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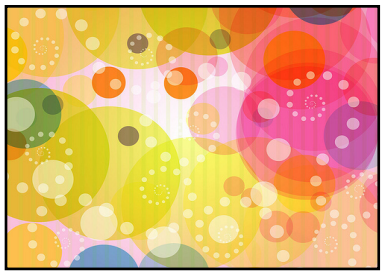

Platforms, Communities, and Business Ecosystems

Welcome to the February 2013 issue of the *Technology Innovation Management Review*. The editorial theme of this issue is Platforms, Communities, and Business Ecosystems. 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.

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Contribute to the TIM Review in the following ways:

- Read and comment on past articles and blog posts.
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Editorial: Platforms, Communities, and Business Ecosystems

Chris McPhee, Editor-in-Chief

Steven Muegge, Guest Editor

From the Editor-in-Chief

Welcome to the February 2013 issue of the *Technology Innovation Management Review*. This month's editorial theme is Platforms, Communities, and Business Ecosystems. As our guest editor for this issue, we welcome Steven Muegge, Assistant Professor at the Sprott School of Business and faculty member of the Technology Innovation Management program (carleton.ca/tim) at Carleton University in Ottawa, Canada. This issue contains four articles and a report on the first TIM Lecture of 2013: "Energy Efficiency and Data Security in Modern Data Centres".

In March and April, we offer two issues on the topic of open innovation. The theme in March is Local Open Innovation, and the guest editor is Christophe Deutsch, R&D Manager at Telops (telops.com) and Director/Co-Founder of Seeking Solutions (seeking-solutions.com) in Quebec City, Canada. In April, the theme is Open Innovation and Entrepreneurship and the guest editor is Jean-Pierre Segers, Head of the PHL Business School (phl.be) in Limburg, Belgium, and Chairman/Co-Founder of Creative Inc (creativeinc.be).

We are also planning an unthemed issue in late spring; this is a good opportunity for authors to submit an article on any topic within our overall scope.

I am also very pleased to announce the publication of the TIM program's first ebook: *Best of TIM Review for Technology Entrepreneurs* (tinyurl.com/ab29v5n). It features 16 of the most insightful, most relevant, and most popular articles on technology entrepreneurship published in the TIM Review, as selected and introduced by Tony Bailetti, Director of the TIM program, and Brian Hurley, President and CEO of Purple Forge, with a foreword by Denzil Doyle, Chairman of Doyletech Corporation.

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

Chris McPhee, Editor-in-Chief

From the Guest Editor

In this issue of the TIM Review, we explore the theme of Platforms, Communities, and Business Ecosystems. An appropriate subtitle for this issue would be Technology Entrepreneurship in an Interconnected World.

The separate notions of platforms, communities, and business ecosystems are likely familiar to TIM Review readers: all three have been recurring themes throughout the history of this journal, and its predecessor, the *Open Source Business Resource* (OSBR). This issue offers a fresh perspective in at least two ways. First, each article in this issue speaks directly to the technology entrepreneur – a perspective that is underrepresented in the management literature generally (Bailetti, 2012: timreview.ca/article/520; Bailetti et al., 2012: timreview.ca/article/557) and in the management research on platforms, communities, and business ecosystems specifically (Muegge, 2011; timreview.ca/article/495; Muegge, this issue). Second, this issue explicitly considers these three management phenomena together. Each article either approaches one of these phenomena from a new perspective or examines systems that bundle together platforms, communities, and business ecosystems as components of something larger.

These articles will be of particular interest to technology entrepreneurs who operate simultaneously in multiple platforms, communities, and business ecosystems, and who participate in field settings that comprise multiple instances of these components. Interconnected systems of platforms, communities, and business ecosystems, such as Lead To Win (leadtowin.ca)(see Bailetti and Hudson, 2009: timreview.ca/article/308; Bailetti, 2010: timreview.ca/article/325), or Eclipse (eclipse.org) (see Smith and Milinkovich, 2007: timreview.ca/article/94; Skerrett, 2011: timreview.ca/article/409), or the multitude of community-developed open source software projects with company participation and commercial derivatives and complements (e.g., Wheeler, 2009: timreview.ca/article/229; Weiss, 2011: timreview.ca/article/436; Lindman and Rajala, 2012: timreview.ca/article/510), are increasingly becoming the normal contexts for technology entrepreneurship rather than exceptions.

Editorial: Platforms, Communities, and Business Ecosystems

Chris McPhee and Steven Muegge

This issue is also significant in at least one other way. This past year, my colleagues in the Technology Innovation Management (TIM) program at Carleton University identified a set of specific research priority areas that would become focal points for our own research and our work with graduate students. Each research priority area addressed a specific management challenge faced by technology entrepreneurs. The October 2012 issue on "Born Global" (timreview.ca/issue/2012/october) was the first issue of the TIM Review to showcase work in one of these research priority areas – how technology entrepreneurs can globalize early and rapidly. This is the second issue of the TIM Review to showcase work on a research priority area – in this case, how technology entrepreneurs can benefit from platforms, communities, and business ecosystems. All of the authors are associated with the Lead To Win business ecosystem or Carleton's Technology Innovation Management program.

In the first article, I provide lessons for technology entrepreneurs facing choices about engaging with existing systems of platforms, communities, and business ecosystems, and the nature and extent of participation. The source material is a re-examination of the published research on platforms, communities, and business ecosystems, re-interpreted from the perspective of the technology entrepreneur, with system architecture as the unifying concept linking the organization of technologies, people, and companies. Although this is primarily a practitioner article, it will also be of interest to researchers and new graduate students seeking high-impact and managerially relevant research topics in technology innovation management and technology entrepreneurship and an overview and entry point to the research and practitioner literature on these topics.

Diane Isabelle, a faculty member of Carleton University's Sprott School of Business, examines the factors that technology entrepreneurs should consider when choosing a business incubator or accelerator. This article contributes recommendations for technology entrepreneurs based on findings from two recent surveys – the author's own survey of Canadian managers of incubators and accelerators and their client firms, and a 2012 survey by the National Business Incubation Association on the North American business incubation industry. Entrepreneurs lacking access to an established business ecosystem can consider incubators and accelerators as possible support mechanism and a means to access partners and resources that would be difficult to obtain otherwise.

Derek Smith, **Mohammad Mehdi Gharaei Manesh**, and **Asrar Alshaikh**, graduate students in Carleton's Technology Innovation Management program, examine how entrepreneurs can motivate crowdsourcing participants. This article contributes recommendations to technology entrepreneurs seeking to effectively motivate crowds, and advocates crowdsourcing as a viable alternative tactic to grow communities.

Tony Bailetti, Director of the Technology Innovation Management program, and **Sonia Bot**, member of the Lead To Win Council, describe the architecture of Lead To Win as a job-creation engine fuelled by technology entrepreneurs. Based on 10 design rules, an architecture links a business ecosystem, various communities of stakeholders, and a platform of shared resources and assets into an engine that converts public funds into jobs. It contributes details on how to design and operate a job-creation engine using an ecosystem approach, and the challenges of changing the components of a job-creation engine.

We hope that you enjoy this issue of the TIM Review, and find it rich with ideas and actionable knowledge that you can apply within your own organizations and entrepreneurial endeavours.

Steven Muegge, Guest Editor

About the Editors

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.

Steven Muegge is an Assistant Professor at the Sprott School of Business at Carleton University in Ottawa, Canada, where he teaches within the Technology Innovation Management (TIM; carleton.ca/tim) program. His research interests include open and distributed innovation, technology entrepreneurship, product development, and commercialization of technological innovation.

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Platforms, Communities, and Business Ecosystems: Lessons Learned about Technology Entrepreneurship in an Interconnected World

Steven Muegge

"I get by with a little help from my friends."

Lennon–McCartney
The Beatles (1967)

Technology entrepreneurs are increasingly building businesses that are deliberately anchored in platforms, communities, and business ecosystems. Nonetheless, actionable, evidence-based advice for technology entrepreneurs is scarce. Platforms, communities, and ecosystems are active areas of management research, but until recently, each has been studied in separate research programs, with results published in different venues, and often examined from the perspectives of incumbent managers or policy makers rather than entrepreneurs and new entrants.

This article re-examines these phenomena from the perspective of technology entrepreneurs facing strategic choices about interconnected systems of platforms, communities, and business ecosystems, and decisions about the nature and extent of participation. It brings together insights from a wide range of published sources. For entrepreneurs, it provides an accessible introduction to what can be a complex topic, identifies a set of practical considerations to be accounted for in decision-making, and offers a guide for further reading. For researchers and graduate students seeking practical and high-impact research problems, it provides an entry point to the research literature and identifies gaps in the current body of knowledge, especially regarding the system-level interactions between subsystems.

Introduction

Technology entrepreneurs in the global information economy share at least three common challenges. First, with limited resources, confronting all of the well-known liabilities of attempting something new, success often depends on access to specialized knowledge and resources that lie outside the entrepreneur's ownership or control. In a hypercompetitive environment, buying or building may not be attractive or even viable options. Second, success often critically depends on the innovations and actions of others who complement the entrepreneur's offer. Prior experience with the customer and supplier relationships of a traditional supply chain is inadequate preparation for the challenges of managing complementors. Third, these critical assets and complementors – as well as suppliers, customers, and competitors – can be located anywhere in the world. The environments in which technology entrepreneurs operate are at once global and densely interconnected.

Platforms, communities, and business ecosystems can provide partial remedies to these and other problems. By building products and services on platform assets developed by others, a technology entrepreneur can focus R&D effort on building differentiating capability. By engaging communities of passionate people, a techno-

Platforms, Communities, and Business Ecosystems

Steven Muegge

logy entrepreneur can learn more effectively about individual wants and needs, benefit from user innovations, and channel the creative energy of the community towards useful endeavours. By operating a business within a networked ecosystem of interdependent and codependent businesses with partially aligned incentives, a technology entrepreneur can achieve more, learn faster, and reach farther than otherwise possible, while sharing some of the risks and costs with others.

Fortunately, we know quite a bit about each of these systems and are learning more every day. There are growing bodies of knowledge about platform architecture and business strategy, community innovation and the design and management of communities, and the dynamics and strategies of business ecosystems. Unfortunately, technology entrepreneurs are not benefiting from this knowledge as much as they could be. There are several reasons for this. First, much of what is written addresses one of these systems only – either platforms, communities, *or* ecosystems – but the real-world systems of interest to technology entrepreneurs often come bundled together with multiple parts: community-developed platforms, business ecosystems anchored around shared platforms, and user communities that complement the market offers of a business ecosystem. In fact, all three systems are commonly bound together as one larger system. For example, an entrepreneur who decides to develop a software product or service on the Eclipse platform of software tools and development frameworks (eclipse.org) is also choosing to couple their outcomes with the Eclipse developer community that maintains and extends the Eclipse platform (Smith and Milinkovich, 2007; timreview.ca/article/94; Skerrett, 2008; timreview.ca/article/160), and the Eclipse ecosystem of companies that produce complementary products and services and employ many of the software developers in the Eclipse community (Milinkovich, 2008; timreview.ca/article/200; Muegge, 2011; timreview.ca/article/495). Similarly, neither a mobile application developer nor a provider of an online service are choosing "just" a platform or community or ecosystem, but rather a bundled system that includes instances of all three subsystem types. The research and practitioner literature rarely considers these systems together or attends closely to their interactions. (A few recent important exceptions are discussed later). Second, the knowledge is scattered in many places – practitioner books, specialized scholarly books, book chapters, journal articles, and other online sources – and it is time-consuming and effort-intensive to assemble these pieces together, transform this incomplete mosaic into actionable knowledge, and to stay current with ongoing developments. Third, the perspective taken in the literature is typically *not* that of an entrepreneur but rather some other stakeholder. The concerns of the established platform leader (Gawer and Cusumano, 2002: tinyurl.com/auvvaet; 2008: tinyurl.com/bjkhq3j), the community designer (Bacon, 2009: tinyurl.com/9thvrn; Kraut and Resnick, 2011: tinyurl.com/as95la8), or the ecosystem keystone company (Iansiti and Levien, 2004a: tinyurl.com/7t4xgvn; 2004b: tinyurl.com/bkg9vfl) may be quite different from those of the resource-limited entrepreneur facing a constrained choice of which existing systems to align themselves with.

This article aims to address all three obstacles by bringing together insights from these disparate sources and presenting their prescriptive implications in a form that is both comprehensible and useful to technology entrepreneurs. The perspective is that of the technology entrepreneur, facing choices about interconnected systems of platforms, communities, and business ecosystems, and the decisions of whether or not to participate in an existing system, and the nature and extent of participation.

The body of this article is structured in five sections. The first section develops the conceptual argument that platforms, communities, and business ecosystems can be understood as different levels of analysis in a complex multilevel hierarchical system, and that *architecture* is the unifying concept that links the three levels. It begins from Tim O'Reilly's assertion that systems *designed* with the right architectural characteristics – what he calls an *architecture of participation* – are more likely to attract contributions from others. The second, third, and fourth sections each examine one of the three system levels: platforms, communities, and business ecosystems, respectively. Each of these sections provides a brief and selective review of research that is salient to the perspective of the technology entrepreneur, highlighting contributions published in the *TIM Review*. The fifth section presents a compilation of the collective "lessons learned" for technology entrepreneurs. A full synthesis of the platforms, communities, and business ecosystems literatures is beyond the scope of this article, but the results thus far are nonetheless instructive. A final section concludes with a call to researchers and new graduate students to continue and extend this line of enquiry.

Platforms, Communities, and Business Ecosystems

Steven Muegge

Architecture

Table 1 provides definitions of *platform*, *community*, and *business ecosystem* as organizational forms that structure different levels of organization in an interconnected world. According to this view, a platform is a particular organization of *things* (technologies and complementary assets), a community is an organization of *people*, and a business ecosystem is an organization of *economic actors*. Each co-exists with familiar traditional forms at the same level of organization: for example, proprietary products and services as systems of things, companies, government groups, and not-for-profits as organizations of people, and industries and industrial organizations as structures of economic actors. In previous decades, as described by Chandler (1962; tinyurl.com/a86usw9) and Porter (1980; tinyurl.com/aoyr3vr) and others, these traditional forms were dominant: companies developed proprietary products and services through closed internal R&D processes, and competed within industries of similar companies developing substitute products and services. In today's interconnected world, platforms, communities, and business ecosystems are viable ways of organizing that co-exist with rather than replace these traditional forms.

In engineering design, *architecture* refers to a high-level design of the over-all way in which the major components of a system fit together. System architecture is important in engineering design for several reasons: it may be technically difficult to accomplish and requires a broad skill set, it often determines (or places upper bounds on) systems performance and (lower bounds on) cost, and it may be difficult (or impossible) to change later thus imposing path dependence. More recently, the notion of architecture has been applied more broadly to subsume what has been called organizational structure when referring to systems of people and industrial organization when referring to systems of economic actors. Various practitioners and researchers have independently observed that the structures at these levels of organization are deeply connected.

Table 1. An architecture at three levels*

Level of Organization (Type of Actor)	Organizational Forms in an Interconnected System	Traditional Organizational Forms at the Same Level of Organization
Organization of economic actors	**Business ecosystem**: a field of economic actors whose individual business activities, anchored around a platform, share in some large measure the outcome of the whole ecosystem.	• Industrial organization
Organization of people	**Community**: a voluntary group of people with common interests and a similar sense of identity. Communities can take many different forms. Two are particularly relevant here: 1. **Developer community**: a community of people, organized as a meritocracy, who collectively maintain and extend a platform 2. **User community**: a community of people who use and consume a platform or the products, technologies, and services built on a platform	• Firm (in the strategy and economics literature) or an organization (in the management and human resources literature) – a privately-held or publicly traded business • Government organization • Not-for-profit organization
Organization of things	**Platform**: a set of technological building blocks and complementary assets that companies and individuals can use and consume to develop complementary products, technologies, and services.	• Integral (non-modular) product or service • The outcome of a closed innovation R&D process

* These definitions closely follow those of Muegge (2011; timreview.ca/article/495), which are adapted from various sources cited in this article and my own research with practitioners.

