Technology Innovation Management Review

April 2016
Volume 6 Issue 4

Satellite image of Black Rock City. Image credit: NASA World Wind

Managing Innovation

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

Carleton UNIVERSITY

www.timreview.ca

Technology Innovation Management Review

April 2016
Volume 6 Issue 4

Publisher

The *Technology Innovation Management Review* is a monthly publication of the Talent First Network.

ISSN

1927-0321

www.timreview.ca

Overview

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

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

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

Contribute

Contribute to the TIM Review in the following ways:

- Read and comment on articles.
- Review the upcoming themes and tell us what topics you would like to see covered.
- Write an article for a future issue; see the author guidelines and editorial process for details.
- Recommend colleagues as authors or guest editors.
- Give feedback on the website or any other aspect of this publication.
- Sponsor or advertise in the TIM Review.
- Tell a friend or colleague about the TIM Review.

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

About TIM

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

Editorial: Managing Innovation

Chris McPhee, Editor-in-Chief

Welcome to the April 2016 issue of the *Technology Innovation Management Review*. The authors in this issue share insights on managing and fostering innovation, whether developing frugal innovations through top-down or bottom-up processes, factoring in the impact of national culture on innovation, stimulating creative behaviours in teams, or weighing the pros and cons of engaging in open innovation.

This issue arose from the TIM Review's association with the ISPIM Innovation Summit, which was held in Brisbane, Australia, from December 6–9, 2015. Earlier versions of most of the articles in this issue were presented at this event and then further developed with input from the attendees and the journal's editorial and review process. ISPIM (ispim.org), or the International Society for Professional Innovation Management, is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management. This year's ISPIM Innovation Summit (conference.ispim.org) is being held in Kuala Lumpur, Malaysia from December 4–7, 2016.

In the first article, **Liza Wohlfart**, **Mark Bünger**, **Claus Lang-Koetz**, and **Frank Wagner** compare top-down and bottom-up strategies for the development of frugal innovations: basic versions of higher-priced solutions made affordable for price-sensitive customer groups. Based on six case studies from various industries, they categorize efforts to develop such solutions into corporate frugal innovation and grassroot frugal innovation. They share lessons learned in comparing these two approaches, particularly in light of the three pillars of sustainability: economic, environmental, and social.

Next, **Tony Smale** from Forté Management in New Zealand examines the role of national culture in innovation outcomes and argues that it should be taken into account when designing innovation strategy and policy. The article takes a practitioner perspective, distilling the managerial implications and providing a list of questions that serve as a checklist to enable practitioners to analyze the implications of their own national and organizational context.

Then, **Tracy Stanley**, **Judy Matthews**, and **Paul Davidson** from the Queensland University of Technology (QUT) in Brisbane, Australia, present a case study designed to identify the factors that contribute to creative behaviours in project-based, interdisciplinary teams. Their findings highlight the value of structured approaches to managing discussions and decision-making processes, including the role of a technology manager with a dedicated focus on the identification and commercialization of new knowledge.

Next, **André Ullrich** and **Gergana Vladova** from the University of Potsdam, Germany, highlight that the possible negative consequences of open innovation are often overlooked, and that companies – particularly smaller ones – lack the tools to weigh the pros and cons of participating in open innovation. They describe the development of a framework and related software tool to help companies self-assess whether a particular open innovation project is likely to bring the desired benefits.

Finally, this issue also includes summaries of two recent TIM events. **Andrea Baptiste**, President and CEO of Benbria Corporation, shared her entrepreneurial experiences and the key lessons she learned transitioning from engineer to executive and "living the startup life". And **Roni Zehavi**, CEO of CyberSpark, introduced efforts to build an international cybersecurity hub and ecosystem in Beer-Sheva, Israel.

In upcoming issues, we will be examining innovation and entrepreneurship in India and in Australia. We also have other unthemed issues in progress, for which we welcome your submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains.

We hope you enjoy this issue of the TIM Review and will share your comments online. Please contact us (timreview.ca/contact) with potential article topics and submissions.

