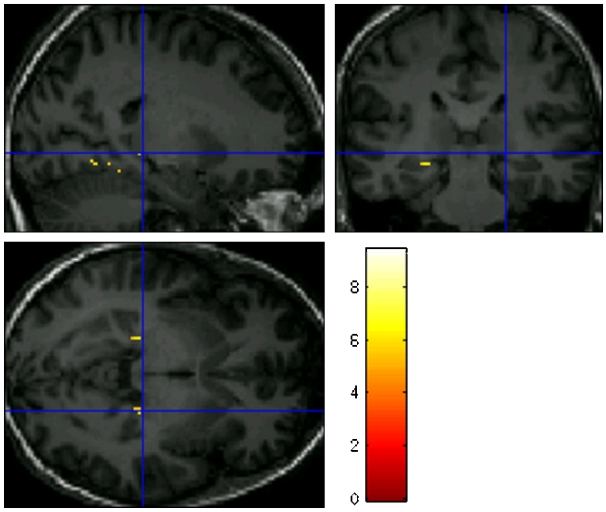

Figure 8. Hippocampus activation

Conclusion

This article showed that neuroimaging is a suitable method for investigating consumer perceptions in situations where pleasure and displeasure can be measured at each step of the customer engagement. For the purpose of the study, we established a Virtual Customer Journey model, which is based on the consultative selling process and is easy to apply in neuromarketing research laboratories. It is useful for neuromarketing research that goes beyond traditional market research and customer satisfaction surveys. The level of satisfaction at each moment of the shopping experience is more important than the emphasis on products. Because the brain's valuation system acts at a conscious level, the information required for analysis is unachievable without the help of neuroimaging. That is, customer preferences are subconscious and difficult to express using words (Berns and Moore, 2012; tinyurl.com/czd4vkr).

Perceived risk is an important factor affecting customers' decision-making processes. However, our analysis could not explain possible fluctuation in perceived risk during the process. The perception of risk among test subjects remained at a low level at each step of the process, meaning that the customer felt safe throughout the buying process. The perceived level of safety only had a marginal drop at the moment of the purchase decision (phase 4). However, the brand used in our trial may indicate a limitation to the study, because Nokia's strong brand in Finland can endorse the feelings of safety and affect neural mechanisms of decision making (cf. Schaefer and Rotte, 2007; tinyurl.com/bplx4q6). Nevertheless, different stages in the buying process were perceived quite similarly, indicating that customers felt comfortable about the consultative selling and purchasing was perceived as easy throughout the process. This finding suggests that consultative selling is an effective way to serve customers and their needs, especially in high-technology markets, and that it reflects a step-by-step customer engagement starting from the moment the customer enters into the retail store and ending only after closing the deal and ensuring the initiation of a longstanding customer relationship.

The analysis showed that important areas in the brain were active during the buying process. These areas included the dorsolateral prefrontal cortex (DLPFC), in which the activity equates to increased feelings of

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safety, thereby having a positive effect on the individual's willingness to buy. Given that neuroimaging reveals brain activity, it can help marketers to identify and reduce negative feelings such as fear, insecurity, danger, and risk among customers, and thus promote customers' willingness to buy. The benefit of neuroimaging is that even a relatively small group of test subjects can provide reliable information on customer reactions to marketing stimuli (Berns and Moore, 2012; tinyurl.com/czd4vkr). The information is especially useful for companies building customer-appealing stores and shopping environments, as well as for planning their sales processes and producing marketing material such as advertisements that support the company's positive image and foster sales.

To sum up, neuromarketing cannot push a "buy button" in the customer's brain because there is no "buy button" to push. However, activation in the inferior frontal gyrus (IFG), which is a part of the mirror neuron system, suggests that test subjects associate themselves with objects (including people) seen on video during the simulated customer journey. The findings indicate that they tend to think "the person on the screen is me", and they behave, react, and feel accordingly. This notion encourages the use of neuromarketing that utilizes still pictures and video clips as well as arbitrarily chosen small groups of test subjects for studying customer behaviour and reactions in different situations. The study also provides suggestions for future research topics in neuromarketing. We believe that the findings and the method can be used not only for assessing the buying process, but also for testing new product and service concepts and applications, especially in the high-tech sector.

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Marketing images are reprinted by courtesy of Nokia.

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Seppo Leminen, D. Sc. (Econ.), Lic. Tech., holds positions as Principal Lecturer at the Laurea University of Applied Sciences and Adjunct Professor in the Aalto University School of Business in Finland. Seppo holds a doctoral degree in Marketing from the Hanken School of Economics and a licentiate degree in Information Technology at the Helsinki University of Technology. His research and consultation interests include value co-creation and capture with users as well as relationships, services, and business models in marketing. He runs various living lab and business model projects relating to ICT.

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Real-Time Mobile Communication of Power Requirements for Electric Vehicles

Derek Smith

> *"Adding an electric vehicle or two to a neighbourhood can be like adding another house, and it can stress the equipment that services those houses. We're talking about doubling the load of a conventional home. It's big."*
>
> Karl Rábago
> Vice President of Distributed Energy Services
> Austin Energy
> (tinyurl.com/ad9xksd)

The periodic power requirements of an electric vehicle are difficult to predict because the vehicle's location, the amount of charge remaining in its batteries, and the timing of its next charge are not known. For clusters of electric vehicles, the problem is magnified, and there is a risk that the demand will strain and overload a power utility's infrastructure. Operational managers are left with reactive management of the infrastructure that may defer or prevent a vehicle charge to balance power demands and safeguard the infrastructure.

In this article, the following key concepts are analyzed to provide background on the problem and to outline the requirements of any solution: i) demand uncertainty and reactive management approaches, ii) electric vehicle power requirements, and iii) demand-management telecommunication capabilities. Then, by abstraction, induction, and creative synthesis, a novel solution to the problem is proposed to provide real-time mobile communication of power requirements. The proposed solution has potential to create new service and business opportunities to managers and entrepreneurs.

Introduction

As indicated in the opening quotation, the power requirements of an electric vehicle are comparable to a house. As adoption of electric vehicles increases, the increased and variable demand will be akin to squeezing an unknown number of new houses and their power requirements onto a neighbourhood's existing power grid. But these new "houses" bring additional variables and challenges. Consider a dynamic neighbourhood of mobile "houses" that are capable of roaming the city and taking their power demands with them on the road to new and unknown places.

These electric vehicles create an opportunity to fundamentally change the manner in which electric utilities manage their infrastructure and do business with their customers. It is paramount for managers at the electrical utilities to transform from reactive management of their infrastructure to proactive management in order to avoid potential strain or damage to the system from the significantly increasing number and potential clustering of electric vehicles at unknown locations in the utility infrastructure.

Accurately locating, predicting, and communicating the amount of energy required at any given time for periodically charging electric vehicles is a challenge. As a consequence, should the current approach of reactive management of the infrastructure continue, it will become highly problematic as the number of electric vehicles increase and, correspondingly, the peak power demands increase.

Previous research proposes a number of different reactive approaches to avoid these power demands caused

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by electric vehicles. For example, operational managers can react to the pending imbalance by: delaying or postponing access, prioritizing access, restricting time access, or buffering energy. However, real-time determination of power requirements and proactive management of the infrastructure have not been considered by previous researchers. Furthermore, real-time mobile monitoring of electric vehicles and communication to enable proactive management has not been considered.

The contributions of this article are:

1. Identification and grouping of key elements for electric vehicle power demand

2. Identification of key telecommunication technologies to solve the problem

3. A proposed solution based upon an abstraction of the problem

4. A description of a potential minimal viable product for real-time mobile communication of vehicle location and power requirements to service providers or electric utilities

In the next section, key concepts necessary to understand the problem and the requirements of any solution are identified. Next, a proposed solution is inductively synthesized from an abstraction of the problem including identification and grouping of mobile data and enabling telecommunication technologies. Then, the proposed solution is further synthesized as a minimal viable product for the real-world problem. Finally, a conclusion is provided.

Key Concepts

This section identifies important factors that contribute to the problem of managing the power requirements of electric vehicles, including demand uncertainty elements and reactive management approaches to balance the supply and demand of electricity, sources of power uncertainty in predicting electric vehicle power requirements, and demand-management telecommunication capabilities.

Demand uncertainty and reactive demand-management approaches

Based on a review of the literature, Mullan and colleagues (2012; tinyurl.com/ahej3ty) identified the impacts on electricity grids of large-scale recharging of electric vehicles as one of "the main policy issues associated with the electrification of the vehicle fleet". These impacts arise, in part, because of the management challenges posed by two types of uncertainty: key demand uncertainty and key imbalance uncertainty. A key demand uncertainty is the amount of power required for a charge for an uncertain duration of the charge (Masoum et al., 2011; tinyurl.com/beu7l64), and this will impact the ability to manage power demands. This impact will increase as the number of electric vehicles increases or cluster together in a particular area of a utility's infrastructure. A key imbalance uncertainty is the location of electric vehicles in neighbourhoods or city parking lots, and it may also cause an unmanageable demand imbalance in particular areas (Kang and Recker, 2009; tinyurl.com/bhgwuh2). Neighbourhoods and city parking lots are two examples of areas where clustering will occur, but the timing and intervals of demand are unknown.