Platforms, Communities, and Business Ecosystems

Steven Muegge

Publicist Tim O'Reilly coined the expression "architecture of participation" to describe "the nature of systems that are designed for user contribution" and introduced it in a series of talks, essays and blog posts (e.g., O'Reilly, 2004: tinyurl.com/3vxstbp; O'Reilly, 2005: tinyurl.com/akobz9v). Within such systems, users pursuing their own selfish interest build collective value as an automatic byproduct, and systems get better the more people use them. Management researchers have described O'Reilly's writing as a collection of *heuristics* – experience-based techniques for problem solving and design that may be effective much of the time. Box 1 provides a summary of some specific practitioner heuristics found in O'Reilly's writing.

Management researchers have made some progress towards placing these practitioner arguments and heuristics on a theoretical foundation. Architectural *modularity* features prominently in the design rule theory of Baldwin and Clark (2000; tinyurl.com/aknjusp), linking the microstructure of designs, organizations, and industry structures deep "in the very nature of things". Modularity in design alters the mechanisms by which designs can change. This enables design evolution – a value-seeking process with strong parallels to biological and ecological processes – and links the architecture of systems of things, people, and economic actors in an interconnected multilevel complex adaptive system. The design rules at each level are reflected in the design

Box 1. Architecture of participation heuristics

A close reading of O'Reilly's essays, articles and presentations, and blog posts at the O'Reilly Media websites published between 2006 and 2008 identified 13 architecture of participation heuristics. Some may be generally applicable to many systems; others are specialized to particular contexts.

1. Small modular applications.
2. Well-defined application interfaces, minimally specified, that place few constraints on interoperability with other applications.
3. Transparency of design: the internal design of the system is open to be examined.
4. A small core and well-defined extension mechanism, also described as a tightly-controlled cathedral surrounded by an open bazaar.
5. Rival ideas and solutions compete with one another in a free market for ideas.
6. Low barriers to entry for new users.
7. Contributions from outside the community are welcomed, and outside contributions compete on a level playing field with contributions from within the community.
8. User value, as assessed by users, is the criterion for selecting one solution rather than a different one.
9. Users have the credible capability to fork the project, providing strong incentives for developers to be responsive to users.
10. Participation is automatic; contribution is the default behaviour of using the system, and no extra effort is required to contribute.
11. Users trust the system.
12. Dial-tone: users can do something themselves that previously required a professional operator, analogous to direct-dialling a telephone call rather than placing a call with the assistance of an operator.
13. Value is extracted from what users already do without requiring behaviour change.

Platforms, Communities, and Business Ecosystems

Steven Muegge

rules of the other two levels. Modularity simultaneously multiplies and decentralizes design options (Baldwin and Clark, 2000; tinyurl.com/aknjusp):

"The multiplication occurs because changes in one module become independent of changes in other modules. Decentralization follows because, as long as designers adhere to the design rules, they are free to innovate [independently] without reference to the original architects or any central planners of the design."

The context in which designs and design processes are lodged operates on designs "like a force" (Baldwin and Clark, 2000; tinyurl.com/aknjusp):

"In particular, economies with capital markets offer large, direct rewards to value-creating enterprises, and commensurately large incentives for human beings to cooperate for the purpose of creating economic value… Metaphorically, they 'pull' designs in the 'direction' of higher market value."

The specifiable, verifiable, and predictable interfaces between technology building blocks determine the efficient placement of firm boundaries (Christensen et al., 2001: tinyurl.com/b4bq7hf; Christensen and Raynor, 2003: tinyurl.com/awog9gg) – whether firms can viably specialize on providing a component of a larger system or must integrate over a larger system to be operationally effective (Langlois and Robertson, 1992: tinyurl.com/b6d723h; Sanchez and Mahony, 1996: tinyurl.com/awv9jly). A business ecosystem of modular specialized firms becomes a viable industry structure around a modular platform.

Platforms

Platforms are typically subject to positive feedback loops through network effects in use (Katz and Shapiro, 1985; tinyurl.com/a3pvqee) and increasing returns in supply (Arthur, 1994: tinyurl.com/b33zb76; 1996: tinyurl.com/b5oe34u) that tend to amplify early advantage: the more people who use platform products, the more incentives there are for complementors to introduce more complementary products (Cusumano and Gawer, 2002; tinyurl.com/aaq3k8e). Gawer (2009a; tinyurl.com/a3te7o4) writes: "Platforms that make it past a certain tipping point tend to become really hard to dislodge. In a sense, as platforms' market share grows, so also grow their own barrier to entry."

An early body of work in platform strategy examined *platform leadership,* defined by Cusumano and Gawer (2002; tinyurl.com/aaq3k8e) as the ability of a company to drive innovation around a particular platform technology at the broad industry level. In this view, platform leaders are "companies that drive industry-wide innovation for an evolving system of separately developed pieces of technology". Complementors (Brandenburger and Nalebuff, 1996; tinyurl.com/aacklb7) are companies that make ancillary products that expand the platform's market. Some companies occupy multiple roles; for example, Intel and Microsoft are both platform leaders and complementors. Platform leaders employ the four levers of platform leadership to maintain and extend a leadership position (Gawer and Cusumano, 2002: tinyurl.com/auvvaet; 2012: tinyurl.com/b4qhmhq): i) scope (decisions of which complements to make in-house and which to deliberately leave to other companies; convey a vision of the larger system); ii) product technology (decisions of modularity, interfaces, and how much information to disclose; build the right architecture and connections); iii) relationships with external complementors (decisions around consensus and control, cooperation and competition, and handling potential conflicts of interest; build a coalition for co-creation); and iv) internal organization (co-evolve the platform while maintaining a central position). Platform leaders face three types of problems (Cusumano and Gawer, 2002; tinyurl.com/auvvaet): i) how to maintain the integrity of the platform in the face of future technological innovation and the actions of other companies; ii) how to let the platform evolve while maintaining compatibility with past complements; and iii) how to maintain platform leadership.

A smaller literature examines the strategies for platform complementors. Cusumano and Gawer (2002; tinyurl.com/auvvaet) offer five managerial prescriptions for platform complementors: i) focus on products that the platform leader is unlikely to offer; ii) be aware that changes occur rapidly, thus work on continuous communication, seek early information, and pay attention to actions of the platform leader; iii) react quickly to demands of the platform leader (to provide no provocation or incentives for the platform leader to become a direct competitor); iv) create products that enhance the value of the core product (thus benefiting the platform leader); and v) work with groups inside the platform company that are likely to offer the most neutral stance to promote the platform (rather than groups that would perceive the complementor as a threat). Weiss and Gangadharan (2010; tinyurl.com/am65fyx) examine the platform strategies of complementors providing software mashups and mashable components.

Platforms, Communities, and Business Ecosystems

Steven Muegge

Because all platforms require complementary innovations to be useful, no platform is fully under the control of its originator (Gawer and Cusumano, 2008; tinyurl.com/bjkhq3j). Nonetheless, some platforms are more tightly controlled than others. West (2003; tinyurl.com/6s68jno) reflects on the tension between appropriability and adoption evident in the "hybrid" platform strategies of Apple, IBM, and Sun Microsystems:

"To recoup the costs of developing a platform, its sponsor must be able to appropriate for itself some portion of the economic benefits of that platform. But to obtain any returns at all, the sponsor must get the platform adopted, which requires sharing the economic returns with buyers and other members of the value chain. The proprietary and open source strategies correspond to the two extremes of this trade-off. In making a platform strategy for the 21st century, leading computer vendors face a dilemma of how much is open enough to attract enough buyers while retaining adequate returns."

Selecting the level of platform *openness* is a crucial decision for firms that create and maintain platforms (Eisenmann et al., 2009; tinyurl.com/a3te7o4). Opening a platform can spur adoption by harnessing network effects, reducing users' concerns about lock-in, and stimulating production of differentiated goods that meet the needs of user segments. At the same time, opening a platform typically reduces users' switching costs and increases competition among platform providers, making it more difficult for them to appropriate rents from the platform. Schilling (2009; tinyurl.com/a3te7o4) identifies three dilemmas facing firms that liberally diffuse technology to would-be competitors: i) they relinquish the opportunity to capture monopoly rents when and if their technology emerges as a dominant design; ii) once relinquished, control can be very hard to regain; and iii) potential for fragmentation of the technology platform. In the computer industry, movement towards open platforms was driven by an increasingly competitive business environment and the pragmatic pursuit of profits (West, 2003; tinyurl.com/6s68jno).

Baldwin and Clark (2006; tinyurl.com/3qnf5xn) argue that the architecture of a software code base is a critical factor that lies at the heart of the open source development process. Drawing on their previous work on design rules, they argue that designs have option-value because a new design creates the right but not the obligation to adopt it. A modular design allows for experimentation and changes within modules without disturbing the functionality of the whole system. The authors then use a series of increasingly sophisticated game-theory models of developer behaviour to show that increased modularity (and thus increased option value) has two effects on the software development process. First, it increases the incentives of developers to get involved and remain involved in the development process. Second, it decreases the amount of free riding in the equilibrium – that is, using with contributing. Both effects promote growth of the developer community, suggesting that modular design is important to the success of open source development projects. Evidence from empirical studies of software platforms supports a deep and positive connection between modularity and design evolution (MacCormack et al., 2001: tinyurl.com/am6axfs; MacCormack et al., 2006: tinyurl.com/avcj478; LaMantia et al., 2008: tinyurl.com/ao7nsyu).

Platform contributions published in the *TIM Review* have included Muegge and Milev (2009; timreview.ca/article/245) on measures of modularity, the May 2010 issue (timreview.ca/issue/2010/may) on platforms for communication-enabled applications (CEA), Poole (2010; timreview.ca/article/391) on open government platforms as an engine of economic development, and Noori and Weiss (2013; timreview.ca/article/647) on the strategies of platform owners to manage complements.

Communities

"Community" is a term with many different meanings. In a broad survey of the research on community, West and Lakhani (2008; tinyurl.com/bas35oa) observe:

"a welter of overlapping literatures and terms: innovation communities, knowledge producing communities, online communities, scientific communities, technical communities, user communities, virtual communities, or communities of practice. That doesn't even include the disparate uses of 'community' in sociology, where ... some 100 different definitions have been used."

For the purposes of this article and the definition provided in Table 1, community membership is comprised exclusively of individual people; community members may also be members of other organizations, but those organizations are outside the community. Bacon (2009; tinyurl.com/9thvrn) associates community with a shared core belief, a sense of belonging, a collection of shared processes, and a social economy whose currency is social capital rather than financial capital: "At the heart of how this movement works is communication". Community membership is always voluntary: new members can join, and existing members can exit.

Platforms, Communities, and Business Ecosystems

Steven Muegge

Within the vast research literature on communities, two particularly salient streams are community innovation and open source software communities. The first stream examines how communities outside the boundaries of firms often play a role in creating, shaping, and disseminating technological and social innovations and providing valuable support to others. Eric von Hippel's research on user innovation (von Hippel, 1988: tinyurl.com/bdgd222; 2001: tinyurl.com/b44fuvs; 2005: tinyurl.com/aygvzd2) and Henry Chesbrough's research on open innovation (Chesbrough, 2003: tinyurl.com/auxxe23; Chesbrough and Appleyard, 2007: tinyurl.com/bksr5t3) both feature prominently. Boudreau and Lakhani (2009; tinyurl.com/ahza5eh) examine the circumstances under which companies should organize outside innovation as collaborative communities rather than competitive markets. Baldwin and von Hippel (2011; tinyurl.com/bkglw9e) examine the circumstances favouring single-user innovation and community-user innovation over producer innovation.

The second salient community stream is open source software and the communities of developers and users that form around successful open source software projects. West and O'Mahony (2008; tinyurl.com/66fly95) examined the communities surrounding 12 open source projects initiated by corporate sponsors and a comparison group of five projects originating from autonomous communities. According to West and O'Mahony (2008; tinyurl.com/66fly95), sponsors consider three design dimensions that together create a specific participation architecture: i) production (they way that the community conducts production processes); ii) governance (the processes by which decisions are made within the community); and iii) intellectual property rights (the allocation of rights to use the community's output). The authors distinguished between two dimensions of openness: transparency (allowing outsiders to follow and understand a community's production efforts) and accessibility (allowing external participants to influence the community's production efforts). Projects with more transparent and accessible production, governance, and intellectual property were more likely to attract external participants and to grow communities.

Two recent books have proposed sets of constructive design propositions for communities. Kraut and Resnick (2011; tinyurl.com/as95la8) apply theories from psychology, economics, and the broader social sciences to propose a set of evidence-based *design claims* for building successful online communities. Schweik and English (2012; tinyurl.com/athekbm) reflect on the results of a five-year multimethod research program, including quantitative tests of more than 40 hypotheses with large sample datasets of projects and individuals, to propose a set of actionable *design principles* for sustainable community-developed software projects. Box 2 provides examples of design propositions from both sources.

Community contributions published in the *TIM Review* have included Smith and Milinkovich (2007; timreview.ca/article/94) on the Eclipse community, Skerrett (2008: timreview.ca/article/160; 2009: timreview.ca/article/219; 2011: timreview.ca/article/409) on open source software communities, and Weiss (2011a; timreview.ca/article/436) on control and diversity.

Business Ecosystems

Moore (1993; tinyurl.com/cygzy6o) introduced the term "business ecosystem" into popular management parlance in a McKinsey Award-winning article in *Harvard Business Review*. Moore argued for an *ecological* approach to management, where the modern business is viewed not a member of single industry, but rather part of a *business ecosystem* that crosses a variety of industries. A follow-up book (Moore, 1996; tinyurl.com/bap2at4) described the business ecosystem as "an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world". The ecosystem includes customers, suppliers, competitors, and other stakeholders, who "coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies". Moore (2006; tinyurl.com/atgf858) argued that business ecosystems are a distinct organizational form – a mode of organizing economic production that differs from markets and the organizational hierarchies of firms. Alternatively, a business ecosystem can also be understood as a network of specialized and complementary opportunity niches – both known and yet to be discovered.

Later scholars further developed these ideas. Iansiti and Levien (2004a: tinyurl.com/7t4xgvn; 2004b: tinyurl.com/bkg9vfl) adapted language from ecology to propose that firms occupying influential *hub positions* (i.e., network nodes that are highly connected to other nodes) can adopt either a *keystone* role or a *dominator* role. *Keystones* exercise leadership to their own benefit, but also to the benefit of other ecosystem members. Keystones create platforms of services, tools, or technologies that other members of the ecosystem can use to enhance their own performance. *Dominators* instead adopt the short-term tactic of maximum value extraction, without attending to ecosystem health.

Platforms, Communities, and Business Ecosystems

Steven Muegge

Box 2. Community design propositions

Two recent books have proposed sets of community design propositions.

Kraut and Resnick (2011; tinyurl.com/as95la8) proposed a set of *design claim*s for building online communities. Design claims are a device to translate theory to design alternatives that achieve community goals. They can be non-comparative (Alternative X helps/hinders achievement of goal Y under conditions Z) or comparative (Alternative X1 is more effective than X2 at achieving goal Y under conditions Z). The claims are organized into five *design challenges*: i) starting a new community, ii) attracting and socializing new members, iii) encouraging commitment, iv) encouraging contribution, and v) regulating misbehaviour and conflict. The first three of 35 claims for encouraging contribution are provided here as examples (ch. 2, pp. 26-27):

1. Making the list of needed contributions easily visible increases the likelihood that the community will provide them.

2. Providing easy-to-use tools for finding and tracking work that needs to be done increases the amount that gets done.

3. Compared to asking people at random, asking people to perform tasks that interest them and that they are able to perform increases contributions.

Schweik and English (2012; tinyurl.com/athekbm) proposed a set of 13 prioritized *design principles* for sustainable community-developed open source software projects. The first two recommendations at the initiation stage (before first release) are provided here as examples (ch. 13, p. 304):

1. Put in the hours. Work hard toward your first release.

2. Practice leadership by administering your project well, and thinking through and articulating your vision as well as your goals for the project. Demonstrate your leadership through the hard work noted just above, and by working toward the vision and goals you have established for the project.

Adner (2012; tinyurl.com/ajcufbq) recently proposed a "wide lens" strategy toolkit for managers seeking to assess, build, or reshape ecosystems. Adner's application cases are well-resourced multinational enterprises; nonetheless, some of the management problems addressed by Adner's tools and frameworks are conceptually similar to the problems faced by technology entrepreneurs.