Chris McPhee
Editor-in-Chief

Editorial: Managing Innovation

Chris McPhee

About the Editor

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

Citation: McPhee, C. 2016. Editorial: Managing Innovation. *Technology Innovation Management Review*, 6(4) 3–4. http://timreview.ca/article/976

Keywords: innovation, managing innovation, frugal innovation, open innovation, national culture, creativity, projects, startups, entrepreneurship, cybersecurity

Corporate and Grassroot Frugal Innovation: A Comparison of Top-Down and Bottom-Up Strategies

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

> *"There's no such thing as simple. Simple is hard."*
>
> Martin Scorsese
> Film director and producer

Frugal innovations aim at the development of basic solutions that are affordable for price-sensitive customer groups. This article looks at the similarities and differences between two major approaches, corporate and grassroot frugal innovation, and identifies initial ideas on how the two streams can learn from each other. The three pillars of sustainability (economic, environmental, and social) provide one of the guidelines for the comparison. The research is based on an analysis of case studies from various industries, six of which are presented in this article.

Introduction

Frugal (i.e., simple, plain) innovations restrict products and services to basic functionalities and embed them in innovative business models to make them affordable for price-sensitive customer groups. Frugal innovation is usually associated with emerging countries such as the BRICS (Brazil, Russia, India, China, and South Africa). It is, however, not a new phenomenon and is not restricted to specific geographical regions. Europe and North America, for example, also offer interesting examples of frugal innovation. They range from innovative concepts of large companies to bottom-up initiatives and aim both at emerging countries and their home markets.

Some companies and universities have even started to establish a dedicated infrastructure for developing frugal innovations. Santa Clara University in Silicon Valley – one of the wealthiest regions in the world – has a Frugal Innovation Lab in its engineering department. Its goal is to develop solutions for people with limited economic resources, whether they are African farmers, children with disabilities requiring expensive support, citizen scientists and students, or homeless people in American cities. The constraints of the lab (e.g., tools and materials) help students as part of their engineering curriculum, not only solving ecological or social sustainability needs, but also making them into better, more creative engineers.

Also in Silicon Valley, there is a strong new trend in technology product development: the lean startup and the minimum viable product (MVP). Even startups that have millions of dollars of venture funding are encouraged to follow this frugal approach to design and engineering, not because it is more sustainable, but simply because it is more effective at creating new products.

Frugal innovation has been a topic in academic and industrial discussions for several years now. Many authors have highlighted the large variety of names for the phenomenon, such as inclusive, grassroot, resource-constrained, or cost innovation (Zeschky et al., 2011). Few researchers have, however, compared and contrasted the different activities to identify the core of the frugal innovation phenomenon or to clearly separate the different streams.

One common aspect of all frugal innovations is their link to sustainability. Frugal innovations are characterized (almost by definition) by a lack of resources, either in the development process or the solution itself. They can, however, contribute to all three pillars of sustain-

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

ability. Frugal innovations can be very profitable from an economic point of view. They can support environmental aims by saving material and energy. And they can have social benefits by making products affordable for more people or creating new work places. Frugal innovation could thus be a strong impetus for sustainability that has not yet been leveraged to a full extent.

This article contrasts two innovation approaches, top-down ("corporate frugal") and bottom-up ("grassroot frugal"). The three pillars of sustainability provide one of the key guidelines for this comparison. Relevant research questions considered are the following:

- What are the key differences and similarities between corporate and grassroot frugal innovation approaches?
- How important are the different aspects of sustainability (economic, environmental, social) in both approaches and how can they be operationalized?
- What can the two streams learn from each other?

The research presented in this article has been conducted by researchers from three different organizations, who have specialized on different aspects of the frugal phenomenon. Organization A (name anonymized) focuses on corporate frugal solutions, Organization B (name anonymized) specifically looks into grassroot frugal phenomena, and Organization C (name anonymized) investigates sustainability aspects of frugal innovations.

The research questions above have been addressed by an extensive literature review followed by a large number of case studies, which have been collected in recent years to identify characteristics and success factors of as well as methods and tools for frugal innovation.

Corporate Frugal: Top-Down Solution Trimming

Large companies have started to pay a lot of attention to frugal business opportunities, since Prahalad raised awareness in his book *The Fortune at the Bottom of the Pyramid* (2010). The striking idea is that companies offering frugal innovations can at the same time make profit from affordable high-quality solutions and contribute to better living conditions of the less well-off.