The current approaches to reduce the impact on electricity grids and ensure a balance of electricity are limited to reactive response-management techniques and include:

- turning off electrical devices during peak power-demand periods
- offering different time slots after peak power-demand hours (Kang and Recker, 2009; tinyurl.com/bhgwuh2)
- restricting access to defined windows of time or other scheduling approaches
- delaying access
- utilizing on-time scheduling of power demand (Koutsopoulos and Tassiulas, 2011; tinyurl.com/d5q4vc2)

This analysis suggests that, as we increase new demand uncertainties and new imbalance uncertainties, the only approach for operational managers is a form of reactive management wherein charging of the electric vehicle will be delayed, restricted, or unavailable without any capability for planning the generation of electricity.

Electric vehicle power requirements

There are a number of different types of electric vehicles available on the market today. For example, the Mitsubishi Imiev (tinyurl.com/cklby2q) is an electric

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city-commuter car with a driving range of 155km on a single charge. The Nissan Leaf is also an electric city-commuter car, and it has a range of 160km on a single charge (tinyurl.com/d9mj2l7). The time to charge these vehicles varies and is dependent upon the charge rate. It may require as much as 18 hours or as little as 26 minutes for the batteries to reach 80% capacity. The Tesla Model S (tinyurl.com/2azpfue) is an electric vehicle designed with a sports car aesthetic and handling, and it includes an optional high-performance 416hp electric motor. With a charge that provides 100km of distance per hour, the vehicle can travel up to 480km on a single charge.

Given the different designs and uses of electric vehicles, it is not surprising that different types of electric vehicle have different power requirements (Weiller, 2011; tinyurl.com/b2hlxmk). Plug-in hybrid electric vehicles that have an auxiliary, fuel-based engine may continue to operate when the battery charge is low, but plug-in electric vehicles may not. Kang and Recker (2009; tinyurl.com/bhgwuh2) point out that electric commuter vehicles and electric sports cars have different ranges, and that battery capacity will also affect power requirements. Also, the type of charge (i.e., slow, normal, or fast) affects the peak power demand for electricity (Fernández et al., 2011: tinyurl.com/aoape28; Weiller, 2011: tinyurl.com/b2hlxmk).

Driving patterns and timing also affect power requirements. The effects of driving patterns are random both from the perspective of departure and arrival (Weiller, 2011: tinyurl.com/b2hlxmk; Masoum et al., 2011: tinyurl.com/beu7l64) as well as the length of each trip. The power requirements are similarly affected by timing, which includes the amount of time required to provide the power to the electric vehicle, the type of day (Weiller, 2011; tinyurl.com/b2hlxmk), and the time of day (Fernández et al., 2011: tinyurl.com/aoape28).

Geographic location (Weiller, 2011; tinyurl.com/b2hlxmk) and the season (Clement-Nyns et al., 2010; tinyurl.com/b5grkgu) will also affect requirements. For example, battery efficiency will be lower in colder weather and power consumption will be greater in mountainous areas.

This analysis suggests that the type of vehicle technology, range, battery capacity, type of change, differing patterns of use, and geographic location compound the difficulty in predicting electric vehicle power requirements. These factors will make it more difficult for operational managers to manage peak demands and plan peak electrical needs due to the uncertainty of these requirements.

Demand-management telecommunication capabilities

Telecommunication capabilities exist between a utility and a customer's smart meter that provide a limited and very basic form of peak-load management (Mullan et al., 2012; tinyurl.com/ahej3ty). The capabilities provided by smart meters allow the utility to control a select set of non-critical electrical devices for demand power management (Koutsopoulos and Tassiulas, 2011; tinyurl.com/d5q4vc2). The utility may coordinate peak-load management by selecting a partial load for an electrical device, delaying an electrical device for a specified period of time, or reducing a load for an electrical device (Shahnia et al., 2012; tinyurl.com/bzylua2). An electric vehicle plugged into a particular circuit at a customer's premises could also be controlled this way as part of peak-load management.

A further extension of this concept applies directly to chargers located in electric vehicles. This extension provides response management when an electric vehicle is being charged away from a customer's premises, such as, at a municipal charging station (Masoum et al., 2011; tinyurl.com/beu7l64). In this situation, telecommunication capabilities would allow the utility to permit or possibly delay charging of an electric vehicle. Commuter versions of electric vehicles have a small range and typically require frequent charging. A consumer's expectation would be that, if the vehicle is plugged in, then it should be able to receive a charge without delay. To either fully charge or to top up a charge to continue on the next portion of the owner's journey is acceptable, but a long unknown delay in charging an electric vehicle will not be acceptable.

Even though there are some telecommunication capabilities in place already, these capabilities are used for reactive response management to reduce a customer's demand for electricity during peak-demand periods and allow the customer's demand during off-peak periods.

This analysis suggests that telecommunications between a utility and the customer's device is available through a smart meter or electric vehicle charger for response demand management. However, response demand management is limited to reducing load during peak demands or scheduling load to off-peak demand

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periods. There is no capability to determine the amount of load required, the duration of the load, the timing of the load, or the location of a load for a mobile device.

Proposed Solution

In this section, a proposed solution to the problem of managing the periodic power requirements of electric vehicles is described through an abstraction of the problem, as illustrated in Figure 1. This abstraction was created by identifying and grouping mobile data into key categories, identifying enabling telecommunication technologies, and applying an inductive approach and creative synthesis to propose the solution.

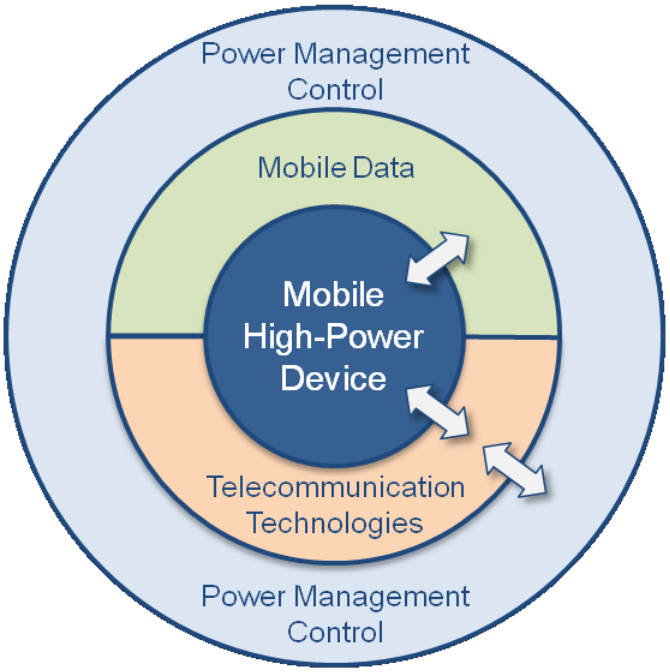

Figure 1. Abstraction

The proposed solution will allow utilities to locate, track, and identify in real time the power requirements of mobile devices with high power requirements. The solution enables proactive power management and control for individual, mobile high-power devices and clusters of such devices. The central construct is a *mobile high-power device*, which could be any electric device that requires power. The device is mobile, or movable, meaning that it can be transported from location to location. Hence, its location varies within the electrical utility's infrastructure.

The *mobile data* construct is related to the *mobile high-power device* construct in that it contains real-time mobile data relevant to the device that must be determined in real time and is grouped into two broad categories of information: charge requirements and device location.

The *telecommunication technologies* construct includes technology that provides for communication capability as well as device monitoring. The relationship to the *mobile high-power device* is through monitoring and logging mobile data. The relationship to the *power management control* construct is from communicating the mobile data for the device to the *power management control* construct as well as communicating commands from the *power management control* construct to the device. The power management control construct includes technology that manages the supply and demand of electric power in the utility's infrastructure.

Previous research has identified existing technologies with the capability of supporting reactive demand management and control of power-consuming devices through smart meters and electric vehicle chargers. In this scenario, a signal is sent to activate or deactivate a power-consuming device, thus enabling a limited form of reactive demand management. When demand exceeds the supply, the power-consuming devices may be deactivated for a period of time and then reactivated when supply is available. In the next section, additional enabling telecommunication technologies for the proposed solution are identified through personal experience and an Internet search.

Enabling telecommunication technologies

Data loggers are electronic devices that capture real-time data including operational parameters. Data loggers may interface with a bus that is located with the mobile high-power device and may be programmed to monitor and log mobile data. In the case of a mobile high-power device, the data logger monitors and captures the first broad category of information for charge requirements.

Global positioning devices are also available. These electronic devices provide, as a minimum, location data. They may also provide other types of data including speed and direction. The global positioning device, or the data logger coupled to the global positioning device, monitors and logs the second broad category of information to determine location of the mobile high-power device.

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Data communication devices provide data communication capability and generally include cellular, WiFi, Bluetooth, and satellite communication technologies. Coupling a data logger with a global positioning device and a data communications device with a mobile high-power device provides the basic capability to send mobile data and receive commands over a telecommunication system to a remote site.