Business ecosystem contributions published in the *TIM Review* include Bailetti's (2008; timreview.ca/article/138) inaugural Technology Innovation Management (TIM) lecture on the business ecosystem approach to commercialization of technology products and services, Milinkovich (2008; /article/200) on ecosystem development, Carbone (2009; /article/227) on business models and ecosystems, Hurley (2009; /article/276) on the opportunities that ecosystems provide to creative entrepreneurs, Bailetti (2010a; /article/325) on how technical entrepreneurs benefit from business ecosystems, Bailetti (2010b; /article/355) on growing the revenue of small technology companies, Weiss (2010; /article/376) on ecosystem keystones, Weiss (2011b; /article/488) on the economics of software product development collectives, and Satsangi (2012; /article/597) on evaluating alliance options. Mike Milinkovich, the Executive Director of the Eclipse Foundation (eclipse.org), offers the following practical advice on ecosystem strategy (quoted by Weiss, 2011; /article/488):

"Define very precisely what your competitive differentiators are for your customers or you're going out of business. Focus all possible energies there, and acquire everything else from open source software, or help build it in open source software. Or in other words: pick your niche; co-evolve the platform in collaboration with other actors in the ecosystem."

Despite the prevalence of real-world systems that combine platforms, communities, and business ecosystems, larger field settings and the multilevel interactions between subsystems have received less attention than each of the organizational forms themselves. Important exceptions include Milinkovich (2010; timreview.ca/article/320) on the connection between community-developed open source software and the business ecosystems that commercialize that software, my own systems model of community-developed platforms (Muegge, 2011; timreview.ca/article/495), Nyman and Lindman (2013; timreview.ca/article/644) on code forking in open source software, and Schweik (2013; timreview.ca/article/645) on the sustainability of open source software commons – all published in the *TIM Review*. Muegge's

Platforms, Communities, and Business Ecosystems

Steven Muegge

(2011; timreview.ca/article/495) systems model considers the platform, developer community, and business ecosystem as codependent subsystems linked by interconnected institutional arrangements, resource flows, and governance structures, and a multilevel systems architecture linking the organization of technologies, people, and economic actors. Gawer and Cusumano (2012; tinyurl.com/b4qhmhq) examine the platform and ecosystem together from the perspective of the platform leader. Weiss and Gangadharan (2010; tinyurl.com/am65fyx) examine the role of platforms in ecosystems from the perspective of the complementor.

Implications for Technology Entrepreneurs

Table 2 is a compilation of prescriptive lessons learned for technology entrepreneurs facing various strategic decisions regarding platforms, communities, and business ecosystems. Table 3 is a recommended reading list for learning more about platforms, communities, and ecosystems. Also note that the author maintains a website of research and practitioner resources, including references to all sources cited in this article: tinyurl.com/ahpyozs.

Conclusion

In the global information economy, the actions and outcomes of a technology entrepreneur are deeply interconnected with the actions and outcomes of others. By making these connections explicit, in strategy formation and in business model design, an entrepreneur can more efficiently interpret new information, more effectively identify opportunities and evaluate alternative courses of action, and more clearly link actions and expected outcomes.

This article has re-examined platforms, communities, and business ecosystems from the perspective of the technology entrepreneur. It brought together insights from various scholarly and practitioner sources to present evidence-based lessons learned for technology entrepreneurs facing choices about whether or not to engage with existing systems of platforms, communities, and business ecosystems, and decisions about the nature and extent of participation within these systems. Contributions include a precise working vocabulary and conceptual framework for thinking about and discussing collaboration (Table 1), a compilation of evidence-based prescriptive lessons learned from prior research (Table 2), and a guide for further reading and private study (Table 3).

This article concludes with a call to researchers – especially to graduate students seeking high-impact topics for thesis and dissertation research in technology management and in business – to extend this line of research in three ways. First, by studying field settings at multiple levels of analysis – not only platforms of technology building blocks, communities of developers and users, and ecosystems of economic actors, but also their interactions and multilevel dependencies. Second, by explicitly considering the perspective of the technology entrepreneur. Third, by framing research questions around managerially relevant problems faced by entrepreneurs in the field. Technology entrepreneurs are a source for much innovation and a driver of economic growth and prosperity for individuals, firms, regions, and nations (Bailetti, 2012; timreview.ca/article/520). Research that improves the magnitude and likelihood of entrepreneurial success can have broad-reaching impact.

About the Author

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Platforms, Communities, and Business Ecosystems

Steven Muegge

Table 2. Summary of lessons learned for technology entrepreneurs

Level	Lessons Learned*
Platform	Technology entrepreneurs deciding whether or not to adopt an existing platform: • Choose a platform with higher modularity and option value; platforms with higher modularity and option value are more likely to attract developer contributions. Technology entrepreneurs producing platform complements: • Focus on products that the platform leader is unlikely to offer. • Expect rapid change: work on continuous communication, seek early information, and pay close attention to the actions of platform leaders. • React quickly to the demands of the platform leader; do not provoke others to become competitors. • Create products that enhance the value of others' products. • When working with potential competitors, work with groups and individuals within the firms who are likely to offer the most neutral stance to promote the platform. Technology entrepreneurs in a platform leadership position: • Employ the four levers of platform leadership to maintain and extend a leadership position: i) scope; ii) product technology; iii) relationships with external complementors; and iv) internal organization. • Recognize the tension between adoption and appropriability when choosing the appropriate degree of platform openness (transparency and accessibility). • Attend deliberately to the three problems of platform leadership: i) maintain the integrity of the platform in the face of future technological innovation and the actions of other companies; ii) let the platform evolve while maintaining compatibility with past complements; and iii) maintain platform leadership. Technology entrepreneurs aspiring to become platform leaders: • Be cognisant of the differences between a product strategy and platform strategy • Design an architecture of participation, with high modularity and well-defined interfaces, that is easy to build on and extend by others, performs a valued function, and where contribution is the default behaviour for users. Employ practitioner heuristics (Box 1).
Community	Technology entrepreneurs deciding whether or not to participate in an existing community: • Choose a community with higher transparency and accessibility of: i) production; ii) governance; and iii) intellectual property; projects that are more transparent and accessible are more likely to attract external participants and to grow communities. • Employ evidence-based design propositions (Box 2) when assessing a community. Technology entrepreneurs seeking to grow and nurture a community: • Employ evidence-based design propositions (Box 2) when designing or reshaping a community.
Business ecosystem	Technology entrepreneurs deciding whether or not to participate in a business ecosystem: • Choose an ecosystem where the organization(s) at the hub position behaves as a keystone (fostering value creation) rather than a dominator (extracting value only). If possible, choose an ecosystem with a membership-based vendor-neutral keystone. • Choose a healthy ecosystem with high productivity, robustness, and niche creation. • Choose an ecosystem with institutional features that motivate resource flows from economic actors in the business ecosystem to developer communities and platforms. • Employ wide lens tools and frameworks to assess ecosystem risks and opportunities. • Participate in multiple ecosystems as a diversification and risk management tactic. Technology entrepreneurs seeking to grow and nurture a business ecosystem: • Behave as a keystone (rather than a dominator) by deliberately nurturing the platform, creating value within the ecosystem, and sharing the value with other participants. • Employ wide lens tools and frameworks to reshape and orchestrate the ecosystem.

*Lessons learned for technology entrepreneurs are compiled from various sources cited throughout the article.

Table 3. Recommended reading

Level	Author (Year)	Source	Contribution
Platform	Cusumano & Gawer (2002)* tinyurl.com/aaq3k8e	Article: *Sloan Management Review*	Platform leadership: ability to drive innovation around platform technology at the broad industry level. Platform leaders use four levers of platform leadership to maintain and extend a position, and face four problems of platform leadership.
	West (2003) tinyurl.com/6s68jno	Article: *Research Policy*	Firms introducing platforms and standards face a tension between adoption (encouraging use by others) and appropriability (earning returns).
	Baldwin & Clark (2006) tinyurl.com/3qnf5xn	Article: *Management Science*	Open source software codebases that are more modular or have more option value increase the incentives for developers to join and remain involved in a project.
Community	West & O'Mahony (2008) tinyurl.com/66fly95	Article: *Industry & Innovation*	Projects with more transparent and accessible (i) production, (ii) governance, and (iii) IP are more likely to attract external participants and to grow communities.
	Bacon (2009) tinyurl.com/9thvrn	Book: *The Art of Community*	Experience-based practitioner advice on building and growing communities.
	Kraut & Resnick (2011) tinyurl.com/as95la8	Book: *Building Successful Online Communities*	Evidence-based design claims for building online communities. Five levers of community change. Five community design challenges.
	Schweik & English (2012)** tinyurl.com/athekbm	Book: *Internet Success*	Actionable design principles for sustainable community-developed software projects; results of >40 hypothesis tests with large-sample data sets.
Business ecosystem	Moore (1993) tinyurl.com/cygzy6o	Article: *Harvard Business Review*	Business ecosystems. Advocates an ecological approach to management.
	Moore (1996) tinyurl.com/bap2at4	Book: *The Death of Competition*	Expanded treatment of Moore (1993); sharper definition of business ecosystem.
	Iansiti & Levien (2004a)*** tinyurl.com/7t4xgvn	Article: *Harvard Business Review*	Roles: keystone, dominator, niche player. Keystone strategy. Ecosystem health.
	Moore (2006) tinyurl.com/atgf858	Article: *The Antitrust Bulletin*	Business ecosystems are an organization form, as important as markets and firms.
	Adner (2012) tinyurl.com/ajcufbq	Book: *The Wide Lens*	Wide lens tools and frameworks for assessing, building, and reshaping ecosystems.
Multilevel system architecture	Parnas (1972) tinyurl.com/axbghlg	Article: *Communications of the ACM*	Introduced influential ideas about modularity, information hiding, and interfaces.
	Simon (1996) tinyurl.com/bjywdfw	Book: *The Sciences of the Artificial*	Hierarchical systems; near-decomposability; emergent properties; design science.
	Baldwin & Clark (2000) tinyurl.com/aknjusp	Book: *Design Rules, Volume 1*	Architectural modularity links designs, tasks, and industry structures in a complex adaptive system; design rules; design operators; design evolution.
	O'Reilly (2005) tinyurl.com/akobz9v	Book chapter: *Open Sources 2.0* (ch. 7); blog posts at oreillynet.com	Systems with an architecture of participation attract user contributions. Users pursuing their own selfish interest build collective value as an automatic byproduct.
	Baldwin & Woodard (2009) tinyurl.com/a3te7o4	Book chapter: *Platforms, Markets and Innovation* (ch. 2)	Joins the research literatures on platforms with the literature on architecture.

*_Platform Leadership_ (Gawer and Cusumano, 2002; tinyurl.com/auvvaet) is an expanded treatment of the material in Cusumano and Gawer (2002; tinyurl.com/aaq3k8e).
**Schweik (2013; timreview.ca/article/645) summarizes the main results (including the design principles) of Schweik and English (2012; tinyurl.com/athekbm) in an open access format.
***_The Keystone Advantage_ (Iansiti and Levien, 2004b; tinyurl.com/bkg9vfl) is an expanded treatment of the material in Iansiti and Levien (2004a; tinyurl.com/7t4xgvn).

Key Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

> *"Ideas are like frog eggs: you've got to lay a thousand to hatch one."*
>
> Peter Drucker
> Professor and management consultant

Technology entrepreneurship rarely succeeds in isolation; increasingly, it occurs in interconnected networks of business partners and other organizations. For entrepreneurs lacking access to an established business ecosystem, incubators and accelerators provide a possible support mechanism for access to partners and resources. Yet, these relatively recent approaches to supporting entrepreneurship are still evolving. Therefore, it can be challenging for entrepreneurs to assess these mechanisms and to make insightful decisions on whether or not to join an incubator or accelerator, and which incubator or accelerator best meets their needs.

In this article, five key factors that entrepreneurs should take into consideration about incubators and accelerators are offered. Insights are drawn from two surveys of managers and users of incubators and accelerators. An understanding of these five key success factors (stage of venture, fit with incubator's mission, selection and graduation policies, services provided, and network of partners) and potential pitfalls will help entrepreneurs confidently enter into a relationship with an incubator or accelerator.

Introduction

What factors should technology entrepreneurs take into consideration when selecting a potential organization to support their development? What is the current landscape of incubators and accelerators in North America? In this article, insights on technology incubators and accelerators from an academic perspective, as well as a practitioner's perspective, are examined. Specifically, findings are presented from a recent survey of Canadian managers of incubators and accelerators and their client firms, conducted by the author, and from a recent survey of the North American business incubation industry (Knopp, 2012; tinyurl.com/buld3wd).

New technology ventures have to overcome several challenges to successfully commercialize their new ideas. Communities around the world have been looking for ways to encourage and support new-business development, in order to enhance economic development and create jobs. One such mechanism is business incubation and acceleration. Technology incubation, a variant of more traditional business incubation schemes, assists technology-oriented entrepreneurs in the start-up and early-development stage of their firms by providing workspace, shared facilities, and a range of business support services (OECD, 2010; tinyurl.com/cb89gw3).

There is evidence that ventures associated with business incubators succeed at a greater rate than non-incubated ventures, however there is also evidence to the contrary (Scillitoe and Chakrabarti, 2010: tinyurl.com/c9o3lz4). Current gaps in the literature include: the lack of understanding of the different incubation models (Grimaldi and Grandi, 2005; tinyurl.com/cq3mf49),

Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

the lack of attention focused on the incubatees and the incubation process, and the lack of peer-reviewed incubator-incubation impact studies or evaluation studies (Hackett and Dilts, 2004; tinyurl.com/blz8vgz; Hackett and Dilts, 2008; tinyurl.com/cuvvx2h).

The purpose of this article is to highlight five key areas of consideration to entrepreneurs who wish to use incubation or acceleration as a mechanism to accelerate the development and success of their new technology-based firm. The article is structured as follows. First, the concepts of incubators and accelerators are introduced. Second, insights from two recent surveys on incubators and accelerators are presented. Finally, conclusions and suggestions for future research are offered.

Incubators

The National Business Incubation Association (NBIA; nbia.org) defines a business incubator as "a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services." The OECD (2010; tinyurl.com/cb89gw3) defines technology business incubators, the focus of this article, as variants of more traditional business incubation schemes that assist technology-oriented entrepreneurs in the start-up and early development stages of their firms by providing workspace, shared facilities, and a range of business support services.

According to the NBIA (2009; tinyurl.com/3l89xgy), the first business incubator in the United States opened in Batavia, New York in 1959, but the concept did not become popular with other communities until the late 1970s. Incubators also date back from the 1970s in the United Kingdom. Today, it is estimated that there are 1,400 business incubators in North America, about 200 in Mexico, 120 in Canada, and over 3,500 worldwide (Knopp, 2012; tinyurl.com/buld3wd). See Box 1 for examples of business incubators in North America.

Incubators have a long history as economic development tools. Throughout the world, universities, governments, and corporations are using incubators to accomplish a range of wealth-creation and social goals. In China, the former East Germany, and Ukraine, for example, incubators have been used to facilitate the transition to a market economy. In Israel, incubators have played a key role in helping to integrate immigrants from Russia and the former Soviet Bloc into the mainstream economy (NBIA, 2009; tinyurl.com/3l89xgy). Asia is a diverse region that has over 2,000 business incubators, mostly located in India, China, and East Asia. These incubators tend to be larger than those in the United States and the European Union, and are linked to universities and technology parks. They are grouped under the Asian Association of Business Incubators (AABI; aabi.info/about.asp).