Corporate frugal examples include the Volkswagen Beetle and IKEA. The original Volkswagen Beetle not only became enormously popular because young people could afford it; it was also praised for its robustness and extravagant design. IKEA likewise has set a clear focus on the needs of its key target group: young families. The company's strong and growing success results from a careful balance of low price, modern aesthetics, and services for small children.

The strict orientation on the specific needs of a selected customer group is a typical feature of Western companies venturing into frugal innovation. They identify a specific group of potential cost-sensitive customers, carefully analyze their needs, and then make clear-cut decisions on relevant features from these customers' perspective to bring down prices. They compromise on the solution spectrum, not on quality, when aiming for affordability. And they even add features that bring up the price if they have a strong relevance for the specific target group. The result is a good-quality solution that is cheaper than existing high-end offerings but more expensive than established low-end alternatives.

The development of corporate frugal solutions is not an easy task because it necessitates a shift of mind-set in established R&D teams: from the design of sophisticated high-end products to a philosophy of reduction. At the same time, frugal solutions have to mirror the quality of the overall company brand to avoid an endangerment of existing product lines.

The development process of corporate frugal innovations is therefore usually not less complex than the one of high-end innovations. Companies use a structured procedure and established methods to come up with frugal innovations. The costs of the invested resources can even exceed the ones of other innovation projects; some companies stressed that the radical re-thinking of frugal innovation needs the vast expertise of specifically skilled senior staff. This staff usually works in dedicated R&D teams that closely collaborate with customers to make sure that their needs are well understood.

Market opportunities that promise economic success are the main driver for the development of corporate frugal solutions. They have smaller margins than high-end products but can still be very profitable due to economies of scale achieved through mass-manufacturing. Corporate frugal solutions that primarily aim at environmental and social sustainability in turn often seem to fail, as seen with the BSH Protos Plant Oil Cooker and the Nike World Shoe project. The specifics of corporate frugal highlighted so far are presented more explicitly in three detailed case studies presented below.

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

Case study 1: Mettler Toledo Entry line

Mettler Toledo, a provider of high-end solutions, was increasingly attacked by low-cost competitors, whose solutions have a low quality but also a low price and are thus affordable for many companies in emerging countries (Strotz, 2014). As a consequence, Mettler Toledo decided to develop an entry-level product line with fewer features and a simpler design than the established Excellence and Classic lines (Figure 1; Table 1). Despite the differences, the three lines show clear similarities when it comes to style and quality. The frugal line clearly matches the overall brand image.

The development of the corporate frugal line was done in four steps (Strotz, 2014). Mettler Toledo first created Strategic Business Units with clear objectives (i.e., dedicated R&D teams) and strategies to then set up a product portfolio that considered the customers' willingness to pay and the benchmark on the market. Based on defined target costs, Mettler Toledo next established low-cost sourcing capabilities and developed a new sales approach (Strotz, 2014).

Figure 1. Mettler Toledo Excellence, Classic, and Entry laboratory balances
Source: Mettler Toledo

Case study 2: Accor Ibis Budget hotel chain

Accor is a hotel chain with a portfolio that encompasses luxury and upscale brands as well as midscale and economy ones. Its low-end hotel Ibis Budget (Figure 2; Table 2) started as Formule 1 in the 1980s, an affordable accommodation for travelling salespeople (Fraunhofer IAO, 2012).

The impulse to start the budget hotel chain was a clear market opportunity: the lack of a suitable solution for the target group. Travelling salespeople have a limited budget and specific requirements such as easy access to the hotel even at late hours and a room setup that ensures an optimum rest. The low price of the hotels was achieved by a strict focus on the key requirements of this customer group (Fraunhofer IAO, 2012). The hotels were placed at traffic junctions and offered simple but good quality furnishings. Services of less importance for salespeople were replaced by low-cost alternatives, including a 24-hours check-in machine instead of a personal receptionist.

In addition, costs were saved through a standardization of rooms, which enabled the industrialized production of furnishings, fast cleaning and maintenance processes, and quality assurance (Fraunhofer IAO, 2012).