The proposed solution is therefore a system. A mobile component of the system includes telecommunication technology for monitoring and logging mobile data relevant to a mobile high-power device. This includes a data logger, a global positioning device, and a data communication device for sending and receiving data. A remote part of the system includes a power management control component located at a remote site with the capability to receive mobile data for storing on a server-based system for use by existing demand-management technology. By knowing the location of mobile high-power devices within the utility infrastructure (e.g., a specific section of the grid) and the corresponding locations of other mobile high-power devices, as well as their electric power requirements, the service provider may apply proactive power management control and distribution to supply and balance power to the mobile high-power devices. Commands to start or stop consumption of power may be sent over the telecommunication's existing network to the mobile high-power device in order to provide access to power or restrict access to power. This system provides a timely, distributed supply of energy to the mobile high-power devices, and even clusters of these devices, by proactively controlling power management without risk to the utility infrastructure or interruption to a customer's supply of electric power.

Minimum Viable Product

This section provides a more detailed description of the synthesis between the proposed solution and the abstract problem. Here, the solution is portrayed as a minimum viable product (tinyurl.com/yhstpma) and is applied to the real-world scenario of electric vehicles operating within a utility infrastructure.

In this scenario, the mobile high-power device is a electric vehicle in the real world. The power category of mobile data maps parameters identified in the literature, such as battery capacity, amount depleted, power required for a full charge, power required for next non-full charge, and vehicle data (e.g., vehicle identification number, plug-in hybrid vehicle, plug-in electric vehicle, battery type). The location category of mobile data maps parameters identified in the literature, such as geographic location and landscape conditions (e.g., mountainous area, city, countryside). A trip category of data is also introduced that can be determined from both the vehicle category of mobile data and the location category of mobile data.

The data logger is a vehicle data logger that interfaces to the vehicle through an on-board diagnostics (OBD II) port in the vehicle and the vehicle controller area network (CAN II) data bus. The data logger monitors, captures, and logs the power category of mobile data. The data logger may also send commands over the vehicle CAN II data bus to control subsystems in the vehicle. For example, it is capable of controlling (i.e., activating or deactivating) an electric vehicle charger. A global positioning system is coupled to the data logger and monitors, captures, and logs the location category of mobile data. A communication device may also be coupled to the data logger and the global positioning system to send mobile data over a telecommunications network and receive commands for the data logger. The data logger, global positioning system, and communications device enable the electric vehicle to monitor, log, and send mobile data to a remote site and receive commands from the remote site.

At the remote site, the mobile data for an electric vehicle is stored on a remote server and monitored in real time. The trip category of data is determined by assessing both the power category of mobile data and the location category of mobile data. This provides information on driving patterns, future charge requirements for the plug-in electric vehicle, and location information as it relates to the infrastructure and other electric vehicles with the aim of identifying potential cluster problems. Essentially, this system provides the capability to determine the real-time amount of demand load and timing of the load for better planning of both power generation and demand management. The system includes a new capability for off-loading an excess supply of power to electric vehicles waiting to receive power.

When charging is required for an electric vehicle, a request is sent over the communication device to the remote site. The remote site determines the real-time amount of power required to charge the electric vehicle and schedules charging with the demand-management system based on peak-demand loads, surplus power, or degree of clustering. Then, based on the schedule, a "start charge" command is sent to the communication

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device and the data logger activates the electric vehicle charger. If required, a "stop charge" command could also be sent to the communication device and the data logger would then deactivate the electric vehicle charger. The process repeats for all plug-in electric vehicles with an installed minimum viable product.

This minimum viable product description illustrates that charging of electric vehicles, including clusters of vehicles, is possible without risk to the utility's infrastructure.

Conclusion

The implications of real-time monitoring of electric vehicles and communication of location and power requirements to service providers and utilities are twofold. First, it permits a change from reactive to proactive management of the electrical infrastructure. Second, it solves the problem of clustering and has the potential to prevent significant risk to the infrastructure associated with clustering of electric vehicles. This solution results in better peak-load management and the creation of oversupply safeguard capabilities.

The proposed solution allows electric utility managers and executives to be equipped with better power-supply planning and to permit proactive demand management. As well, the solution provides entrepreneurs with a potential new business opportunity and a minimum viable product opportunity for deployment to early adopters.

More broadly, real-time monitoring of mobile high-power devices and communication of location and power requirements is applicable to other mobile intelligent power-consuming devices in the home, hospitals, construction sites, airports, and a variety of other commercial and manufacturing applications. Given the unpredictable nature and growing worldwide demand for power, this approach can provide value on a global scale.

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 to navigate and grow their international patent portfolios. Derek has over 20 years of experience working as an intellectual property management consultant and patent agent for IBM Canada, Bell Canada and, most recently, Husky Injection Molding Systems where he was Director, Global Intellectual Property. His role at Husky included working with international counsel to resolve oppositions before the European Patent Office and the United States Patent and Trademark Office. Prior to entering the field of IP, Derek was an advisory engineer at IBM Canada where he was involved in a variety of leading-edge software development projects. Derek is currently a graduate student in the Technology Innovation Management program at Carleton University in Ottawa, Canada. He also holds a BEng degree in Systems and Computer Engineering from Carleton University and is a registered patent agent in both Canada and the United States.

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An Enterprise Perspective on Customer Value Propositions for Open Source Software

Aparna Shanker

> *"The single most important thing to remember about any enterprise is that there are no results inside its walls. The result of a business is a satisfied customer."*
>
> Peter Drucker (1909–2005)
> Professor of business, author, and management consultant

Research on open source software (OSS) has examined value creation primarily from the perspective of the individuals and suppliers that create the software. The perspective of enterprise users who use and pay for OSS has been largely neglected so far. Understanding what paying customers want and how to create products and services they value is the cornerstone of any business model. Therefore, research on what enterprise users value in OSS is of paramount importance to OSS solution suppliers; it can be used to create a new customer base and sustain an existing one.

This study examines the value of OSS as perceived by enterprise customers. Through an analysis of three literature streams (firm participation in open source software, business models, and customer value), a model on customer value creation was developed. Interviews were conducted with nine decision makers from enterprises that use OSS in operational projects. The key findings of this research are that: i) the maturity of the software determines the degree to which customers value their relationship with the supplier; ii) customers value differentiating functionality and costs savings; and iii) switching costs with OSS depend on the size, complexity, and dependencies of the software itself. This research identifies the points of value that the suppliers of OSS should focus on, and it points to the need for marketing strategies that can demonstrate this value to enterprise customers.

Introduction

In the context of open source software (OSS), value creation has been researched from the perspectives of individual users and suppliers. Studies have focused on the factors that motivate individuals and corporations to create and contribute to OSS (e.g., Lerner and Tirole, 2002: tinyurl.com/c64qyft; Dahlander and Magnusson, 2008: tinyurl.com/6w6k95q). Researchers have also focused on the business models that enable companies to generate revenue by selling products and services that are complementary to OSS (e.g., Hecker, 1999: tinyurl.com/cfxmacm; Krishnamurthy, 2005: tinyurl.com/cyaayyq; Fitzgerald, 2006: tinyurl.com/dxwq3jx).

Although the value of OSS to contributors is now well understood, the literature has little to say about the value of OSS as perceived by customers, particularly *enterprise* customers. The lack of a price tag on OSS is no doubt attractive to potential customers, even though there may be additional costs in time, money, and manpower incurred when using or maintaining the software. However, the concept of customer value is broader than a simple analysis of costs and monetary value. Customers can also perceive value in higher quality, time savings, ease of use, reduced hassle, and a multitude of other dimensions. The research described in this article addresses the gap in the OSS literature by examining the perception of customer value in all its forms, with an emphasis on enterprise customers.

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Customers are willing to pay for software and services that produce value for them; so, suppliers need to determine what customers want. Customer value research has typically taken a marketing perspective to understand how customers perceive value and determine what customer would be willing to pay for. There is no marketing research specifically on OSS customers; the research on customer value in the OSS literature focuses on individual users and suppliers. The objective of this research is to analyze how enterprise users perceive value in OSS in an attempt to bridge the gap between the marketing literature and the OSS literature. This research builds on the marketing literature on customer value creation and perception to study how value can be created for enterprise users of OSS.

The deliverables of this research are: i) a list of value points that matter to customers, ii) a model that identifies how value can be created for enterprise users, and iii) a set of propositions and managerial guidelines anchored around the model. The scope of this research is limited to OSS that is used in operational projects and excludes OSS that has been custom made for use in a single enterprise.

There are at least three reasons why research on OSS customers in today's economic environment is relevant. First, entrepreneurs can use the identified points of value as a source of competitive advantage to compete on dimensions other than cost. For example, if cost savings cannot be realized, an entrepreneur could provide better products or service along other dimensions such as quality or customer service. Second, OSS suppliers can conserve valuable resources and capabilities by focusing on the identified points of value that matter to customers, thereby maximizing profits. Third, developing effective customer value propositions can increase customer satisfaction and be used as a means of competitive advantage.

This remainder of this article is organized as follows. The next section describes previous literature on firm participation in OSS, business models, and customer value. Following the literature review, the research method and results are presented. The article concludes with a discussion of the key findings, limitations of the research, and future research directions.

Literature Review

Three literature streams were selected for the purpose of this research. The first stream is "firm participation in OSS", which identifies the points of value that drive the production of OSS. The second literature stream is "business models", which helps us understand how value creation and value delivery strategies can be employed by a firm. The third literature stream is "customer value"; although the concept of customer value is defined within a business model, an in-depth analysis on value creation and value perception was needed to develop a model on customer value creation. Therefore, the marketing literature pool was studied to better understand these concepts.