Box 1. Examples of incubators in North America

United States
- Cambridge Innovation Center (cic.us)
- TechColumbus (techcolumbus.org/incubator)

Canada
- MaRS Discovery District (marsdd.com)
- WaveFront (wavefrontac.com)
- Innovate Calgary (innovatecalgary.com)

Ottawa region
- Invest Ottawa (investottawa.ca)
- The Code Factory (thecodefactory.ca)
- Exploriem (exploriem.org)
- Incubators attached to federal government laboratories, such as the Communication Research Centre (crc.gc.ca) and the National Research Council (nrc-cnrc.gc.ca)

Several regions of the world have been trying to replicate the success of Silicon Valley as an incubator of startups, mostly without much success of their own (Aaboen, 2009; tinyurl.com/c5gvvsw). However, in spite of the relatively long history of incubation, there is conflicting evidence as to whether or not incubation works. On the one hand, there is evidence that new firms associated with incubators have a higher survival rate and achieve a greater rate of growth, generally expressed in terms of sales and job creation, than non-incubated firms (Hackett and Dilts, 2004; tinyurl.com/blz8vgz). On the other hand, there is contradictory evidence that suggests little or no effect of incubation on the success of firms (Scillitoe and Chakrabarti, 2010; tinyurl.com/c9o3lz4). However, measuring incubation success is difficult due to different selection criteria, lack of data, lack of access to data, local political influence, and the diversity of incubators. In its recent survey, NBIA notes that one-third of the respondents reported not collecting outcome data from graduates of their programs (Knopp, 2012; tinyurl.com/buld3wd). The lack of comparison with a control-group of non-incubated firms and the fact that selection criteria for incubatees might result in a selection bias constitute important challenges in the

Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

measurement of impacts (Hackett and Dilts, 2004; tinyurl.com/blz8vgz). Further, most research has been descriptive, targeting a practitioner audience and focusing on incubators and their configuration (Hackett and Dilts, 2008; tinyurl.com/cuvvx2h). Given this, how should entrepreneurs discern important factors to take into consideration when deciding on an incubation process?

Accelerators

Over the last few years, a new model of providing assistance to new technology entrepreneurs has emerged, and it is generally referred to as a seed or venture accelerator (see examples in Box 2). Although there is no clear consensus on a definition of accelerators, this incubation model has a more explicit focus on accelerating the growth of firms than an incubator (Bosma and Stam, 2012; tinyurl.com/d7z3nah). An important distinction between incubators and accelerators appears to be their legal status. Incubators are typically not-for-profit organizations, whereas most accelerators are for-profit organizations designed to bring a return on investment to their sponsors by providing fast-test validation of business ideas, typically in fields such as mobile applications and related areas (Knopp, 2012; tinyurl.com/buld3wd). The author's survey included eight Canadian not-for-profit organizations and two for-profit organizations. The NBIA survey reported that 93% of the respondents' accelerators were not-for-profit and 7% were for-profit. This distinction may affect a technology entrepreneurs' choice of assistance, because for-profit organizations are more likely to take equity in client firms. However, in practice, the terms incubator and accelerator are often used interchangeably. Furthermore, these two models have some similarities and operate in overlapping spaces with technology entrepreneurs.

Insights for Entrepreneurs

This section identifies five factors that technology entrepreneurs should take into consideration when evaluating business incubators and accelerators. These insights are drawn from three sources: two new research studies and the prior academic literature on incubators and accelerators. The first research study is the author's survey of ten managers of Canadian technology incubators and accelerators and six of their client firms, conducted in September 2012 via in-depth phone interviews. The second research study is an NBIA survey of 235 respondents to evaluate the state of the business incubation industry in North America (Knopp, 2012; tinyurl.com/buld3wd).

Box 2. Examples of accelerators in North America

United States
- Y Combinator (ycombinator.com)
- TechStars (techstars.com)
- DreamItVentures (dreamitventures.com)
- AngelPad (angelpad.org)
- Launchpad LA (launchpad.la)

Canada
- WaveFront (wavefrontac.com)
- Communitech (communitech.ca)
- InCubes (incubes.ca)
- GrowLab (growlab.ca)
- VentureLab (venturelab.ca)

The five key factors that entrepreneurs should consider when selecting a business incubator or accelerator are as follows:

1. Stage of the new venture
A very-early-stage venture developing an idea will have different needs than a venture that already has a finished product and some initial sales. An incubator is likely more appropriate for very-early-stage ventures. In fact, selection criteria of accelerators, which generally include initial traction in the market, differentiated technology, and potential to scale the business, might exclude such very-early-stage ventures. Table 1 summarizes perceived distinctions between incubators and accelerators from the Canadian survey respondents.

Respondents to the author's survey provided a variety of definitions and distinctions for the terms "incubator" and "accelerator", some of which were diametrically opposed. A few respondents used the analogy of an incubator for chicken eggs – "the role of the incubator is to grow the brand-new, hatched little chicks." Yet, others did not perceive any significant differences between the terms. Some of the managers indicated that their facility was both an incubator and an accelerator. Others mentioned that the word "incubator" had developed a negative connotation given the failure of Internet incubators following the dot-com crash in the early 2000s and that therefore, the word fell out of favour. Given this apparent confusion, entrepreneurs should focus on their needs relative to the specific types of support offered, and not what label a program gives itself.

Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

Table 1. Distinctions between incubators and accelerators from the perspective of the Canadian survey respondents

Incubator	Accelerator
For early-stage startups	For next stage, for high-growth firms
Long-term process	Short-term process
Sectors with longer time to market	Sectors with shorter time to market
An institution	A program within an institution
Building sustainable firms	Short-term horizon, cohort-based
More focused on economic development	More focused on growth and ROI
Generally not-for-profit	Generally for-profit
Older establishments	Newer establishments or programs

2. Fit between the entrepreneur's needs and incubator's mission, purpose, and sector focus

Incubators are most successful, and hence so are their client firms, when their mission and goals correspond with the specific needs of the region's entrepreneurs and the incubators' sponsoring organizations. It is therefore imperative for entrepreneurs to have a good understanding of the mission and goals of any incubator or accelerator under consideration. However, the diversity of Canadian incubators, accelerators, and "hybrid" models makes it challenging for entrepreneurs to muddle their way through potential options. This situation is exacerbated by the various lifecycle stages of such support organizations. Some are in start-up mode, others are in a business-development stage, and yet others are in a maturity stage. Half of the respondents in the NBIA survey were from incubators that had opened in the last 10 years, including almost one-third that represented incubators that began operations since 2007.

Beyond growth stage and age, there are other aspects of incubators that make the evaluation process challenging for entrepreneurs. For example, some older organizations have evolved into a new model, while some mature organizations have merged together to become an incubator or accelerator. Some are very large such as the MaRS Discovery District (marsdd.com) in Toronto, others have only been recently set up. Some offer local or regional services, while others aim to provide virtual services nationally. As well, some have dual missions of supporting the regional development of new ventures and supporting the local universities, for instance Innovate Calgary (innovatecalgary.com) and the Genesis Centre in Newfoundland (genesis.mun.ca/GenesisCentre/), so are in effect a hybrid of an incubator and a technology transfer office. In fact, some of the managers interviewed by the author found it challenging to articulate their mission. For example, one respondent replied "We're not an accelerator. We're an incubator, but we're more than an incubator." Another replied: "We're kind of an accelerator-Plus." To make matter worse, some call their organizations incubators, while they are in fact accelerators, and likewise. The NBIA survey reported that three goals – creating jobs for the local community, fostering the community's entrepreneurial climate, and building or accelerating growth of local industry – received highest ratings. Commercializing technologies was rated fifth in importance. However, the NBIA survey covered all types of incubators, not only technology incubators. The recommendation for entrepreneurs then, is to look at the actual focus of activities for a given incubator or accelerator: is it about nurturing the very early stage of a firm? Or developing it? Or is it about technology incubation? Commercialization? A boot camp? Others?

Although mixed-use incubation – incubators working in a variety of industries – is the most prevalent type of incubation program, there is a growing trend toward incubation in specific industry sectors. Hence, most incubators and accelerators in North America focus on ICT, software, mobile applications, wireless technology, and related areas. A few target the bioscience/life science areas. Other sectors include healthcare technology, medical devices, and "cleantech". Entrepreneurs must ensure that their industry sector is an area of focus of any incubator they are evaluating.

In addition to looking at the mission and goals of incubators and accelerators, entrepreneurs should pay attention to the reputation of the organizations under consideration. Performance measures such as management effectiveness, occupancy rate, number of clients, and external performance measures such as survival rates of firms, jobs created, external investments raised, royalties collected, and valuation of companies could provide indications of overall effectiveness. However, such measures might not be readily available to potential client firms, not to mention that some incubators or accelerators may not have formal graduates yet. The

Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

reputation of the incubator or accelerator is a crucial factor in the decision because it will increase the visibility of the firm, which in turn will help the firm attract capital, resources, and talent.

3. Selection and graduation policies

When selecting firms, incubators and accelerators apply selection criteria, which depend on the focus of the organization as well as whether it considers itself an incubator or an accelerator. Incubators and accelerators typically carry out an initial needs assessment and evaluate each candidate firm's fit with the mission of the organization and the industry sector, and they check that the firm meets any geographical location requirements (if applicable). In addition to these criteria, entrepreneurs must be aware that the "coachability" of the entrepreneurs was the next selection criterion most often mentioned by the Canadian managers of incubators and accelerators that were interviewed by the author. In addition to these criteria, accelerators tend to look at high growth potential, team composition and experience, existing prototypes, intellectual property, and market opportunities.

When a firm moves on from an incubator or accelerator, it is said to have "graduated". However, graduation policies vary across organizations, and therefore entrepreneurs should examine the policies of each organization under consideration. In the organizations surveyed by the author and the NBIA, these policies typically trigger a firm's graduation when the incubator or accelerator no longer adds value to the firm, when a firm exceeds a specific amount of office space or number of employees, or after a fixed period of time. However, there seems to be flexibility in the application of these policies. Overall, graduation policies have shifted from time limits to policies based on client growth and development. Still, entrepreneurs should try to anticipate their needs for employees and space so that they do not find themselves in a situation of having to move out at an inopportune time.

Graduation policies for accelerator programs are different: they tend to have a predetermined time limit. For instance, several accelerator programs in Canada are modeled after US programs such as Y Combinator (ycombinator.com) and TechStars (techstars.com), in which firms have 90 days to conceive, build, and launch a product into the market. Entrepreneurs must be mindful that such programs were perceived by some respondents of the author's survey as being too short for the Canadian context, which includes lower availability of venture capital relative to the United States. Other respondents expressed the view that these programs tended to focus too much on prepping up the technology entrepreneurs for the "big demo day" with investors, but that there was little follow up once the program was over, and consequently no real sustainable businesses. Others, however, see a continuum from an incubator to an accelerator program to develop the new venture toward successful commercialization and long-term sustainability.

4. Nature and extent of services

Incubators provide entrepreneurs with a broad array of services to help them get their ventures off to a successful start. Carayannis and von Zedtwitz (2005; tinyurl.com/caay6aa) have identified five defining services of incubation business models: i) access to physical resources, ii) office support, iii) access to financial resources, iv) entrepreneurial start-up support, and v) access to networks. Because incubators are speeding up business development and reducing uncertainty, Carayannis and von Zedtwitz believe that organizations offering fewer than four of these services lack too many elements of incubation to be considered incubators. Respondents from both surveys considered the following services to be most important: office space, help with business basics, marketing assistance, technology commercialization, links to strategic partners and access to investors.

Entrepreneurs must be mindful that smaller or newer incubators may offer fewer services, and that incubators and accelerators do not generally provide direct technical assistance with product development, but rather, link firms with external partners such as universities and research institutes. Other considerations include the number, expertise, and availability of staff – staffing levels may range from a mere one employee to hundreds of employees, depending on the size and age of incubators. Past research has shown that high-quality management with business expertise and past work experience in the private sector is a strong contributing factor to the success of a technology incubator (OECD, 2010; tinyurl.com/cb89gw3). Yet, the NBIA survey notes that many incubation programs continue to experience very lean staffing and might be trying to do more with less. Therefore, entrepreneurs should pay attention to the ratio of staff to both tenant and offsite firms.

Another important aspect is the sponsoring entities and availability of funding – generally provided by government, economic-development organizations, academic institutions, and, less frequently, private sources. The NBIA reports that these types of organizations have ex-

Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

perienced strained budgets during the recent economic downturn, leading to the scaling back of some existing incubation programs. In Canada, the recent Economic Action Plan (actionplan.gc.ca) includes dedicated funding to support entrepreneurship; however, there is no specific federal program to fund incubators and accelerators. Consequently, incubator managers must dedicate a fair amount of time to the management of multiple sources of funding, and this is time taken away from assisting entrepreneurs and developing networks. Entrepreneurs should seek to gain insight into the functioning of the incubator or accelerator. Where do they get their funding from? When does it expire? Are there any threats to ongoing funding? Are the services over subscribed? What is the amount of time that staff and network can realistically dedicate to firms? Also, if equity is involved, entrepreneurs must understand the potential short- and long-term impacts on their venture.

The NBIA survey reports that many incubation programs have expanded their service offerings to assist entrepreneurs at all stages of business development, that is pre- and post-incubation services. These services allow their programs to reach a broader audience of entrepreneurs, diversify their revenues streams, and raise their visibility in the business community. In fact, 2% of respondents reach an international customer base, a figure that although small is perhaps indicative of the larger trend of increased interest in doing business globally.

Several Canadian managers of incubators and accelerators mentioned offering a mixed approach of physical as well as virtual services to offsite clients. However, client firms interviewed by the author were generally not positive toward the virtual approach, citing in particular the need for face-to-face contacts with advisors, other tenants, and network partners. To quote one: "Long-distance mentorship is not effective." Another mentioned: "If it's 100% virtual then you lose a whole lot of the communication that is absolutely mandatory if the government funds are going to achieve their aim." The NBIA survey notes that, despite increased interest in virtual incubation, the vast majority of incubators (93% of respondents) continue to have an incubation facility in which they house and assist client firms.

5. The network of partners

A critical component of the services offered by incubators and accelerators is an extensive network of advisors, "entrepreneurs in residence", partners, and service providers to complement the business assistance provided to technology entrepreneurs by the incubator staff. For instance, several incubators house representatives from organizations offering services in accounting and financial management, marketing assistance, intellectual property management, and legal services to support entrepreneurs. In-house support or linkages to strategic partners, technology commercialization partners, and to higher-education resources can also be provided. In the ICE (information technology, communications, and entertainment) sector, some incubators and accelerators have established strategic alliances with large firms such as Microsoft so that entrepreneurs can develop and test applications. Furthermore, an important function of incubators and accelerators is to help entrepreneurs access funding. Incubators and accelerators can provide access to angel investors, venture capital investors, and commercial banks. In addition, entrepreneurs can access government assistance programs such as National Research Council's Industrial Research Assistance Program (IRAP; nrc-cnrc.gc.ca/eng/irap/) in Canada and the Small Business Administration (SBA; sba.gov) in the US. Thus, an important aspect for entrepreneurs to consider is the availability of advisors, mentors, or coaches (paid? volunteer? part-time? full-time?) and the nature and quality of the service providers.

Conclusion

Across North America and around the world, business incubators and accelerators are seen as playing a vital role in promoting innovation and economic growth through their efforts to help entrepreneurs turn their business ideas into profitable, sustainable new ventures. In spite of the measurement challenges mentioned above, most research suggests that ventures graduating from incubation programs have higher survival rates than non-incubated ventures.

In conclusion, when deciding whether or not to join a technology incubator or accelerator, a technology entrepreneur should consider five factors:

1. The stage of their new venture. Incubators are generally better suited to a very-early-stage venture whereas an accelerator tends to focus on growing a firm quickly.

2. The fit between the entrepreneur's needs and incubator's mission, purpose, and sector focus. With the proliferation of incubators and accelerators, technology entrepreneurs must pay close attention to their short- and long-term needs to ensure an adequate fit with potential incubators or accelerators.

Factors Affecting a Technology Entrepreneur's Choice of Incubator or Accelerator

Diane A. Isabelle

3. The selection and graduation policies. Entrepreneurs should also consider the flexibility in how these policies are applied.

4. The nature and extent of services provided. Here, technology entrepreneurs need to objectively assess their most urgent needs and the capacity of the incubator or accelerator to meet these needs in a timely fashion, and at a reasonable fee.

5. The network of partners. Entrepreneurs should look for a variety of expertise to support firms (e.g., legal, regulatory, technical, intellectual property, finance).

The concept of incubators, and especially accelerators, is relatively new in Canada and is evolving. There is therefore a need for more analysis of their operations and effectiveness. Further, much attention has been focused on the ICT and related short time-to-market sectors. Therefore, less is known about the effectiveness of incubators and accelerators with longer time-to-market sectors such as biotechnologies and the life science sector. In addition, few services are offered by incubators and accelerators to support the internationalization efforts of entrepreneurs. These and other gaps in our knowledge about incubators and accelerators are opportunities for future research.