Firm participation in OSS

Firms participate in OSS projects by contributing code, collaborating in code development, providing an OSS product, or integrating OSS components into a software system (Hauge et al., 2010; tinyurl.com/7sdhvjl). Feller and Fitzgerald (2002; tinyurl.com/c9u54hg) identify the economic, social, and political motivations for firms to participate in OSS. The economic motivation of open source is that it allows small to medium-sized enterprises (SMEs) to compete independently from the pricing and licensing policies of large software companies. Moreover, participation in open source projects provides a recruitment ground for firms to find qualified future employees. The social motivation for a firm's participation in OSS projects is sharing the ideology of OSS. Technological motivations include the advantages of levering the intelligence of collectives, obtaining code that is not available in proprietary software, and the quality and reliability of OSS. Morgan and Finnegan (2008; tinyurl.com/bmoj8re) identify the need for firms to participate in an OSS strategy to lower costs and to take advantage of the scalability and reliability of OSS.

Business models

Among the many definitions of the term business model is the widely cited definition proposed by Magretta (2002; tinyurl.com/cc9bj6o): "A business model explains how a company makes money and the economic logic behind it". With a business model for proprietary software, value can be created by producing software that fulfills a customer's need to get a job done. Value is appropriated by methods such as licenses to use the software and patents (if possible). When a firm uses open source assets to satisfy a customer's needs, value must be captured in different ways because the supplier cannot charge for the OSS.

Most open source business models rely on selling complementary goods and services and leveraging other intangible sources such as tacit knowledge over rivals to capture value (West, 2007; tinyurl.com/d5stuaa). There are

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two main themes in the literature on OSS business models. The first theme focuses on revenue generation and the sale of complementary assets as a means to profit from software that is essentially free (e.g., Hecker, 1999: tinyurl.com/cfxmacm; Krishnamurthy, 2005: tinyurl.com/cyaayyq; Fitzgerald, 2006: tinyurl.com/dxwq3jx; Bonaccorsi et al., 2006: tinyurl.com/7vnupff). The second theme focuses on the concept of value creation, the open source value network, and value capture as a means to profit from OSS (e.g., West and Gallagher, 2006: tinyurl.com/3eb73sq; West, 2007: tinyurl.com/d5stuaa; Morgan and Finnegan, 2008; tinyurl.com/d7bg257).

Customer value

In a recent article, I reviewed the concept of customer value and how entrepreneurial firms can deliver it (Shanker, 2012a; timreview.ca/article/525). I began with Woodruff's (1997; tinyurl.com/825pdwn) definition of customer value, which is: "a customer perceived preference for and evaluation of those products attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations". Thus, as described earlier, the concept of customer value is broader than a simple analysis of costs and monetary value. Beyond price considerations, the term may refer to receiving what is desired, receiving quality for what is paid, or receiving something in return for what is given (Zeithaml, 1988; tinyurl.com/7kjz6nf). The literature identifies the various dimensions of customer value, as shown in Table 1. Value is context-specific, so Table 1 also identifies the context in which each set of value dimensions apply.

A customer value proposition is a firm's pre-emptive value offering that proposes to create value for customers. An effective customer value proposition can attract new customers, increase customer satisfaction, and provide a competitive advantage for the firm (Woodruff, 1997; tinyurl.com/825pdwn). There is no widely accepted framework or methodology for customer value creation and researchers have adopted divergent views on this construct (Sánchez-Fernández and Iniesta-Bonillo, 2007; tinyurl.com/cxwl7vm). At the same time, re-

Table 1. Dimensions of value

Authors	Value dimension	Context
Ulaga (2003; tinyurl.com/ c77vpud)	• Product quality • Service support • Delivery performance • Supplier know-how • Time to market • Personal interaction • Price and process costs	• Dimensions of value that apply to manufacturer-supplier relationships
Smith and Colgate (2007; tinyurl.com/759o9j3)	• Functional/instrumental value • Experiential/hedonic value • Symbolic/expressive value • Cost/sacrifice value	• Marketing managers perspective that identifies types of value and how an organization can create these types of value
O'Cass and Ngo (2011; tinyurl.com/d74rafh)	• Performance value • Pricing value • Relationship value • Co-creation value	• Value offerings from a firm's view; interpretation of what customers are looking for in the marketplace and what firms provide in response

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searchers also acknowledge that understanding the customer value creation strategies applicable to various contexts is central to marketing strategy (Smith and Colgate, 2007; tinyurl.com/759o9j3). For this reason, I recently proposed a customer value creation framework specifically for businesses that generate revenue with OSS (Shanker, 2012b; timreview.ca/article/534).

A firm's value creation strategy begins by identifying what points of value to provide to their customers and then developing a pre-emptive plan to provide those benefits (O'Cass and Ngo, 2011; tinyurl.com/d74rafh). A firm's customer value proposition signals the pre-emptive value that a firm proposes to create for customers. A customer value proposition identifies target customers, the job that the customer needs to have done ,and the offering that fulfills the customer's requirements. As far as I am aware, there are only two examples of research on customer value creation with OSS as a key resource: the first is by West (2007; tinyurl.com/d5stuaa) and the second is by Morgan and Finnegan (2008; tinyurl.com/bmoj8re). The value dimensions and context identified by these authors are presented in Table 2.

Lessons Learned and Preliminary Model Development

The value drivers in OSS creation and use have primarily been studied from the perspective of software producers and individual users. Little is known about how enterprises users value OSS. The literature pool on business models clearly identifies the need for an effective customer value creation and delivery strategy to create a new customer base and sustain an existing one.

The business model literature also identifies a customer value proposition as the cornerstone of any effective business model and the marketing literature identifies the different types of value that can be created for customers. In order to achieve a differentiating advantage, customer value propositions in OSS should focus on features that are unique to OSS.

Figure 1 represents a preliminary model of customer value creation that I developed using the points of value identified in the literature review (Table 1). The preliminary model identifies five types of value and the key attributes of each type of value. (Detailed descriptions of these value types and attributes are provided later, along with the final, refined model.) The value creation strategy outlined in the model shows that a customer value proposition has to be developed and then a firms' value offering has to be refined by re-combining its existing resources and capabilities. The model identifies that customer value perception is constantly evolving and therefore customer value propositions have to evolve to meet changing customer requirements. Further information on the value points identified in the model can be found in my article that describes a customer value creation framework for OSS businesses (Shanker, 2012b; timreview.ca/article/534).

Table 2. Value creation with open source software as a key resource

Authors	Value dimension	Context
Morgan and Finnegan (2008; tinyurl.com/bmoj8re)	• Price value • Scalability/quality • Staff development • Consumer demand • Desire of top management • OSS components • Reduced vendor lock-in • New way of collaboration	• Reasons why firms embrace an OSS strategy
West (2007; tinyurl.com/d5stuaa)	• Price value • Less vendor lock-in	• Ways in which buyers identified that OSS created value for them

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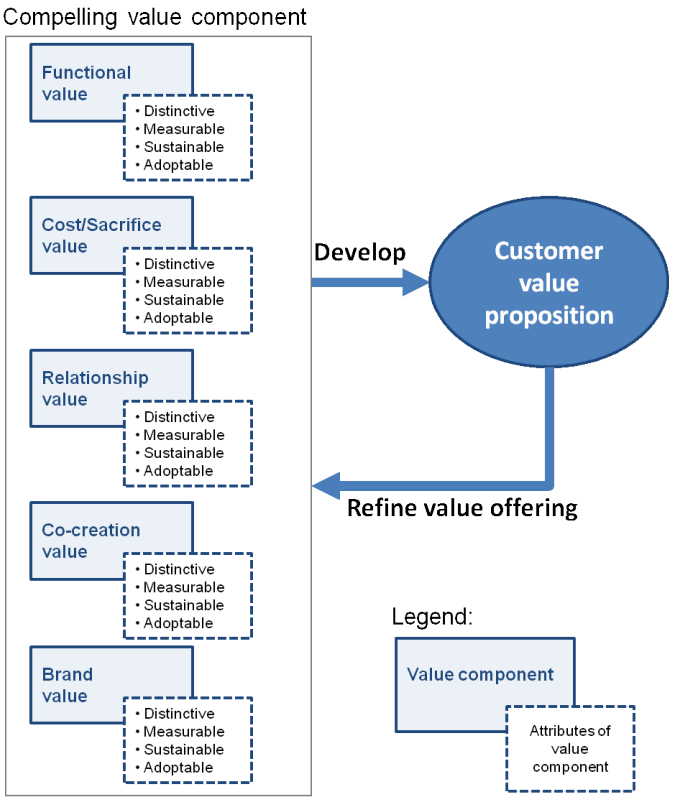

Figure 1. A preliminary model on customer value creation

Box 1. Questionnaire presented during interviews with decision makers in enterprises that use open source software

Based on the preliminary model (shown in Figure 1):

1. Rank the five points of value shown in the model in order of importance to you.
2. How do each of the above points create value for you?
3. Are there any other points of value that you would add to the above list?
4. What made you choose an open source solution instead of closed source?
5. Do you think the value creation strategy illustrated in the model would be effective? Why?
6. How do you think the model can be improved?

Research Method

Once the preliminary model of customer value creation was developed from the literature review, it was refined and validated based on nine semi-structured interviews with managers and leaders of enterprises that use OSS. Interview subjects were presented with the preliminary model and a questionnaire (Box 1), which was developed in consultation with three industry experts.