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How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

> *"We saw that entrepreneurs could gain the backing of larger global communities to create tomorrow's innovations and participate in the journey from early on."*
>
> Myra Landsburg
> Brand Champion, Grow VC
> (tinyurl.com/ae5s32t)

Crowdsourcing is a way to access a global crowd of talented people and to channel their talent and creative effort towards some useful endeavour. Technology entrepreneurs who may have limited resources, especially during the start-up phase of the business, will be attracted to crowdsourcing as a means to access funding, knowledge, subject matter experts, and resources on a global scale. In this article, we review the published research on crowdsourcing as it relates to motivation, and distil the insights from that research that will be useful to technology entrepreneurs. First, we organize the published research into three streams according to crowd type: i) task-based public crowd, ii) information-exchange public crowd, and iii) employee-based crowd. Next, we identify the motivational drivers common to all streams as well as the motivational drivers that are unique to each stream. Finally, we offer five recommendations for technology entrepreneurs seeking to apply crowdsourcing.

Introduction

When starting up a company, technology entrepreneurs face significant challenges, such as limited funding, lack of resources, and a broad range of difficult technical issues. Access to local funding can be difficult and restrictive. Finding resources on a limited budget can be challenging. Seeking solutions to that last unique technical issue preventing commercialization can be stressful and expensive.

Crowdsourcing is a compelling way to address all of these issues and create connections with talented people and resources from all over the world. These connections present a new opportunity to entrepreneurs to grow their community by selectively adding talent from a target crowd, finding required resources, and developing solutions to technical issues. However, an additional problem for entrepreneurs is to know the right form of motivation to motivate the target crowd, because applying the wrong form of motivation can turn a crowdsourcing initiative into an expensive, time-consuming distraction that yields poor results.

Crowdsourcing remains a relatively new process and the research into motivation with crowdsourcing tends to be limited to specific and particular applications of crowdsourcing that cannot be sufficiently generalized to be useful to most entrepreneurs. One option for entrepreneurs is to learn from others who have successfully applied crowdsourcing in a particular application and see the specific form of motivation that ensured their success. Entrepreneurs can use these specific forms of motivation when their application is similar to that of the literature. Alternatively, entrepreneurs can use the general principles from the literature and look to find other real-world examples more closely related to their application for guidance. Another option is see-

How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

ing what others have done from the perspective of motivating a type of crowd that identifies more generally applicable forms of motivation that ensure success. Entrepreneurs can use these generally applicable forms of motivation when the application is different to that of the literature.

This article makes four contributions. First, it argues that technology entrepreneurs should consider crowdsourcing as a possible tactic to grow their technical community, and get work done quickly, at low cost, and at high quality. Second, it identifies 12 published research articles on motivation in crowdsourcing and summarizes their contents in a form useful to entrepreneurs. Third, it distinguishes between three different types of crowd: i) a task-based public crowd, ii) an information-exchange public crowd, and iii) an employee-based crowd – and it summarizes the differing motivational drivers reported for each type. Fourth, it provides five recommendations to entrepreneurs and managers seeking to effectively motivate crowds.

Crowdsourcing and Motivation

Jeff Howe (2006; tinyurl.com/q28us) initially identified and described crowdsourcing as follows:

> *"Welcome to the age of the crowd. Just as distributed computing projects like UC Berkeley's SETI@home have tapped the unused processing power of millions of individual computers, so distributed labor networks are using the Internet to exploit the spare processing power of millions of human brains... But now the productive potential of millions of plugged-in enthusiasts is attracting the attention of old-line businesses, too...Hobbyists, part-timers, and dabblers suddenly have a market for their efforts, as smart companies in industries as disparate as pharmaceuticals and television discover ways to tap the latent talent of the crowd."*

Crowdsourcing (tinyurl.com/yom4t8) has become a modern day form of outsourcing; it brings an endeavour to a globally distributed group of unrelated people with varying degrees of motivational needs, skills, and talent. Crowdsourced endeavours have included both simple and complex tasks relating to problem solving, design, and product development. Crowdsourcing provides an entrepreneur with access to resources on a global scale through the Internet. These resources may be much more cost effective for the entrepreneur as well as valuable when looking to find and engage the best people to solve problems and add value.

However, asking the crowd for help is only part of the challenge; an entrepreneur must also encourage members of that crowd to step forward. Finding and applying the right type of motivation is essential for success in crowdsourcing. Two primary types of motivation described in the literature are *extrinsic* and *intrinsic* motivation (Leimeister et al., 2009: tinyurl.com/adzjqv6; Hossain, 2012: tinyurl.com/apnqdk6). Extrinsic motivation is external, or outside an individual. Extrinsic motivation provides an incentive that the task itself does not provide to the crowd member, such as money or prizes. Intrinsic motivation is internal to an individual and provides benefit to the crowd member who contributes to the actual crowdsourcing task. An example of intrinsic motivation is enjoyment.

Three examples of motivational approaches in crowdsourcing are provided below.

Lufthansa

Some companies have used crowdsourcing to engage customers to shape the future of a business segment. An example is Lufthansa's Air Cargo Innovation Challenge for Customer Service (tinyurl.com/ago54fh). Lufthansa was looking for creative ideas about the future form and function of customer service as it related to cargo and in particular the touch points between a customer and Lufthansa customer service representatives. Lufthansa also seized the opportunity to find "out of the box ideas" from the crowd. Members registered to join this crowdsourcing community and created a pool of ideas for consideration by a corporate jury. The motivational drivers used by Lufthansa to motivate the crowd were three different prizes that included training in a flight simulator located at the Frankfurt International Airport and different amounts of air miles (i.e., points to be redeemed against future passenger flights). The top three ideas provided customer insight into a certification program to create trust and loyalty, a CargoTRIS idea to educate people about Lufthansa Cargo, and a CargoPedia idea to build a cargo knowledge base with specific knowledge.

Bombardier

Crowdsourcing can also engage customers to participate in the design of a product. An example is Bombardier's innovation contest (tinyurl.com/yf8ytew), which sought ideas relating to the future of train interiors. Bombardier was looking for innovative features to be incorporated into the interior based upon insight from leisure passengers, business travelers, and everyday passengers. Participants registered to join this crowd-

How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

sourcing community and a corporate jury considered the submissions. The motivational drivers selected by Bombardier for the top 10 submissions in two categories were different levels of cash prizes from 2,000 Euros to 200 Euros as well as Netbook computers. The two categories related to the coach interior and a new seat design. The winning designs provided focus to Bombardier, insight into the passenger needs, and a high level of innovation for the next train product.

Zooniverse

Crowdsourcing can also engage members from the public to participate in scientific research in situations where funding and staff are limited. Zooniverse (zooniverse.org) is an online science and research site that applies crowdsourcing to citizen-based science projects in a number of different categories. One project relates to studying photos from Mars to determine weather patterns. The group of researchers on this project was too small to effectively review the multitude of images in the photo library while remaining within the time constraints and scope of the project. Volunteers are assisting the researchers with visual identification of particular features on the images such as "fans" and "blotches" on the Martian surface, which are indicative of wind direction and speed. The primary motivational driver for the volunteers is being allowed access to amazing satellite images from Mars. As of January 2013, over 60,000 volunteers had reviewed and reported on more than 3 million photos.

Literature Review

Our review of the crowdsourcing literature began with a search in the Business Source Complete (BSC; tinyurl.com/22teqry) database on the keyword "crowdsourcing". When restricted to full-text scholarly journals, the database query identified 103 individual articles, with the earliest publication in 2006, the same year as Howe's original crowdsourcing article. A review of the abstracts, keywords, and introduction of the 103 articles identified a subset of 11 articles about motivation. We examined the references of these articles and added one additional article to this set for a total of 12 articles. Articles unrelated to motivation were set aside.

We speculate that the literature on crowdsourcing motivation is limited, in part, because the topic is relatively new. Motivation has long been of a topic of central interest to researchers in psychology, economics, and organizational behaviour (e.g., Hertzberg, 1968; tinyurl.com/a3ojrnh), but only recently have researchers turned their attention to crowds.

The 12 articles were published in 11 different journals and conference proceedings. The journals vary widely in disciplinary focus, including marketing, information systems, and innovation. The articles focus on specific applications of crowdsourcing such as designing T-shirts, exchanging technical information in a community, and creating ideas. Table 1, Table 2, and Table 3 present summaries of the field settings, research designs, and unique contributions of the 12 articles.

Motivation based upon the specific application of crowdsourcing varied significantly, suggesting that motivation is unique to the application. However, we were able to identify three crowd types based on similarities in motivational approaches and contexts: i) task-based public crowds, ii) employee-based crowds, and iii) information-exchange public crowds These groups differed from each other with respect to the participants and function of the crowds examined. Organizing the literature in this way revealed insight into groupings of motivational categories and drivers common to each type of crowd. It also revealed insight into a contrasting view of each individual finding in the literature and uncommon motivational categories and drivers. Each of the three crowd types is defined and described in the following subsections.

1. Task-based public crowds

Public task-based crowds perform a specific task or a set of tasks. There are few or no relationships between the crowd participants, who each contribute using their individual abilities. We identified seven articles in this literature stream (Table 1).

The field settings examined in this research include six intermediary companies offering a crowdsourcing service to customers or corporations and two companies that use internal crowdsourcing capabilities as part of their business model. The types of design tasks in this stream relate to electronics, product design, digital media products, T-shirts, graphics, advertisement, and websites.

Motivational drivers examined in these articles include: immediate financial payment (of varying amounts), skills improvement, enjoyment and fun (of varying type), and community-related motivations. Technology entrepreneurs involved in similar tasks could consider motivating their own crowds in similar ways. However, it is important to note that financial payment might not be the best way to motivate a crowd (Antikainen et al., 2010: tinyurl.com/aj4zn3e; Bogers and West, 2012: tinyurl.com/aevdk4v) because other forms of motivation can be more important.

How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

Table 1. Published studies of task-based public crowds

Author (Year)	Journal or Conference	Field Setting(s)	Research Design	Contribution
Antikaninen et al. (2010) tinyurl.com/aj4zn3e	*European Journal of Innovation Management*	Three crowdsourcing intermediary companies: Crowdspirit, FelloForce, Owela	Multiple case study, email questionnaires, archival documents	Identified motivational drivers of open innovation communities and tasks related to product design and development. Motivational drivers included interesting objectives, open and constructive atmosphere, influencing better products/services, synergy, sense of cooperation, fun, community (identification, love), and sense of efficiency.
Brabham (2010) tinyurl.com/b9ggauv	*Information, Communication & Society*	A crowdsourced-based company: Threadless	Instant messaging interviews with members in a community	Identified motivational drivers relating to a T-Shirt design company. Motivational drivers included addiction, pastime, fun, cash payment, freelance opportunities, improving skills, and knowledge gathering.
Bogers & West (2012) tinyurl.com/ba3gg3x	*Creativity and Innovation Management*	n/a	Literature review of open- and user-innovation research	Distinguished between motivation for cash and no cash
Muhdi & Boutellier (2011) tinyurl.com/ay2u646*	*International Journal of Innovation Management*	A Swiss crowdsourcing intermediary company: Atizo	Electronic survey of members in a community	Identified the motivation drivers of an open innovation community. Motivational drivers included social contract, sense of efficiency, rewards, and learning. Organized motivational drivers into six categories: social aspect, competition, learning, sense of efficiency, rewards, and platform.
Busarovs (2011) tinyurl.com/abb3rk9	*Journal of Business Management*	n/a	Conceptual; literature review of prior research on motivation	Examined the relationship between type of task (routine, complex, or creative), amount of cash payment (no cash, pennies, dollars, millions of dollars), and expected outcomes
Zheng et al. (2011) tinyurl.com/bczelno	*International Journal of Electronic Commerce*	A Chinese crowdsourcing intermediary company (not identified)	Quantitative study of participant characteristics, motivation, and participation; results of hypothesis tests	Identified motivational drivers for a contest to include skill variety, task autonomy, analyzability, and recognition
Kaufmann et al. (2011) tinyurl.com/bk6eeec	Seventeenth Americas Conference on Information Systems	A crowdsourcing intermediary company: Mechanical Turk.	Online survey posted as a task to crowdsourcing website; respondents paid 30 cents for participation	Identified motivational categories and drivers of crowdsourced workers. Three extrinsic categories: immediate payoffs, delayed payoffs, and social motivation. Two intrinsic categories: enjoyment-based and community-based. Drivers included skill variety, task identity, task autonomy, direct feedback from the job, pastime, communication identification, social contract, payment, signaling, human capital advancement, action significance by external values, action significance by external obligations, and indirect feedback from the job.

* Muhdi and Boutellier (2001; http://dx.doi.org/10.1142/S1363919611003477) appear in both Table 1 and Table 2 because they cover field settings of two different crowd types.

How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

Table 2. Published studies of employee-based crowds

Author (Year)	Journal or Conference	Field Setting(s)	Research Design	Contribution
Hossain (2012) tinyurl.com/apnqdk6	International Conference on Innovation Management and Technology Research	n/a	Conceptual; literature review of prior research on crowdsourcing platforms	Assembled motivational drivers into groups based upon the literature to include three categories: financial, social, and organization. Motivational drivers included benefits, job opportunities, personal needs, career options, marketing oneself, professional prestige, responsibilities, recruiting, collaboration, ego, experience, frustration, knowledge gathering, networking, recognition, power, privilege attainment, publicity, reputation, skill development, social, status, charity, competence, desire to solve, enjoyment, fun, pleasure, self satisfaction, altruism, autonomy, belongingness, community drives, identification, self determination ,ideas, learning, pride, and self fulfillment.
Stewart et al. (2009) tinyurl.com/b67msrm	ACM SIGKDD Workshop on Human Computation (HDD-HCOMP'09)	A language translation task within a multinational ICT and service company: IBM	Quantitative survey; hypothesis tests	Identified motivational drivers for an employee based type of task to include social contract, positive impact on the community and the world, reward, learning, fun, and brand image
Muhdi & Boutellier (2011)* tinyurl.com/ay2u646	*International Journal of Innovation Management*	A Swiss bank: PostFinance	Electronic survey of participants	Identified motivational factors of employees in a bank. This included six categories such as social aspect, competition, learning, sense of efficiency, rewards, and platform. Motivational drivers included social contract, sense of efficiency, rewards and learning.

* Muhdi and Boutellier (2001; http://dx.doi.org/10.1142/S1363919611003477) appear in both Table 1 and Table 2 because they cover field settings of two different crowd types.

Table 3. Published studies of information-exchange crowds

Author (Year)	Journal or conference	Field setting(s)	Research design	Contribution
Toubia (2006) tinyurl.com/an5fpfu	*Marketing Science*	Controlled simulation of an ideas game	Experimental design; manipulation of motivation drivers and measurement of outcomes	Illustrated that participates could be motivated differently to create new ideas or to build upon existing ideas. The motivational drivers included prizes and payments.
Leimeister et al. (2009) tinyurl.com/adzjqv6	*Journal of Management Information Systems*	Competition hosted by a multinational enterprise software company: SAP's SAPiens Ideas Competition	Field study	Identified motivational drivers of an Internet-based ideas competition, including prizes, career options, marketing oneself, recognition (peer, organizer) and knowledge (experts, mentors, peers)
Wasko & Faraj (2000) tinyurl.com/a4sqcbw	*Journal of Strategic Information Systems*	Three online Usenet communities: C++, object oriented design, and databases	Examined messaging activity over time (archival online records); email survey of participants	Identified motivational drivers for knowledge exchange and sharing to include fun, altruism, community identification, sense of efficiency, job opportunities, rewards, and learning

How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

2. Employee-based crowds
Participants in a corporate, employee-based crowd are employed by the host company. We identified three articles in this stream (Table 2). Two articles examined large-company field settings: one was based in Switzerland (Muhdi and Boutellier, 2011; tinyurl.com/ay2u646) and the other examined a multinational corporation (Stewart et al., 2009; tinyurl.com/b67msrm). The third article (Hossain, 2012; tinyurl.com/apnqdk6) is a literature review on motivation and incentives. The crowdsourcing tasks examined in this literature stream included internal idea generation and language translations.

Motivational drivers in these articles include immediate payment of rewards, such as peer recognition, career advancement, and professional development.

3. Information-exchange public crowds
This type of crowd includes participants seeking technical information as well as participants providing technical information, and these roles are interchangeable. Some tasks may also require creativity in addition to technical information.

We identified three articles in this stream (Table 3). Two articles examined field settings; one was an ideas-based community organized around a company-sponsored contest, and the other was a knowledge-based community anchored around online Usenet groups about computer programming and databases. The third article was a controlled experiment by marketing researchers who could manipulate the points system used to reward participants for contributions and thus shape crowd behaviour. In this last article, one point system resulted in more new ideas, while a second point system resulted in more ideas that built upon existing ideas.

Motivational drivers examined in these articles include access to technical experts to solve problems, learning, fun, and being part of a community.

Recommendations for Entrepreneurs

From a close reading of the published research on crowdsourcing motivation, and from looking closely at the similarities and differences in the field settings and results of various studies, we offer five recommendations for technology entrepreneurs seeking to gain global access to resources from crowdsourcing.

1. Learn from what others have done by identifying and using known motivational drivers to achieve early success
Tables 1, 2, and 3 provide a starting point for identifying motivational drivers. If a project is similar to one of the field settings previously examined in the literature, then the entrepreneur should first consider the motivational drivers used to motivate crowd. For example, if a crowdsourced project relates to open innovation, then the articles by Antikainen and colleagues (2010; tinyurl.com/aj4zn3e) and Muhdi and Boutellier (2011; tinyurl.com/ay2u646) may provide some guidance. If the project relates to crowdsourcing workers, then the article by Kaufmann and colleagues (2011; tinyurl.com/bk6eeec) might be insightful.

If a crowdsourcing project differs greatly from the field settings in in the literature, then the entrepreneur should consider the type of crowd they want to build. For example, prior research on task-based public crowds has examined immediate financial payment, skills improvement, enjoyment and fun, and community-related motivations (Kaufmann et al., 2011: tinyurl.com/bk6eeec; Brabham, 2010: tinyurl.com/b9ggauv; Busarovs, 2011: tinyurl.com/abb3rk9; Antikainen et al., 2010: tinyurl.com/aj4zn3e; Muhdi and Boutellier, 2011: tinyurl.com/ay2u646). Prior research on technical information based crowds has examined access to people for learning, and enjoyment and fun (Wasko and Faraj, 2000: tinyurl.com/a4sqcbw; Leimeister et al., 2009: tinyurl.com/adzjqv6). Prior research on employee-based crowds has examined rewards of immediate payment and access to people technical experts for learning (Muhdi and Boutellier, 2011: tinyurl.com/ay2u646; Stewart et al., 2009; tinyurl.com/b67msrm).

Crowdsourcing is a new research area with relatively few published studies, thus the past experience of others should be suggestive rather than definitive. Also, many implementation details must still be decided. After identifying motivational drivers, entrepreneurs and managers need to identify the motivational details such as the range or amount of payment, the type of rewards, and the calibre of people or makeup of the community.

2. Create a selection and range of motivational drivers, and learn by varying those drivers
Research suggests there is no single combination of motivational drivers generally applicable to all crowds. Managers offering a selection and range of motivational drivers and varying the implementation details over time can learn more quickly about what works for their particular situation. In the examples presented earlier, Bombardier varied the dollar amount of cash incentives, whereas Lufthansa varied the amount of the air miles awarded.

How Can Entrepreneurs Motivate Crowdsourcing Participants?

Derek Smith, Mohammad Mehdi Gharaei Manesh, and Asrar Alshaikh

The literature also suggests that motivational drivers may be changed during an active crowdsourcing project to achieve different results (Toubia, 2006; tinyurl.com/an5fpfu) – a technique we call *adaptive motivation*. For example, the Zooniverse project studying photos from Mars employed different motivational drivers to either focus the crowd on specific photographs or to have the crowd revisit a previously studied photograph.

3. Select implementation details that are matched to the particular context and identify relevant motivation drivers
The research suggests the most effective motivational driver is only revealed by breaking down or expanding each aspect of motivation. For example, a form of extrinsic motivation is immediate payoffs, which can take different forms, including cash payments, career options, prizes, and points. Each form of immediate payoff can be set at different levels: different amount of cash, size and selection of prizes, and number of points. In the example of Lufthansa, the extrinsic immediate payoff was prizes with the specific aspects of a training session in a flight simulator and differing amounts of air miles. In the case of Bombardier, the extrinsic immediate payoffs were varying levels of financial reward.

4. Consider the geographical and cultural diversity of the target crowd
Crowdsourcing can attract participation from individuals located in different countries with different cultures. By understanding the mix of your potential crowd, entrepreneurs and managers may identify and select motivational drivers to target attracting members to the crowd to form an initial community or adding different members to the community during the course of the crowdsourcing. For example, motivational drivers that work globally may not work locally and may be country specific. For example, Busarovs (2011; tinyurl.com/abb3rk9) indicates that financial payment on the order of pennies will be sufficient to motivate participants in some communities, whereas other communities will require payment on the order of dollars.

5. Employ multiple motivational drivers to obtain the full benefit of crowd diversity
The crowdsourcing motivational literature tells us that different individuals are motivated differently by different incentives. To motivate a diverse crowd, it follows that technology entrepreneurs should employ multiple motivation drivers that appeal to different potential participants in the type of crowd. Beyond this suggestion, however, prior research offers little prescriptive advice on specifically *how* to develop an effective mix of crowdsourcing motivation drivers. This is a promising and important area for future work.

Conclusion

This article reviewed the published research on crowdsourcing and motivation, presented the content and contribution of that research in a series of tables organized by crowd type, and proposed five actions for technology entrepreneurs seeking to benefit from crowdsourcing. Based on our close reading of the research, we recommend that technology entrepreneurs learn from what others have done by beginning from known motivational drivers, learn quickly through experimentation by varying the implementation details, select implementation details that are matched to their particular context, consider the geographical and cultural diversity of the target crowd, and employ multiple motivation drivers to obtain the full benefit of crowd diversity.

Entrepreneurs need to select and apply the right form of motivation to motivate target crowds in crowdsourcing. If their particular application of crowdsourcing is similar to one of the specific applications described in the tables in this article, then entrepreneurs may select the corresponding form of motivation to successfully motivate their target crowd, seeking further detail from the literature as required. If their particular application of crowdsourcing is different to the applications described in the tables, then entrepreneurs should select the table that best matches the type of crowd they wish to motivate and apply the general approaches used by those applications. In both cases, entrepreneurs should also seek out additional real-world examples of applications similar to their own, while applying the principles and recommendations described here to their interpretation of those examples.

Successful motivation of the target crowd will increase the likelihood of success with crowdsourcing and will provide entrepreneurs with a way to solve significant challenges such as quests for funds, resources, and solutions to unique technical issues for the commercialization of their products.

How Can Entrepreneurs Motivate Crowdsourcing Participants?

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An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

> *"Startups aren't everything when it comes to job growth. They are the only thing."*
>
> Tim Kane
> Economist, entrepreneur, and author

Job creation is at the centre of the rationale provided by governments and publicly funded organizations for investing in services purported to support entrepreneurs to launch and grow technology startups. However, little is known about how to design and build the engines that convert these publicly funded services into jobs in a region. In this article, we argue that the architecture of a job-creation engine fuelled by technology entrepreneurs is important and that it should be made visible to the stakeholders of a regional venture system. The manner in which the components of a job-creation engine are organized and integrated determines the effectiveness and efficiency of the conversion of public funds into jobs. Making visible the architecture of a job-creation engine enables individuals and organizations to: i) better understand the link between the investment made to service technology entrepreneurs and systematic job creation; ii) utilize the regional venture system more effectively; and iii) set the performance benchmark for capability improvement and rapid adjustment to environmental changes. The experience gained from operating Lead To Win since 2009 is used to describe the architecture of a job-creation engine fuelled by technology entrepreneurs that operate in Canada's Capital Region. Lead To Win is an ecosystem designed to help a technology venture generate sufficient revenue to create six or more knowledge jobs in the region within three years of inception.

Introduction

We know that public funds are spent to deliver services to technology entrepreneurs. We also know that technology startups create jobs, many of which are high-paying jobs. What we do not know is what the different types of engines that convert publicly funded services into jobs looks like. If we do not know what a job-creation engine fuelled by technology entrepreneurs looks like, how can we improve its effectiveness and efficiency? Or, know its limits? Or, add new components? Or, adjust it to cope with environmental turbulence?

The objectives of this article are twofold: i) to highlight the importance of the architecture of an engine that converts public services delivered to technology entrepreneurs into jobs and ii) to describe the architecture of Lead To Win, a job-creation engine designed and operated using the ecosystem approach.

We argue that the visibility of the architecture of a job-creation engine is important and that job-creation engines with good architectures are critical in regions where jobs have been lost. The architecture of a job-creation engine should be made visible to the stakeholders of the venture system, including taxpayers, technology entrepreneurs, investors, service providers, and government personnel. To match or exceed the jobs lost in a region, a robust job-creation engine is needed.

The article makes two contributions. First, it provides details on how to design and operate a job-creation engine using an ecosystem approach. To accomplish this, we share the experience gained from operating the Lead To Win job-creation engine in Canada's Capital Region since 2009. Although Lead To Win is used as an example of a job-creation engine, there is no intention to position it as the best model for regional job-creation engines. We share Lead To Win's architectural design

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

rules, components, processes, and governance so others can contribute to making them better and to encourage others to share their own architectures for job-creation engines. Second, the article acts as a white paper that can be used to improve the ecosystem that exists today for the purpose of launching and growing "born globals" – ventures that address global market opportunities from inception (Tanev, 2012; timreview.ca/article/532).

In this article, we identify publicly-funded services delivered to technology entrepreneurs, define what is meant by the architecture of a job-creation engine, describe the architecture of Lead To Win, and identify the challenges of changing components of a job-creation engine. The last section provides conclusions.

Publicly Funded Services for Technology Entrepreneurs

To create new knowledge jobs, public funds in many regions are being used to:

- provide entrepreneurs with subsidized space in prominent, multi-million-dollar buildings that house providers of public services, consultants, and commercial enterprises
- hire dozens of individuals to provide advice to entrepreneurs
- pay bureaucrats to select and fund technology startups deemed to be the "winners" of the future
- replicate what other regions have done to generate jobs
- operate incubators, accelerators, entrepreneurship centres, and hubs
- support venture capital funds that invest in technology firms
- invest in R&D projects and prototype development
- provide large tax incentives to multinational firms that can act as anchors for the region's technology
- organize competitions and networking events that promote entrepreneurship
- attract rich immigrants with entrepreneurial experience
- link economic development organizations across regions
- deliver courses and workshops in entrepreneurship
- pay for travel and accommodations abroad

This list is not exhaustive. But, despite all these efforts, it is not clear how investments to help technology entrepreneurs are being converted into jobs. Although public funds are being used to pay for the delivery of a wide array of services to technology entrepreneurs, it is not clear what configurations of components are used to convert these services into jobs.

There have been few attempts at formally analyzing the efficacy of investor-centric technology startup accelerators that have emerged since 2005 (Miller and Bound, 2011; tinyurl.com/aoh3h6e). Private funds are used to operate these startup accelerators and they do not focus on job creation as an important outcome (Startup Genome, 2012; tinyurl.com/b3e477d).

Architecture of the Lead To Win Job-Creation Engine

Lead To Win (leadtowin.ca) is an ecosystem that delivers services to technology entrepreneurs for the purpose of creating knowledge jobs in Canada's Capital Region. With a population of 1.4 million, Canada's Capital Region is an official federal designation for the Canadian capital of Ottawa, Ontario, the neighbouring city of Gatineau, Quebec, and surrounding urban and rural communities. Employment in the high-technology sector has decreased significantly due to the bankruptcy of Nortel (tinyurl.com/24gm7a). Bailetti and Hudson (2009; timreview.ca/article/308) provide background information on Lead To Win and the region where it operates.

Today, Lead To Win is a job-creation engine fuelled by technology entrepreneurs. The engine is used to convert services to technology entrepreneurs into jobs in Canada's Capital Region.

The Lead To Win job-creation engine can be conceptualized as a collective of organizations and individuals that collaborate to support the launch and growth of technology ventures. Each venture is expected to create a minimum of six knowledge jobs in Canada's Capital Region within three years after its inception. The collective seeks to deliver outcomes that are not achievable by the organizations and individuals working on their own. The number and diversity of knowledge jobs and investment attracted to the region are this engine's key outcome indicators.

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

A distinguishing feature of Lead To Win, relative to other ecosystems, is that it incorporates best practices grounded in sound academic principles and utilizes action-oriented metrics for decision making and tracking progress.

Architectural design rules
The architecture of Lead To Win is based on the following 10 design rules:

1. Each technology venture must commit to creating a minimum of six knowledge jobs within three years of inception.

2. An ecosystem approach is used to help entrepreneurs launch and grow successful technology ventures.

3. Stakeholders are anchored around a process-centric platform based on governance rules that guide the engagement between entrepreneurs and implementers as well as the stakeholders that support them.

4. Shared resources (e.g., a sales force, boards that track and guide ventures' progress, access to investors, workshops, opportunity review boards, back office support) and assets (e.g., educational resources, journal articles, software platforms) are developed on an ongoing basis.

5. Stakeholder engagement points are aligned with the ventures' needs for growth and the health of the ecosystem.

6. Compelling value propositions are developed for each stakeholder group that is able and willing to satisfy the needs of technology entrepreneurs and their ventures.

7. The cost structure to venture stakeholders must lead to ecosystem sustainability.

8. Indicators, endpoints, and parameters relevant to regional economic prosperity are used to assess how well the ecosystem is functioning.

9. Program services are provided only to technology entrepreneurs whose opportunities have been rated "green" by a Lead To Win Opportunity Review Board using a seven-dimension rating system.

10. Transparent ecosystem governance is provided through the Lead To Win Council.

Components
Technology entrepreneurs whose opportunities have been rated "green" by the Lead To Win Opportunity Review Board receive benefits (e.g., services) from program elements that are organized into five components. These components differ in terms of the value they add to creating jobs and the specialized knowledge required for delivering these services. Figure 1 identifies the five components used to organize the services delivered by Lead To Win to technology entrepreneurs.

Component 1 consists of renting space operated by incubators or accelerators located in various neighbourhoods. Space is then provided free of charge to technology entrepreneurs. Lead To Win does not own its own building.

Component 2 includes the following services to technology entrepreneurs: opportunity assessments, a six-day bootcamp, the Technology Innovation Management Lecture Series, workshops for entrepreneurs, and events delivered jointly with ecosystem member organizations.

Component 3 comprises services provided by five "desks", which are differentiated by their functional elements. A network of university-student interns and service providers delivers the services offered by each desk. An individual "desk prime" leads the operations of the desk and coordinates its activities with the leads of the other desks and the Lead To Win Council. There are five Lead To Win desks:

1. **Invest Desk:** educates, trains, and coaches startup founders regarding external investment and facilitates fundraising for companies with global opportunities that have matured sufficiently to be ready for external investment. It also assists founders to define and refine the list of target investors.

2. **Develop Business Desk**: educates, trains, monitors, coaches, and advises startup founders on how to grow their businesses using state-of-the-art business development, sales, and investment principles. It also assists startup founders in defining and refining a list of target business relationships and in the development of business pitches for partnership activities.