This approach was chosen because it allowed me to confirm findings across multiple cases (Eisenhardt and Graebner, 2007; tinyurl.com/ckek69c) and to compare and extend emerging patterns across these cases (Yin, 1993; tinyurl.com/caso9gq). The interviewees were split into three groups of cases to increase the probability of developing novel theory by identifying similarities and differences across sets of data (Eisenhardt, 1989; tinyurl.com/7dfuc3z). After completing each set of interviews and analyzing the data, the preliminary model and the questionnaire were refined in an iterative fashion based on the responses from interviewees.

Model Refinement

Following three iterations of refinement, the final model was completed (Figure 2). The main differences between the value components identified in the preliminary and the final model were:

1. Relationship value was split into two categories: relationship with the supplier and relationship with the customer. Some of the interview subjects observed that the relationship value component in the preliminary model was too vague. In some cases, there was a relationship with a company, and in other cases, there was a relationship with the OSS community at large.
2. Co-creation value was removed as a value component and added as an attribute of functional value because most customers perceived it as a subset of OSS functionality. They assumed that co-creation was a feature of OSS that was inherent to its functionality.

The attributes of each value component were also modified based on interview data. Initially, each point of value was considered to be distinctive, measurable, sus-

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tainable, and adoptable. Each value attribute that remained in the final model had been confirmed by more than one customer during the interviews. Any value attribute that was not confirmed by customers, or had its relevance questioned by interview subjects, was removed from the model. New value attributes were added to the model, and remained there, only if they were validated in subsequent interviews.

The final model shown in Figure 2 identifies five key types of value that can be created by OSS solution suppliers and the essential attributes of each value component. These value points and attributes are described below.

1. Functional value

There are six key attributes of functional value, which refers to the features of the produce itself:

1. **Distinctive:** the functionality should be different from other market offers, providing the customer with a differentiating value driver.

2. **Sustainable:** the functionality and quality should remain the same over time.

3. **Extensible:** customers should be able to extend the core functionality of the product to interface with their software and services.

4. **Customizable:** customers should be able to customize a solution to suit their specific needs.

5. **Simple:** users should be able to understand the functionality of the software with a reasonable amount of effort.

6. **Adoptable:** the software should be usable in the customer's environment without them having to make major changes to their internal environment.

2. Cost/sacrifice value

The product should be worth it to the customer. The cost paid can be in monetary terms, time, effort spend defining requirements, or any other way in which the customer invests in a firm's offering. There are four key attributes of cost/sacrifice value:

1. **Distinctive:** the sacrifice between "give and get" components for the customer should be less than other alternatives.

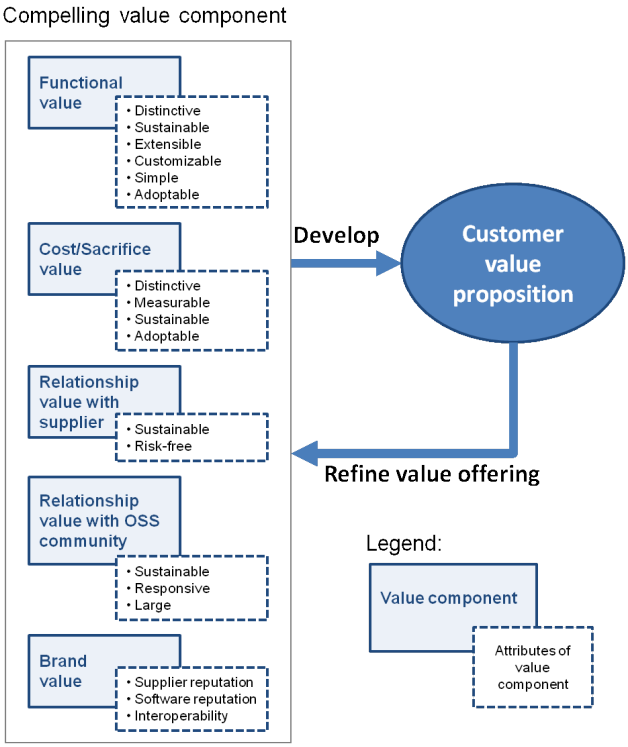

Figure 2. Final model of customer value creation

2. **Measurable:** there should be significant cost savings for the customer in comparison to other market offers or making the software in-house.

3. **Sustainable:** the customer should perceive the sacrifice between "give and get" components as being worth it over time.

4. **Adoptable:** the effort required to overcome barriers to adoption should be perceived as worth it to the customer.

3. Relationship value to supplier

This type of value refers to the customer's relationship to an OSS supplier of complementary assets such as customization, consulting, and integration. There are two key attributes of relationship value with suppliers:

1. **Sustainable:** the supplier should provide the same value to the customer over time by constantly adapting to the customer's requirements.

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2. **Risk-free:** the supplier should be able to guarantee a risk-free experience for the customer where support requests are resolved within the timelines required by the customer.

4. Relationship value to OSS community

This type of value refers to the customer's relationship to the open source developer community, and it includes their interactions through support forums, developer conferences, and code contributions. There are three key attributes of relationship value to the OSS community:

1. **Sustainable:** the community activity rate should be sustained over time. If the community becomes less active over time, customers do not perceive the same value from the community.

2. **Responsive:** the community needs to be responsive to the customer's unique needs.

3. **Large:** customers perceive the size of the community as a signal for how responsive a community can be and the popularity of the software. A large, well-managed community gives credibility to the community.

5. Brand value

The open source brand itself is not important to customers; this is not a factor that motivates them to use OSS, nor is it a value driver for their end-customers. The brand of the software and the supplier are value drivers for customers and there are three key attributes that can be associated with brand value:

1. **Supplier reputation:** customers trust software that is from a reputable supplier brand that they can trust.

2. **Software reputation:** customers rely on the online reputation of OSS as their selection criteria.

3. **Interoperability:** customers consider the interoperability of OSS an advantage, and the open source brand signals the potential for better interoperability with their own hardware and software.

Research Propositions

Based on the final model presented in Figure 1, the a set of research propositions were developed. These propositions can be tested by future research to determine the strength of the relationship between customer value and the value points identified in the model.

The propositions are:

1A *Functional value is increased when OSS provides differentiating functionality that fulfills the customer's exact requirements.*

1B *Functional value is increased when OSS can be used to reduce time to market.*

2 *Time and cost savings increase (in comparison to closed source) when customers use OSS in their product offerings.*

3A *Relationship value to an OSS supplier decreases as OSS product maturity increases.*

3B *Customer value increases as the size and activity of the OSS community increases.*

3C *Relationship value increases when suppliers are willing to mitigate risk via a support contract.*

4 *Customers do not value the OSS brand; they value the reputation of the supplier and the OSS itself.*

5A *Switching costs increase as the scale of the software deployment expands.*

5B *Switching costs increase as the number of dependencies in the OSS code increase.*

5C *Switching costs are low when OSS is used peripherally.*

Managerial Guidelines

Based on the findings of this research, five guidelines were developed for managers and leaders of firms that seek to sell OSS solutions to enterprise users. Firms can use these guidelines to develop an effective customer value delivery strategy. In the interviews conducted during this research, customers confirmed that a value proposition that contains the points of value identified in the model would be part of their software selection criteria. Cost was not always ranked as the most important value driver by customers; functional value was more important to some customers. The five managerial guidelines developed from this research are:

1. *A customer value proposition should include differentiating points of value based on the relevant attributes identified in the model.* Customers of OSS require support, but the customers that were interviewed for this

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research did not express satisfaction with the support they received from suppliers or the community. Support contracts that accommodate fast response times and bug fixes are required by customers, and they are currently not available.

2. *A customer value proposition should promise faster turnaround times for support with a credible promise to mitigate risk and provide bug fixes.* Lower switching costs were only perceived by customers when OSS was used peripherally, in a small scale deployment or when there were few dependencies between software modules.

3. *Lower switching costs should only be included in customer value propositions for OSS that is used peripherally, on a small scale or when the software structure is modular.* When providing feedback on the model, two interviewees (customers) mentioned that the value creation strategy identified by the model would apply to them, but they usually do not get approached by open source vendors.

4. *OSS suppliers should market their abilities to compete with software vendors that sell proprietary solutions.* Customers typically seek out the vendors themselves, using the reputation of the software and the supplier as a guide.

5. *OSS suppliers should build their online reputation to attract customers.*

Conclusion

This research identifies how customer value propositions can be created by firms that use OSS as a key resource. This research subject is unique in at least two ways. First, it contributes to the academic literature on OSS by studying customer value perception from a marketing perspective. Second, it studies enterprise users, whereas most research on OSS to date has studied individual users or OSS suppliers. The findings of this research are also unique because they focus on one type of user: the enterprise. The advantage of focusing on just one specific type of OSS user is that there was no need to generalize the identified types of value to apply to a broad range of customer categories. The applicability of the developed model on a different customer base could be an avenue for future research.

The key conclusions of this research are that a customer's relationship to software suppliers or the open source community depends on four factors: i) the maturity of the OSS; ii) the size and activity of the community; iii) the responsiveness of the supplier in providing support; and iv) the ability of the supplier to manage risks for the customer. Customers value the reputation of the software and supplier; they do not value the OSS ideology itself or the fact that the software they are using is OSS to the same extent. Therefore, suppliers of OSS should focus on managing and marketing their own reputation rather than selling the fact that their product or service is based on OSS. Customers value the functionality of the software; therefore, functionality can be levered as a value driver by suppliers when it is not possible to compete based on cost alone. Customers select OSS based on the reputation of the software and the supplier; they are not approached by OSS vendors. This research identifies the need for marketing strategies that enable open source suppliers to compete with suppliers of proprietary software.

In terms of the limitations of this research, the accuracy of the findings in this research depends on the analysis of data collected from interview subjects and subjective interpretations of these responses. To reduce the risk of inaccurate interpretations, multiple interviews were conducted and all propositions were confirmed in at least two interviews. The results cannot be generalized to a large population or other geographical and cultural settings due to the small set of data derived from a geographically limited area. Both public (universities) and private (for-profit companies) were included in this study and changes in value perception based on the size and profit model of the company were not taken into consideration.

This research identifies the points of value that matter to customers but it is up to the decision makers within a firm to recombine their existing resources and capabilities to deliver value to their customers. Each type of value creation could either be a core competency or a peripheral resource that is already externalized by a firm. Identifying how and when to internalize or externalize the creation and delivery of the five identified value components could be an area for future research.

Further research could also test, validate, and refine the propositions presented. The key question to answer now is: how can these identified points of value be translated into an effective value delivery strategy?

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About the Author

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Governance of Open Source Software Foundations: Who Holds the Power?

Ludovico Prattico

> *"The greater the power, the more dangerous the abuse."*
>
> Edmund Burke (1729–1797)
> Politician, philosopher, and author

The research reported in this article attempts to discover who holds the power in open source software foundations through the analysis of governance documents. Artificial neural network analysis is used to analyse the content of the bylaws of six open source foundations (Apache, Eclipse, GNOME, Plone, Python, and SPI) for the purpose of identifying power structures. Results of the research suggest that: i) the actions of an open source software foundation are centered around one of three groups: Members, Chairman/President/Executive Director, and Board of Directors; ii) in only one of the six foundations is the Board of Directors responsible for both the community and the product; and iii) artificial neural network analysis of the content of bylaws provides unbiased insights of the power structure of open source software foundations. These results may prove useful to those who contribute to open source foundations and use their products and services.

Introduction

Open source software foundations (OSSFs) create, enhance, and support open source technology such as tools, frameworks, operating systems, productivity software, and content management systems. These foundations act as keystones to anchor ecosystems of companies that generate revenue by developing and commercializing products based on the outputs produced by the foundations. Examples of OSSFs include the Apache Software Foundation (apache.org), which supports the Apache HTTP Server among many other projects, and the Eclipse Foundation (eclipse.org), which supports the Eclipse software development environment.

For foundations members, the benefits of OSSFs include: spreading development costs across participating members, increasing revenue generation through increased sales of complementary products, increasing the addressable market by competing more effectively across "technology stacks", and acting as a common good through which member firms increase their goodwill and general welfare (Riehle, 2010; tinyurl.com/ac3fzob).

In order to guide their operations and achieve their objectives, OSSFs develop governance policies, or bylaws, in at least four areas:

1. Board of Directors composition

2. Foundation bylaws

3. Membership agreement

4. Intellectual property rights

Although researchers have studied OSSF governance from a variety of perspectives, few have examined OSSF governance based on studies of governance documents. The objective of this research is to answer the question: Where does the power lie in the governance of open source software foundations? The question is answered by examining the bylaws of not-for-profit, member-supported, OSSFs that are the keystone organizations upon which open source software products are anchored on.

This article is structured as follows. First, prior research into OSSF governance is examined to provide context

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and background for the research described here. Next, the research method is described, including the definition of "power" that was applied to the context of OSSFs. Then, the results of the artificial neural network analysis of the content of the six foundations' bylaws are presented. Finally, conclusions are provided.

Prior Research in OSSF Governance

An overview of governance mechanisms uncovered in the studies of open source software development was provided by de Laat (2007; tinyurl.com/a2udonn). The mechanisms include spontaneous governance, internal governance, and "governance towards outside parties". Spontaneous governance is characterized by communities of volunteers who enjoy the intellectual stimulus, have a desire to learn and improve their skillset, or need the code created for their current professional employment or personal use. These communities cross institutional boundaries, are self-directing, and have no formal control. Typically, the de facto leaders are the 20% that produce 80% of the code.

The second governance method, internal governance, is related to projects that use explicit and formal tools to co-ordinate and control open source software projects. Internal governance is characterized by six groups of tools: modularization, division of roles, delegation of decision-making, training and indoctrination, formalization, and autocracy/democracy (de Laat, 2007; tinyurl.com/a2udonn).

The third governance method is "governance towards outside parties". This form of external governance is a result of outside parties, such as firms, governments, and non-governmental organizations taking an interest in the benefits of open source software. In order to deal with the challenges associated with creating software in the commons and the threats from patent infringement, this form of governance creates a "legal shell" around the project (de Laat, 2007; tinyurl.com/a2udonn).

O'Mahony (2007; tinyurl.com/cbf2sk5) discusses what it means to be community managed. From research on four large and mature open source software communities, she identified five principles for the community-managed governance model: i) independence of any one sponsor; ii) pluralism in diversity of contributors, management of conflict, and determination of leadership; iii) representation where contributing members can be represented in all community decisions; iv) decentralized decision making (e.g., how contributors gain access to decision-making structures); and v) autonomous participation in that all contributors are welcomed and members contribute on their own terms.

Xie (2008; timreview.ca/article/194) uses the term governance structures to refer to "who participates in the decision making" and concludes that there are three types: i) Merit, ii) Merit Dominated, and iii) Sponsor Dominated. In foundations with Merit governance structures, all members are merit members with full voting rights. In foundations with Merit Dominated governance structures, merit members are the majority, which makes it difficult for sponsor members to affect the outcomes. In foundations with Sponsor Dominated governance structures, sponsored members are typically company employees and would have a greater say in decisions.

This research described in this article builds on the work carried out by Xie (2008; timreview.ca/article/194) by studying the power structures within OSSFs through analyses of their governance documents. More specifically, the research looked at where the power is centred according to the governance documents (bylaws).

Method

The objective of this research is to study how the management of an OSSF is centred according to the policies set out in its bylaws. In essence, the analysis was a search for the power centres in OSSFs. Power is generally defined as the ability to influence the behaviour of others with or without resistance (Wikipedia, 2012; tinyurl.com/aputt9p). For the purposes of this research, power was defined as the capability of one social actor to overcome a resistance in achieving a desired objective (Pfeffer, 1981; tinyurl.com/amxc9dr). Power has many sources, including delegated authority, social class, material resource, charisma, knowledge, expertise, and so on (Pfeffer, 1981). In addition, French and Raven (1959; tinyurl.com/bfsussh) defines five bases of power: reward, coercive, legitimate, referent, and expert. This research examined legitimate power stemming from internalized values in one social actor, A, that another social actor, B, has a legitimate right to influence and who is obliged to accept the influence of B (French and Raven, 1959).

To examine the power relationships within OSSFs, the bylaws of the same six foundations studied by Xie

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(2008; timreview.ca/article/194) were analyzed. Following Xie's criteria, to be included in the sample, an OSSF must:

1. Have at least one active open source software project

2. Be incorporated in the United States

3. Have 501(C) tax exempt status

These criteria ensure that the foundations studied are active, not-for-profit organizations in a common jurisdiction, and are operating under the same laws.

The six foundations selected for analysis were:

1. Apache (apache.org)

2. Eclipse (eclipse.org)

3. GNOME (gnome.org)

4. Plone (plone.org)

5. Python (python.org)

6. SPI (spi-inc.org)

Each of these organizations has its bylaws available for download from its website. Inspection of the documents downloaded showed that, in general, the bylaws of the foundations incorporated the rules on the foundation's management structure, the bylaws and the details of the membership agreement. The bylaws were downloaded from the foundations' respective websites and converted to text format for further analysis.

The bylaws were studied using content analysis (Neuendorf, 2002; tinyurl.com/c7gcvvg), which is also known as discourse analysis (George and Bock, 2011; tinyurl.com/dxnzqol). For text-based documents, content analysis involves studying the language used in the documents to identify patterns in the content. Content analysis can be performed manually, but the process can more efficient and reliable if performed using software. One of the benefits of computer-aided text analysis is that it can be performed without bias arising from the researcher's personal experience and knowledge of the content being analyzed. Because of the textual nature of OSSF bylaws, computer-aided text analysis is well suited for studies such as described here.

There are numerous software applications that perform computer-aided text analysis, mostly stemming from research in the social sciences (Neuendorf, 2002; tinyurl.com/c7gcvvg). The method chosen for this research was artificial neural network analysis (tinyurl.com/yqj9h6), using the Catpac application (tinyurl.com/bcjpzjl). Artificial neural network analysis has been used for qualitative research in various disciplines including business and sociology. Artificial neural network analysis permits the discovery of ideas and recurring concepts in text that are not immediately obvious (Woelfel, 1998; tinyurl.com/a4e79uj), which made it an appropriate tool to use when looking for the power centres in OSSFs.

The following steps were undertaken to analyze the OSSF bylaw text using artificial neural network analysis:

1. A word-count analysis identified words that appear in the documents with high frequency.

2. High-count words that likely would not contribute meaningfully to the analysis were excluded from further analysis. Examples include prepositions, conjunctions, and articles.