3. **Sales Desk:** educates, trains, monitors, and coaches startup founders on how to improve the success of their customer sales engagements and assists founders to: define and refine the list of prospect cus-

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

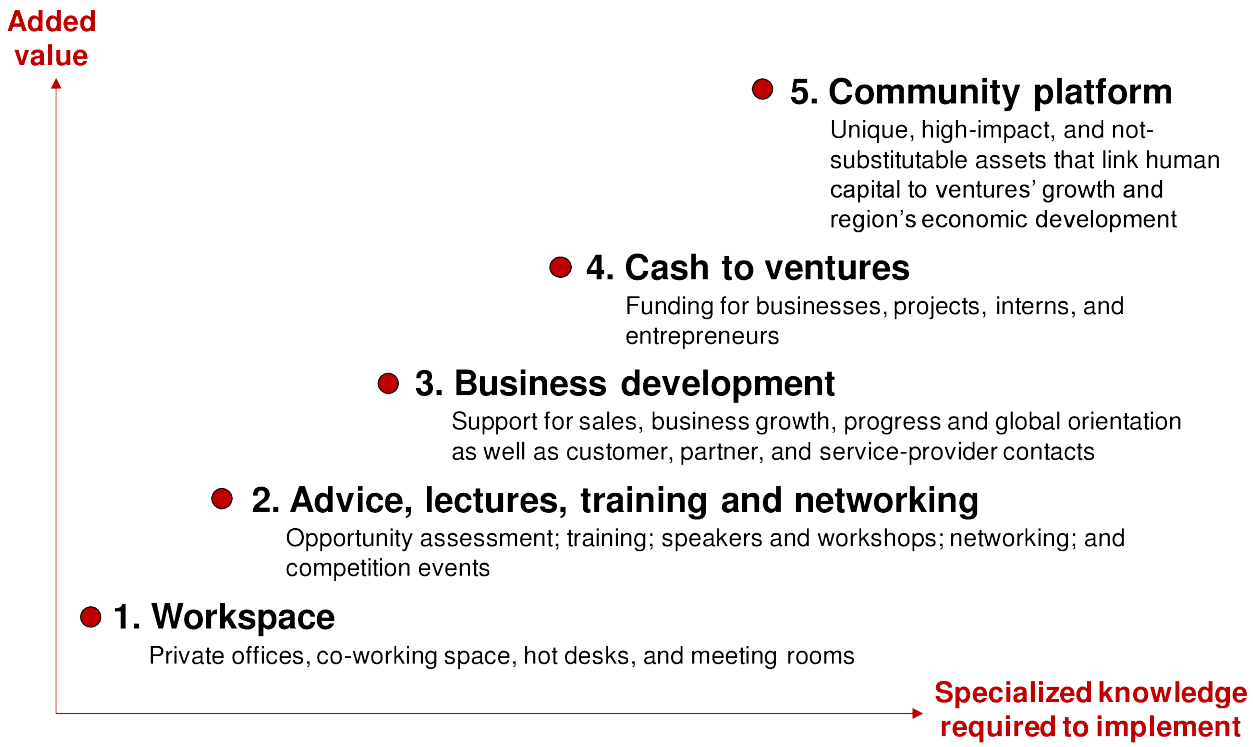

Figure 1. Five components of Lead To Win services delivered to technology entrepreneurs

tomer accounts, develop call scripts, make cold calls, actively engages in sales campaigns, form new customer relationships, and strengthen existing customer relationships. It also supports startup founders to close sales.

4. **Progress Desk:** manages board reviews that ensure companies meet growth milestones. It also maintains accurate data and reports on ventures' milestones, enforces criteria for maintaining "green" status, manages the process for removing nonperformers, and assists founders to meet milestones at each stage of the growth process.

5. **Global Desk:** educates, trains, and coaches founders and stakeholders on how to launch and grow ventures that are global upon inception, assists startup founders and stakeholders to develop and grow born globals (that is, ventures that are global from inception), works with all desks to define and develop tools to support founders of born globals and identify milestones relevant to born globals, and leads the transition from the current state to a state where all companies are born globals.

Component 4 comprises programs that deliver cash to entrepreneurs and their technology ventures. Currently these programs pay for: student interns working for a startup, living expenses of student entrepreneurs, and projects to launch born-global ventures.

Component 5 includes services derived from assets that are unique, high-impact, and not substitutable. These assets link human capital to ventures' growth and the region's economic development. Currently these assets include: Founders and Ventures, Mentors, Faculty and Reviewers Network, the TIM Review (timreview.ca), master-level theses and projects (carleton.ca/tim), the BigBlueButton web conferencing system (bigbluebutton.org), tools and processes, and the Research Centre for Technology Innovation.

Process platform

The Lead To Win ecosystem is anchored around a process platform that guides the engagement among ecosystem members throughout the venture-creation lifecycle. Members of the governance council ensure that the ecosystem as a whole operates effectively and that each venture delivers a minimum of six jobs three years after inception.

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

Figure 2 provides a view of a venture's stakeholders anchored around a process for venture creation that helps founders of technology startups move from the idea stage through the opportunity stage to the stage where their ventures can generate sustainable revenue to support six or more jobs. Venture stakeholders are organized into three groups: i) entrepreneurs and implementers (denoted as leaders), ii) stakeholders that support the entrepreneurs (denoted as feeders), and iii) members of the governance council. The "leaders and feeders" notation follows Feld (2012; tinyurl.com/a2s2vf3).

Entrepreneurs lead the creation of ventures. Therefore, they become leaders of the startup community. Implementers bring about and build the ventures' offers. Implementers include startup's founders, employees, board of directors, advisors, and consultants. Implementers have a financial stake in the venture such as payment for services rendered or equity stakes in the venture. Everyone else provides for the community.

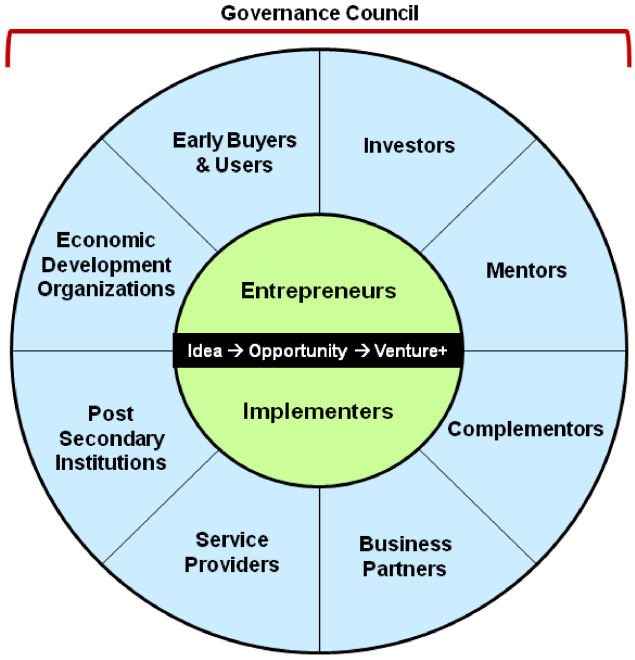

Figure 2. Venture stakeholders anchored around a process platform

The feeder stakeholders are defined as:

1. **Mentors:** provide domain knowledge or management expertise to entrepreneurs, based on experience. Mentors are volunteers; they have no financial stakes in the ventures they assist.

2. **Post-secondary institutions:** universities and colleges provide entrepreneurial knowledge and assets, reviewers for opportunity assessments, entrepreneurs, implementers, lab access, and research ready to exploit for commercial interest.

3. **Service providers:** professionals that provide services to the venture. Service providers include accountants, lawyers, and human resources providers.

4. **Business partners:** at the business-operations level, business partners are commercial entities that have some form of alliance with the newly forming venture. These stakeholders can include channel-to-market partners, supply-chain partners, and manufacturing partners.

5. **Complementors:** businesses that directly sell products or services that complement the product or service of the new venture by adding value to mutual customers, thereby increasing the value to each complementor above the value achieved if operating as a standalone entity. For example, Microsoft (with its operating system) and McAfee (with its anti-virus software) are complementors.

6. **Economic development organizations:** public and not-for-profit groups that provide assistance to businesses, communities, and the organizations that support them.

7. **Early buyers and users:** in the diffusion-of-innovations timeline (tinyurl.com/27v6a3), this is the minority group of the addressable market that will try and buy the product or service.

8. **Investors:** provide dilutive capital funds to grow the venture. Vehicles include angel investors or groups, venture capital firms, and strategic investors (i.e., large, established firms).

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

Venture-Creation Process

The venture-creation process anchors the business ecosystem. This section describes this process from two perspectives: i) the startup lifecycle and ii) ecosystem engagement points.

Startup lifecycle

Technology startups go through stages of development and maturation. Various models to conceptualize these stages exist. Some of the most popular ones include: i) the funding stages model (tinyurl.com/3x3vg3), ii) Steve Blank's customer development model (tinyurl.com/b2eho2l), and the iii) the Marmer model for Internet startups (tinyurl.com/b3xpbnz).

Figure 3 illustrates the Lead To Win lifecycle stage model of a technology startup. Phase I focuses on evaluating the idea. Proponents pitch their ideas for an opportunity to a review board, where they are evaluated on criteria relating to customer value, competitive, and partner value. Once the criteria are met, the opportunity moves to Phase II, which provides training, feedback, and two tiers of opportunity reviews. An opportunity moves to Phase III once it meets the criteria for customer value, competitiveness, partner value, jobs generation, financial soundness, foundation for leveraging resources, and team. At Phase III, the entrepreneur has access to the full Lead To Win ecosystem. Phase III focuses on building out the minimum viable product (tinyurl.com/yhstpma) and the minimum value organization to accelerate sales to first customers. Phase IV focuses on scaling up the venture.

Figure 3. Lead To Win lifecycle stage model

The startup lifecycle process is flexible to accommodate various types of startups, such as hardware and software products, enterprise products and services, Internet services, and consumer products and services.

Within this lifecycle stage model, various best practices for execution (e.g., business-model design, customer development, lean startup, agile development) are refined, supported, and tailored to the type of startup. As new practices and functions evolve, they are readily incorporated into the model.

Every business is different. However, in order to gain market credibility and succeed each business must get four things right: offer, customer, cash, and organization (Frei, 2008; tinyurl.com/32an5yl). Figure 4 shows the progression from inception where these four key elements are built up throughout the Lead To Win lifecycle stage model.

Offer	Business hypotheses, Product idea, Alpha prototype		Minimum viable product	Product
Customer	Problem to solve		User, 1st paying customers	Paying Customers, $1M per year
Cash	Family, Friends	Economic development	Angels	Investor
Organization	Founder	Founders	Minimum viable organization	Scale to 6+ jobs

Figure 4. Building the four key elements of a startup through the Lead To Win lifecycle stage model

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

Ecosystem engagement points

As the startup progresses through its lifecycle, it engages with the Lead To Win ecosystem at various points appropriate to its stage of development, as shown in Figure 5.

The economic development organizations and the post-secondary institutions are available to the startup throughout each phase, though the nature of contribution is tailored to each stage. For example, the post-secondary institutions organize and conduct the opportunity reviews for Phases I and II, while drawing in members of the community to assist as reviewers. At Phase II, they lead the bootcamp training, which engages both academic and industry practitioners. Together with the economic development organizations, they secure early funding for the startups through government grants and endowments for Phases III and IV. Regardless of phase, the post-secondary institutions develop assets such as journals and lecture series for practicing technology entrepreneurs, graduate degree programs, research on timely issues, technology-transfer support, tools and processes, and back-office support for the Lead To Win ecosystem.

There are two key inflection points for a startup in the Lead To Win ecosystem. The first is qualifying for the Lead To Win Phase II, which enables the startup to participate in the Lead To Win bootcamp training and opportunity development review and feedback, where pitches are formally presented to a review board at two points in the bootcamp. The second is qualifying to enter Phase III, which gives access to the full complement of the ecosystems resources. Once in Phase III, the engagement is continuous and always active, per the needs of the startup.

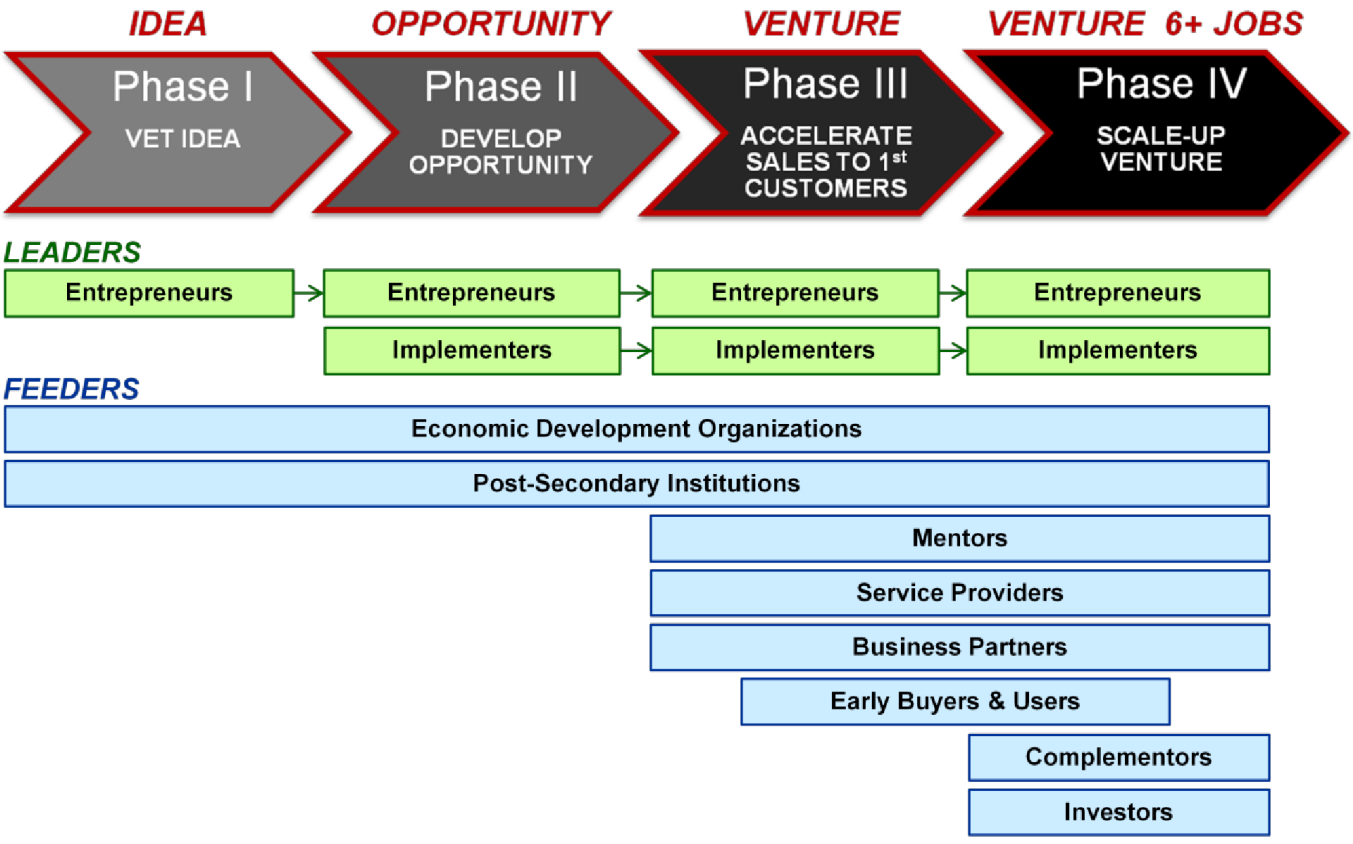

Figure 5. Engagement points with stakeholders in the Lead To Win ecosystem

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

Governance
Transparent governance of the startup ecosystem is essential in ensuring the ecosystem is operating effectively. Recently, the governance of the ecosystem has been transferred from the Technology Innovation Management Council to a 15-member Lead To Win Council. Both authors of this article are members of the Lead To Win Council.

The members of the Lead To Win Council are expected to be strategically focussed and act as a coordination and continuous improvement mechanisms. Tactics are the responsibility of the individuals and organizations delivering the services to technology entrepreneurs.

The governance model (Figure 6) will evolve as the ecosystem evolves. The orientation of the Lead To Win Council is data-driven, with predictive and outcome indicators for startup success, job creation, and regional prosperity. The governance board does not get involved in the management of the ventures; this is the responsibility of the ventures' own management teams.

Notable Features

The following features of the architecture of the Lead To Win job-creation engine are worth highlighting:

1. In return for free or heavily subsidized services, a technology entrepreneur is expected to grow their company's revenue to a level that can support a minimum of six knowledge jobs in the region. The focus of Lead To Win is to help technology entrepreneurs grow their companies revenue for the purpose of generating jobs in the region.

2. The Lead To Win stakeholder model does not have the "entrepreneur in residence" as a central role, as is typical with many other accelerators and incubators. The intent is to preserve autonomy for entrepreneurs and their top management teams.

3. The modularization of the ecosystem's components and elements enable rapid change.

4. Lead To Win provides services to technology entrepreneurs for the purpose of helping them navigate a process that helps them launch and grow companies in a region.

5. Desks help entrepreneurs "get things done" so they can advance their businesses, not just get advice about what needs to be done.

6. Feeder stakeholders are actively engaged in helping technology entrepreneurs launch and grow their businesses. It is a "pull system", where the leaders (i.e., entrepreneurs) declare when they are ready for the support of the feeders and the feeders respond quickly.