3. Dendrograms (hierarchical cluster diagrams) and conceptual maps were created using the Catpac tool. (Examples of each type of visualization are shown in Figures 1 and 2, later in this article.)

4. The relationships between terms that represent governance, such as "Board of Directors", "Chairman", etc. were identified through the analysis of the cluster diagrams and conceptual maps.

Results

Results of the Catpac analysis were plotted as dendrograms and conceptual maps, which were then used to locate the centres of power for each OSSF. The following two subsections report on results from the analysis of the Eclipse Foundation's bylaws only, to illustrate the process; the dendrograms and conceptual maps used in the analyses of the other foundations are available on request from the author. In the final subsection, the power-centre results for all foundations are described.

Eclipse Foundation dendrogram

A dendrogram is method to illustrate the arrangement of data that clusters together from the result of performing cluster analysis. In a dendrogram, terms or concepts

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that appear together in the text under analysis are said to have a stronger relationship than concepts that are not close together. Figure 1 illustrates the dendrogram for the Eclipse Foundation; the output from the Catpac tool is shown in the lower portion of the figure, and a portion of the resulting "tree" is illustrated in the upper portion. Two strong clusters are found around the terms EXECDIREC (Executive Director) and ECLIPSE FOUNDATION. From the first cluster, we note that EXECDIREC has a strong relationship with COMMITTEE, OFFICER, ACTION, and COMMITTER. The SET and FORTH concepts cluster strongly together because they are used heavily in the bylaws in contexts such as "set forth in Section 3.8". This cluster has a strong relationship with EXECDIREC.

In the cluster around the COMMITTEE concept, EXECDIREC has a strong relationship because the Executive Director is involved in setting up committees. For example, in Section 4.1 it reads, "Each committee shall consist of two (2) or more directors nominated by the Executive Director, including ..."

The second major cluster consists of the relationships between a number of other concepts and the ECLIPSE FOUNDATION. This cluster illustrates a close relationship between the concepts of ECLIPSE FOUNDATION and DIRECTORS and the BOARD of DIRECTORS and the work of the foundation in terms of strategic direction and membership.

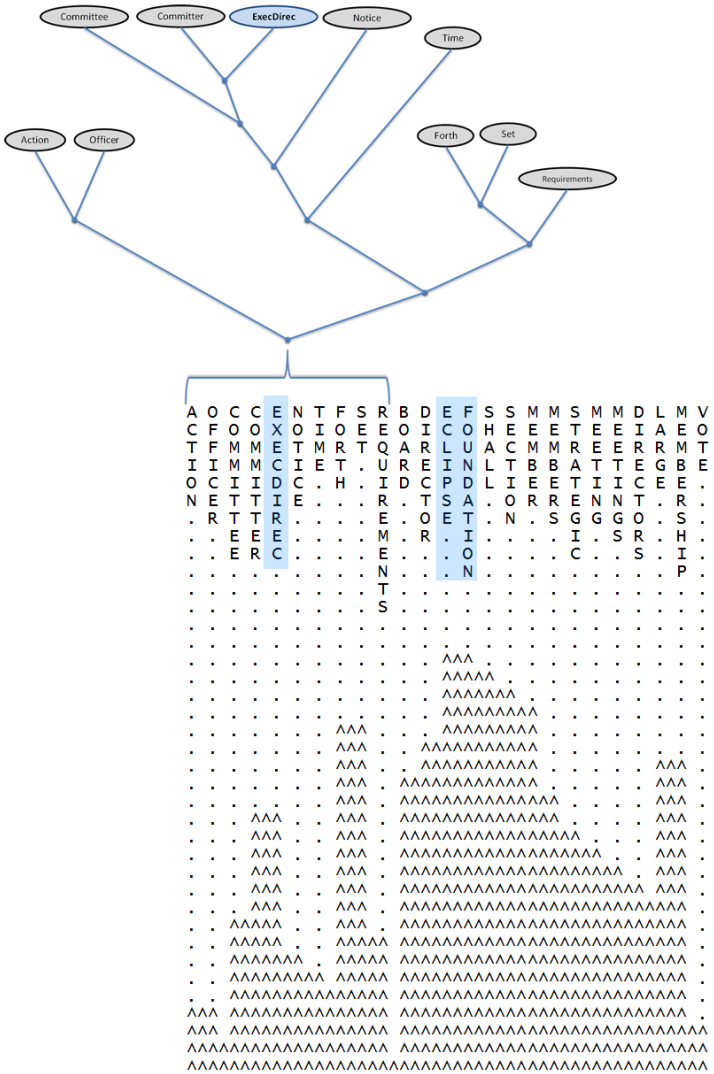

Figure 1. Eclipse Foundation dendrogram

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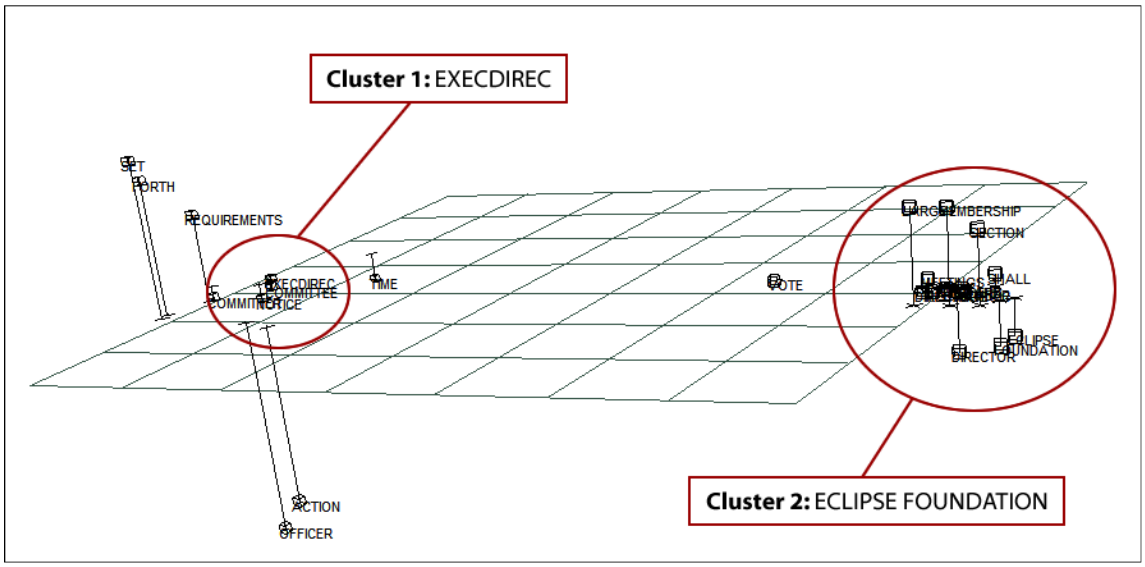

Figure 2. Eclipse Foundation conceptual map

Eclipse Foundation 3D conceptual map

A conceptual map illustrates the same data as the dendrogram except that it provides a three-dimensional view. The closer the terms in the conceptual map, the stronger the relationship between the concepts they represent. What is important is the relative distance between the terms, not their position relative to the plane. The advantage of a conceptual map is that it is three-dimensional; it illustrates the relative relationship strength of all the terms to one another.

The 3D conceptual map in Figure 2 shows two distinctive clusters, Cluster 1 is closely tied to the EXECDIREC term and Cluster 2 is closely tied to the ECLIPSE FOUNDATION, as with the dendrogram. The map clearly shows that the strongest relationships in managing the foundation are related to the Executive Director.

Centres of power for all six foundations

The content analysis showed that power in an OSSF is distributed across three groups: i) Members, ii) Chairman/President/Executive Director, iii) and Board of Directors. Thus, the relationships described in the previous subsections can be illustrated in a triangular diagram whose apexes represent these three groups (Figure 3). In the diagram, the power centre of each of foundation was plotted based on the results from the analysis of the dendrograms and conceptual maps for each OSSF.

As Figure 3 shows, the management-related functions in the Eclipse Foundation cluster around the Executive Director. In the case of the Apache Foundation, the Board of Directors has the majority of the power with a skew towards the Members and away from the Chairman/President. The same holds true for the Plone Foundation. However, the power is skewed a little farther away from the Chairman/President than for the Apache Foundation. In the case of the Python Foundation, the power is squarely on the Board of Directors-Members axis. In the case of the Eclipse Foundation, power lies clearly with the Chairman/President (in this case the Executive Director). In the case of the GNOME and SPI Foundations, the power is more centered with a skew towards the Board of Directors and Members.

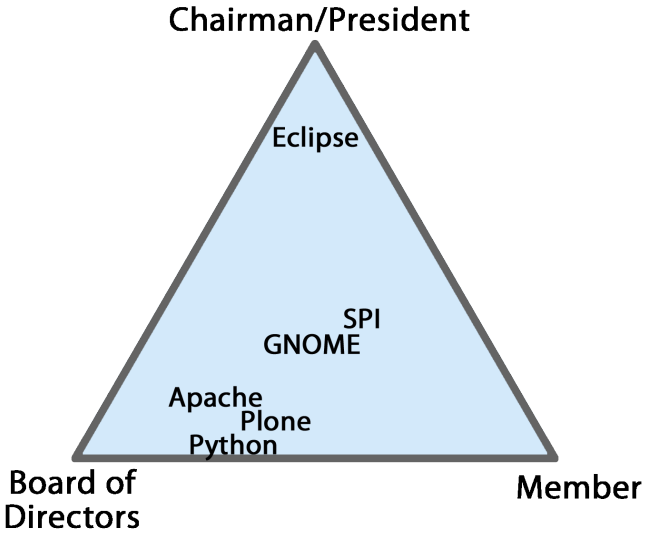

Figure 3. The power centres of six open source software foundations

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Conclusion

Three conclusions can be drawn from this study:

1. Computer-aided text analysis of OSSF bylaws demonstrated that the actions of an open source software foundation are centered on one of three groups: Members, Chairman/President/Executive Director, and Board of Directors. However, this research did not study why power lies within different groups of a given foundation.

2. The majority of the literature on OSSF governance focuses on the mechanisms and processes used to manage OSSFs. This work touches on one aspect of how OSSFs are managed through the application of the bylaws, but more work is needed to see how the bylaws impact the management of the OSSFs.

3. Artificial neural network analysis of OSSF bylaws provides unbiased insights on the power structure of OSSFs. Each bylaw uses its own language, thus causing the researcher to interpret results based on the bylaw's unique language. This can be improved upon by creating a standardized dictionary of term that map terms used in a given bylaw with a standardized term. For example, all the terms for the highest office (President, Chairman, Executive Director, etc.) would be mapped into the term EXECDIREC.

Finally, this research showed that the power in OSSFs lies within different groups, but provided no insight on why this is the case. Further studies into the underlying reasons for the power distributions observed in this study would contribute to a better understanding of how OSSFs operate and how they can be organized to provide greater benefit to their members.

About the Author

Ludovico Prattico is a recent graduate of the Technology Innovation Management program at Carleton University in Ottawa. In addition to his Master's degree research at Carleton, he oversaw the operations, external content, and overall support of the Carleton Entrepreneurs program and recruitment of candidates for the Lead To Win program. Previously, he worked at Nortel Networks and Bell-Northern Research, where he led the Optical Networks architecture and standards development team, and the high capacity OC-48 hardware team with the responsibility for the development and introduction of the dense wavelength division multiplexing product. Mr. Prattico also holds a Bachelor of Engineering (Electrical) degree from McGill University.

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TIM Lecture Series Intellectual Property Paradigms for Global Business

Gordon Freedman

> *"All decisions about patents, trademarks, and other forms of IP protection should be business decisions. Don't decide based on emotion, or pride, or ego. Your IP protection strategy must focus on what can make you money."*
>
> Gordon Freedman
> Entrepreneur, lawyer, and patent and trademark agent

Overview

The ninth TIM lecture of 2012 was presented by Gordon Freedman, CEO of Power Trip (powertrip.us) and lawyer at Freedman & Associates (freedmanandassociates.ca). Freedman shared his views on intellectual property (IP) paradigms, which are based on his experiences as an entrepreneur, lawyer, and patent and trademark agent. The event was held at Carleton University in Ottawa, Canada, on November 8th, 2012.

The TIM Lecture Series is hosted by the Technology Innovation Management program (carleton.ca/tim) at Carleton University. The lectures provide a forum to promote the transfer of knowledge from 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.

Summary

Freedman began his presentation by describing the clash between two completely different paradigms in today's fast-paced business world. Patents and patent portfolios are being bought and sold with record valuations, and yet, many in the business community feel that patents serve little or no purpose. How can it be that something that many consider useless can be sold for so much money? The objective of the lecture was to discuss the benefits of IP protection and explore related opportunities, misunderstandings, and pitfalls, including the reasons why both of the contrasting paradigms have merit.

Trademarks

From the start, Freedman emphasized that IP protection was about more than just patents. Trademarks, for example, offer a number of benefits. Trademarks help a company protect its brands and encourage brand adoption by customers. Also, trademarks act as a repository of goodwill; customers know what to expect from the product, service, or company because of goodwill associated with a trademark. These positive associations can even be transferred to related markets as the company expands. In a well-run business, trademarks are business drivers, although some entrepreneurs make the mistake of letting the business drive the trademark. Finally, trademarks are inexpensive and easy to manage relative to other forms of IP protection.

For global businesses, however, there are downsides – or at least limitations – to trademarks. While a trademark may be suitable in one market, it may not be sufficiently distinct to offer the same benefits in all markets. A trademark's meaning or even colour scheme may not translate well in other locales and may not convey the intended message in other languages. Furthermore, a similar trademark may already be in use by another company elsewhere in the world. Thus, trademarks are not global in nature, and therefore they do not automatically offer global protection.

Intellectual Property Paradigms for Global Business

Gordon Freedman

Patents

Regarding patents, a common misconception is that they allow a business to generate revenue. Freedman pointed out that: "Patents are not about revenue, they are about downside protection. If you are making money, you don't care about patents." Thus, patents may protect the company's long-term interests against loss, particularly in large markets, but that does not mean they should be considered a business driver. For example, business and technology decisions should not be made based on what is patentable. Furthermore, beyond the large upfront costs, a company must put substantial time and money into managing a patent portfolio and monitoring potential infringement over the years, and therefore patents are not always cost effective.

The pros and cons of IP

Some see mechanisms for IP protection – especially patents – as not necessary or helpful, or as impediments to innovation. Others contend that patents encourage innovation and protect innovators by providing a reward for successful innovation. The merits of each of these opposing views may depend on the context, but there are clear advantages and drawbacks to IP, as shown in Table 1.

In comparing the pros and cons of IP, Freedman emphasized that there is no "one size fits all" solution. In some situations, the cons of IP might outweigh the pros, and vice versa. Reasons why the balance might tip against IP include:

1. **IP expends valuables resources.** There can be opportunity costs associated with both the money and the time spent managing and protecting IP. Companies should be careful that IP measures do not prevent a product launch, for example.

2. **IP protection takes a long time.** Companies should not protect things that will not be valuable five years from now.

3. **IP is local in nature.** To be effective, an IP strategy should be global. The costs associated with a global strategy can quickly become prohibitive for some companies and markets.

Reasons why the pros of IP might outweigh the cons include:

1. **IP is valuable in and of itself.**

2. **IP is a tool for negotiation and profit.** When a company has IP, it has more options when negotiating or deciding on business models.

3. **IP can be sold or licensed.** Although it is not a physical "thing", IP is property and it can be sold or used to generate revenue through licensing.

4. **IP is cost effective.** For companies that have access to sufficient capital, patents and other forms of IP protection are worth the cost.

5. **IP is divisible.** For example, a patent portfolio can be divided or sold independently from other assets.

Global strategies

Next, Freedman outlined five common strategies for protecting IP on a global scale:

Table 1. The pros and cons of IP

Pros	Cons
• IP can be monetized through sale and license	• IP is expensive to acquire, protect, monitor, and enforce
• IP leaves value if the venture fails	• IP is risky
• IP improves competitive landscape	• IP does not prevent competition
• IP protects future markets	• IP does not generate sales
• IP can bring marketing benefits	• IP timelines are long
• IP-generation activities can have tax benefits	• IP needs to be managed
• IP has "home run" potential	• IP "home runs" are rare

Intellectual Property Paradigms for Global Business

Gordon Freedman

1. **IP scattering.** Spread out protection with a scattered approach across some – but not all – jurisdictions. When backed by statistical models, this strategy can be a cost-effective method of downside protection.

2. **IP consolidation.** Focus all efforts in one country (e.g., the United States) that allows damage claims to extend to other countries.

3. **IP to protect market.** File patents only in countries that have particularly strong and relevant markets.

4. **IP to protect manufacture/use.** Focus protection on the countries where the company makes or uses the relevant technology.

5. **IP to protect corporate structure.** Mitigate against the risk of key staff leaving to start their own company in a jurisdiction where the IP has been left unprotected.

Conclusion

Freedman reinforced the lessons about IP protection with In closing, Freedman offered the following tips to new entrepreneurs:

1. Look forward. Do not look back at all the great ideas from your past and wonder "What if...?"

2. Keep an innovation journal to capture ideas and notes.

3. Be very picky; focus on your best ideas.

4. In your first business, focus on the process of building a business and making money. Very few entrepreneurs make "big money" on their first real idea, but lessons from earlier attempts help them get there.

5. The only way to learn is by doing it. Every entrepreneurial lesson is a benefit in some way – even the ones that hurt.

6. Ask a lot of questions. Go the extra distance to try to understand what you do not know.

7. When faced with a business decision, do not blindly accept anything someone tells you. Everyone is motivated by self-interest and their own paradigm, which can cloud their judgement even when they have the best intentions. Make your own decisions.

About the Speaker

Gordon Freedman is an entrepreneur, lawyer, and patent and trademark agent registered to practice before the Canadian Intellectual Property Office and the United States Patent and Trademark Office. With clients ranging from early-stage technology startups to Fortune 500 companies, he brings a business-centric approach to patents and patent enforcement. Gordon honed his business acumen by founding, growing, and selling a high-tech startup; his blend of business skill and intellectual property expertise make him a unique resource. He has particular technical expertise in electronics, including semiconductor manufacturing, semiconductor circuit design, miniaturization, communications, transducer systems and information technology, including software, consumer electronics, security, image processing, and communications.

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