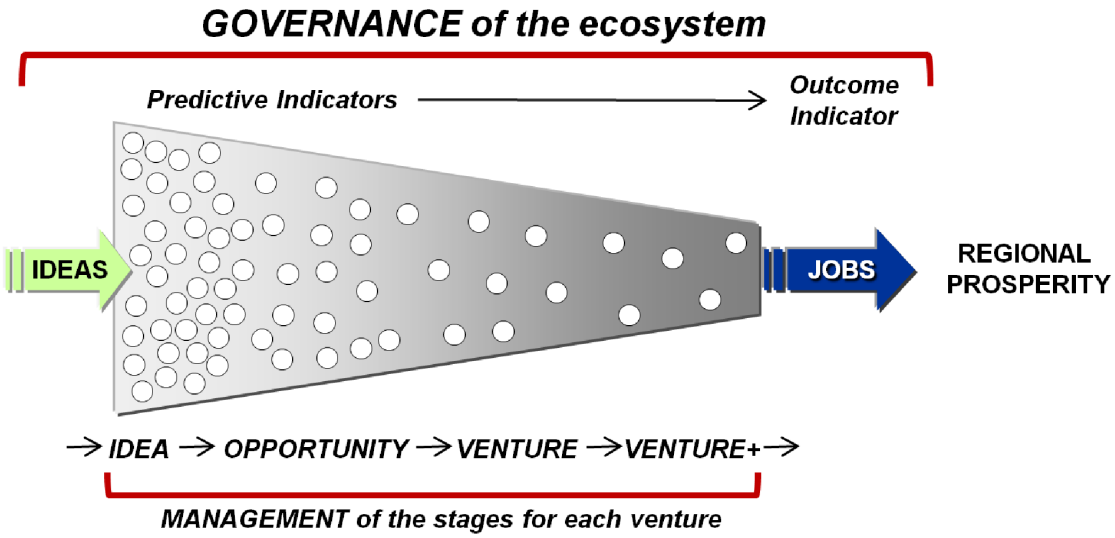

Figure 6. Governance of the venture ecosystem

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

Adding New Capability to the Ecosystem: Born Global

One of the strengths of this startup ecosystem is its responsiveness and resiliency in embracing changes in the environment, whether it is new technologies, management processes, or business models. The Lead To Win ecosystem is ready to take on the next challenge: incorporating the capability to launch and grow born-global ventures.

According to Tanev (2012; timreview.ca/article/532), born globals are firms designed to compete globally from their inception. They meet the needs of a global market – a market comprised of various markets that may include the company's domestic market. Most new technology firms first focus on the domestic market and then internationalize slowly; they become global by emergence, not by design. Born globals grow much faster than other firms. Being a "born global" is more about profiting from innovative business models than just selling to foreign customers.

A born-global technology firm can be readily distinguished from new, domestic-based small firms and conventionally internationalizing firms by examining the projects in which it invests. A born-global firm invests in projects to assemble and deploy specialized individuals and assets to derive significant competitive advantage from the use of resources and sales of outputs in multiple countries.

Lead To Win support for born globals in the ecosystem is a new differentiator relative to other job-creation engines that support entrepreneurs, one that is expected to significantly contribute to job creation and regional prosperity. Expanding the born-global capability in the ecosystem can be rolled out progressively. The post-secondary institutions are already engaged in bringing together effective practices and business models based on sound academic theory and empirical results.

The next step is to engage highly reputable private-sector industry practitioners to share their experience in growing and operating global businesses as part of a mentorship program. The mentorship program will focus exclusively on born globals; this is the "sweet-spot" for job growth and regional prosperity for technology startups.

The mentorship program will follow mentorship best practices and will establish effective processes for attracting, managing, and reporting work done by mentors. The mentorship program will: i) link the mentors with the venture founders; ii) train and support the mentors; iii) develop and disseminate mentoring best practices for launching and growing global businesses early and rapidly; and iv) maintain high quality and consistency of mentoring services to entrepreneurs. A simple process-management control system will be the underlying engine that monitors performance and raises flags when interventions are required. The intent is to build an adaptive system.

Over time, born-global support will pervade throughout all the stakeholder groups in the Lead To Win ecosystem.

Conclusions

The time has come for a formal analysis of the architectures of the engines designed to convert investments in public services delivered to technology entrepreneurs into jobs in a region. We encourage others to make visible the architectures of the engines they use to convert public investments to deliver services to technology entrepreneurs into regional jobs. Visibility of job creation architectures can help stakeholders better navigate the regional venture systems, compare them, and enhance them.

In this article, we make the Lead To Win engine visible because of our experience designing and operating it, and our desire to motivate others to make visible the distinguishing features of their own job-creation engines.

An Ecosystem-Based Job-Creation Engine Fuelled by Technology Entrepreneurs

Tony Bailetti and Sonia D. Bot

About the Authors

Tony Bailetti is an Associate Professor in the Sprott School of Business and the Department of Systems and Computer Engineering at Carleton University, Ottawa, Canada. Professor Bailetti is the Director of Carleton University's Technology Innovation Management (TIM; carleton.ca/tim) program. His research, teaching, and community contributions support technology entrepreneurship, regional economic development, and international co-innovation.

Sonia Bot is an entrepreneurial-minded leader/executive and strategic thinker with extensive experience in technology innovation and global business management. She specializes in new venture creation, product management and delivery, business transformation and strategy, and leading organizational change. She is an accomplished industry presenter, author of numerous peer-reviewed published articles, and industry executive member of the Technology Entrepreneurship & Commercialization Council at Carleton University. Ms. Bot currently partners with executives and entrepreneurs of small-medium enterprises and large entrepreneurial companies to assist in building, growing, and transforming new ventures and to solve wicked business problems. Her prior work experience includes Research In Motion / BlackBerry, Nortel, Bell-Northern Research, IBM, and TransCanada Pipelines. She holds degrees in Computer Science with Systems Design / Electrical Engineering (BMath) from the University of Waterloo and Biomedical Engineering (MASc) from the University of Toronto, and she is a certified Lean Six Sigma Master Black Belt. In November 2012, Ms. Bot received the honour of "Innovators & Entrepreneurs" by the Institute of Biomaterials and Biomedical Engineering at the University of Toronto.

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TIM Lecture Series

Energy Efficiency and Data Security in Modern Data Centres

Jerry Glowka, Jason van Gaal, Scott Moore,
Bill Bowerman, and Peter Smetny

> *"It's easy to come up with new ideas; the hard part is letting go of what worked for you two years ago, but will soon be out of date."*
>
> Roger von Oech
> Author and speaker on creativity and innovation

Overview

The first TIM lecture of 2013 was led by Jerry Glowka, Vice President of Solutions Architecture at IceBerg Networks (icebergnetworks.com), an Ottawa-based business that focuses on the provision of low-power technologies and innovative solutions for highly compact data centre solutions. To discuss innovation in energy efficiency and data security in data centres, Glowka was joined by Jason van Gaal (Granite Networks; granite-networks.ca), Scott Moore (Bell Canada; bell.ca/enterprise/), Bill Bowerman (FusionIO; fusionio.com), and Peter Smetny (Fortinet; fortinet.com).

The event was held at Carleton University in Ottawa, Canada, on January 17th, 2013, in collaboration with the IET Ottawa Local Network (iet-ottawanetwork.ca) and IEEE Ottawa Section (ieeeottawa.ca). This lecture was the result of co-operation between Professor Michael Weiss (Carleton University) and David Mann (President of Ayrshireton Consulting Inc. and Committee Member of the IET Ottawa Local Network).

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

Glowka began the lecture by describing the current state of affairs in data centres, where increasing demand and power costs have created a challenging situation for data centre operators. There are currently over 50 billion devices in the world and projections indicate that these devices will be making over 1 trillion financial transactions per year by 2014. With every one of these transactions requiring "a little bit of power", Glowka underscored three reasons why data centres need to transition to green solutions. Although environmental concerns are a strong motivator, the need for this transition is driven as much by economics and resource demands.

Glowka explained that one of the underlying causes of the challenges facing data centres today relates to a "performance gap" in server technology. Advancements in CPU speed in recent years have outstripped growth in other technologies. Thus, fast CPUs cannot perform at optimal levels because they end up waiting for work to be completed upstream by other technology, and while they wait, they continue to consume power. The typical approach to solving this performance gap is to add more servers, however this is an inefficient approach that further increases power consumption in data centres.

Not only do increases in business demands directly increase the power demands of the servers themselves, but they also indirectly increase the power demands of cooling systems. Traditional data centres largely consist

Energy Efficiency and Data Security in Modern Data Centres

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of blade servers that generate substantial heat. Power and cooling systems are reaching their limits, levels of carbon dioxide emissions are at historic levels, and the cost of power is increasing. In fact, power costs now dominate all other data centre costs.

The remainder of the lecture focused on key perspectives that affect energy efficiency and security in data centres and server technology, with an emphasis on innovations that will help the data centre industry "go green". The first part of lecture focused on the design and operation of the data centres. The speakers emphasized that efficiency gains could be realized through state-of-the-art technology and new approaches to data centre design. The second part of the lecture looked at green innovations at the level of server technology. Innovations are aimed at reducing the performance gap, maximizing efficiency, increasing the workload capacity of data centre IT equipment, increasing the use of virtualization, and providing higher-level security to deal with the challenges raised by increased reliance on "the cloud".

Designing and operating a green data centre

Jason van Gaal, COO of Granite Networks (granite-networks.ca), described the challenges faced when designing and operating a data centre that is both green and reliable. When Granite Networks were building their new Tier 3 data centre in Ottawa, they knew they needed to strike the right balance between performance, efficiency, reliability, and costs. Key design aspects included:

1. Lowering costs by choosing the "right-sized equipment" for a given need and ensuring that redundancies carried lower loads

2. Efficient placement of server racks for optimal cooling

3. Maximizing "free cooling hours" from cold Canadian weather

4. Optimizing air distribution via floor layout and aisle design

With annual power costs exceeding spending on IT equipment, the efficiencies resulting from a green data centre design have a real impact on the company's bottom line. Thus, green is a competitive advantage for Granite Networks.

A perspective from Bell Canada

Scott Moore, Project Manager at Bell Business Markets (bell.ca/enterprise/), offered insights from Bell Canada, which has been expanding its data centre portfolio. Bell's strategy is to increase their investment in infrastructure; acquire existing data centres and build additional new facilities; and enhance their certification program, all so that they can offer their customers greater security, performance, and availability.

Moore next described Bell's new data centre in Ottawa, which is a Tier 3 facility for public and private customers. The facility aims to combine industry-standard equipment with innovative design to achieve a low PUE (a ratio of facility-power to IT-equipment-power relative to cooling costs). Historically, a typical PUE was 2:1, but now a PUE around 1.5:1 is standard; Bell is targeting 1.3 or lower. To achieve this level of efficiency, this new facility takes advantage of the following green technologies and design innovations, among others:

1. Increased efficiency and decreased use of lead through flywheel technology instead of batteries for energy storage

2. Decreased use of copper through single-step electricity transformations

3. Reduced water consumption through air cooling (with A/C backup)

4. Reduced cooling costs by maximizing free cooling (90%) versus mixed cooling (10%) reserved for high-heat, high-demand days

5. Reduced heat demands in non-server areas of facility by retaining and redistributing heat generated by the servers

6. Reduced lighting costs with white server cabinets, which also creates a nicer working environment for employees

This new Bell facility has achieved Leadership in Energy and Environmental Design (LEED; tinyurl.com/2xqdgy) Gold certification. Also, Bell Canada and the facility's designers, Urbacon Architecture, were awarded the 2012 Green Enterprise IT Award (tinyurl.com/aqy6yfx) for facility design innovation.

Energy Efficiency and Data Security in Modern Data Centres

Jerry Glowka, Jason van Gaal, Scott Moore, Bill Bowerman, and Peter Smetny

Enabling a greener data centre through fast storage
Bill Bowerman, Solutions Architect at FusionIO (fusionio.com), described how innovations in server technology are helping data centres become greener. FusionIO drives are designed to overcome the trap that many data centres fall into when faced with adding additional CPUs in an attempt to increase performance to keep up with customer demand. FusionIO drives use NAND Flash technology to reduce latency – which is the key when trying to maximize CPU utilization – to remove dependencies on intermediary technology for read/write access. From a green perspective, the key benefit of low latency and high performance is the efficient use of hardware and substantial reductions in power consumption. With much less equipment running in data centres, the power and cooling demands are also reduced, which lowers both the costs and carbon footprint of the facilities.

Beyond firewalls
Peter Smetny, Systems Engineer at Fortinet (fortinet.com), discussed the ever-increasing security challenges faced by modern data centres. Although virtualization and cloud-based technologies bring benefits in terms of business and financial performance, in addition to environmental benefits, they have changed the way data centres approach security. Data centres face similar types of security threats (e.g., attacks, disruptions, threats to data loss and confidentiality), but they now have less control over the infrastructure. A simple firewall is no longer sufficient because the concept of a secure perimeter no longer applies.

In response to more sophisticated threats – including botnets and underlying vulnerabilities in software on user devices – and a poorly defined perimeter, data centres seek a unified threat-management solution for their networks. However, traditional processors and memory are not fast enough to perform the inspections needed on incoming and outgoing data (at the data centre) to detect and prevent known and hypothesized threats. Smetny discussed key technologies – including ultra-fast application-specific integrated circuits (ASICs) and field-programmable gate arrays (FPGAs) – that not only protect against modern threats but also use power efficiently, to support the green advantage sought by data centres.

Lessons Learned

In the discussions that followed the first and second parts of the presentation, audience members shared the lessons they learned from the presentation and injected their own knowledge and experience into the conversation. The audience also identified the following key takeaways from the presentation:

1. Green adds to brand value and makes good economic sense.

2. There are many different approaches to cooling and reducing power consumption; lots of opportunities for innovation.

3. A lot of technology and efforts go into the mechanical design (e.g., server chimneys, plenum design, flywheels).

4. The geographical location of a data centre greatly affects power and cooling costs. Canada is a good place for data centres because cold winter weather provides free cooling.

5. Flywheels are still useful and innovative!

6. It is surprising to learn that power costs exceed IT equipment costs.

7. CPU improvements have exceeded advances in other areas (i.e., there is a "performance gap"), but there is still room for greater efficiency at the chip level.

8. Going green involves innovation even at the level of storage protocols.

9. Having more efficient hardware means you need less of it, which lowers equipment, power, and cooling costs.

10. Disks are now 22,000 times bigger but are only 16 times faster.

11. There is no longer such as thing as a secure perimeter; threat management is no longer about building walls.

12. A paradox: security needs to be rock-solid, yet flexible enough to handle future threats.

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About the Speaker

Jerry Glowka is the Vice President of Solutions Architecture at IceBerg Networks (icebergnetworks.com). Jerry has deeply developed skills in networking, security, and storage that allows him to combine best-of-breed technology to produce robust secure solutions for data centres as well as cloud computing. Jerry has been successful in identifying, working with, and bringing together world-leading technologies to address data centre exhaust and unmanageable power demands, and to overcome consumer fears related to the use of virtualized resources. Jerry is IceBerg's representative in the NSERC Strategic Network for Smart Applications on Virtual Infrastructure (SAVI), which is researching the evolution of today's Internet, its protocols, and its structure.

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Topic

Start by asking yourself:

- Does my research or experience provide any new insights or perspectives?
- Do I often find myself having to explain this topic when I meet people as they are unaware of its relevance?
- Do I believe that I could have saved myself time, money, and frustration if someone had explained to me the issues surrounding this topic?
- Am I constantly correcting misconceptions regarding this topic?
- Am I considered to be an expert in this field? For example, do I present my research or experience at conferences?

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

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

- Emphasize the practical application of your insights or research.
- Thoroughly examine the topic; don't leave the reader wishing for more.
- Know your central theme and stick to it.
- Demonstrate your depth of understanding for the topic, and that you have considered its benefits, possible outcomes, and applicability.
- Write in a formal, analytical style. Third-person voice is recommended; first-person voice may also be acceptable depending on the perspective of your article.

Format

1. Use an article template: .doc .odt
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4. Begin with a thought-provoking quotation that matches the spirit of the article. Research the source of your quotation in order to provide proper attribution.
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