Table 1. Case summary: Mettler Toledo Entry line

Dimension	Description
Novel product/service offering (including target group)	• Entry-level laboratory balances aimed at Chinese low-end markets
Conventional offering with higher complexity (including target group)	• Excellence and Classic laboratory balances aimed at global high-end and medium markets
Approach for reducing complexity compared to conventional offering	• Copy & paste, collaboration of central and local teams
Economic aspects	• Increasing market share in emerging markets
Environmental aspects	• Less material use (assumed)
Social aspects	• Provision of affordable quality solutions for companies with a low budget

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

Figure 2. Accor Ibis Budget hotel room
Source: AccorHotels; Photographer: Christoph Weiss

Today, Ibis Budget is still in line with the original concept, although the room concepts have been modernized (Grallert, 2014). Many hotels still have restricted receptionist hours, supported by an automated check-in option. The emergence of competitors such as Motel One shows the high need for affordable accommodation. The different brands of Accor sometimes cannibalize each other, when customers change from a high-price to a low-price hotel, for example during times of economic crisis. However, this cannibalization can also be an advantage. Accor manages to keep customers attached to their portfolio in these situations, instead of losing them to competitors.

Case study 3: Siemens SMART line (healthcare sector)
Siemens started its SMART (Simple, Maintenance-friendly, Affordable, Reliable, and Timely-to-market) line to explore new growth options (Fraunhofer IAO, 2014). In addition, they saw that competitors were very active in emerging countries and that the market shares of companies from these countries (i.e., "emerging giants") were growing. The SMART line extends Siemens' product portfolio from top- and high- to medium- and low-end markets and is a good fit to the global portfolio despite its differences in functionalities and price.

SMART line products can be found, for example in Siemens' healthcare sector offerings (Table 3). Medical SMART products have comparatively low prices (for both purchase and maintenance), good quality, and simple handling. Their affordability makes them attractive for healthcare professionals in emerging countries, who want to improve the ease and quality of their services. In addition, they sometimes serve as secondary or replacement device for professionals in developed countries (Fraunhofer IAO, 2014).

The development of the SMART healthcare products follows a structured process (Glemser, 2013). It starts with the identification of a target market and the analysis of the needs of this market as well as trends supported by local partners. The development and management of the products is then done by a local R&D team that knows about the specific requirements of the customers in this market and the features of com-

Table 2. Case summary: Accor Ibis Budget hotel room

Dimension	Description
Novel product/service offering (including target group)	• Frugal hotel chain aimed at low-budget business travellers
Conventional offering with higher complexity (including target group)	• Luxury, upscale, and midscale brands aimed at high-budget business travellers and tourists
Approach for reducing complexity compared to conventional offering	• Standardization, automation
Economic aspects	• 51% of Accor's operating result is from its economy segment (Grallert, 2014).
Environmental aspects	• Standardized furnishings enables material saving
Social aspects	• Affordable, good quality accommodation for business travellers

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

Table 3. Case summary: Siemens SMART line (healthcare sector)

Dimension	Description
Novel product/service offering (including target group)	• Siemens SMART line aimed at medium- and low-end markets
Conventional offering with higher complexity (including target group)	• Siemens SMART line aimed at top- and high-end markets
Approach for reducing complexity compared to conventional offering	• Less functionalities, smaller size (exemplary)
Economic aspects	• The entry level in emerging countries offers a high potential sales volume and a resulting high growth potential for Siemens (Glemser, 2013)
Environmental aspects	• Low energy consumption (exemplary)
Social aspects	• Affordable (i.e., low price, low installation and operation costs) quality solutions for budget-restricted hospitals and physicians

peting offerings. The team is supported by headquarter teams of the respective sector that can provide technical and procedural know-how. If possible, the complete value chain is also set up locally.

The development of the frugal solution is based on an existing product first, before a new solution is set up (Glemser, 2013). Costs are saved by optimizing the functionality spectrum, using inexpensive material and integrating components from local suppliers. A "mix and match" approach using existing components helps to reduce development costs. The two-step approach enables an alignment of the choice of functionalities with the market needs and to assess the product's chances of success. In addition, it helps to learn about the handling of the product technology and the translation of local requirements into product functionalities.

Grassroot Frugal: Bottom-Up Solution Exploration

Frugal innovation examples in developing economies often illustrate how people reuse materials and parts to which they have easy, free access, and how they apply clever shortcuts and workarounds to compensate for a lack of professional tools or skills. These practices occur in developed economies as well, but the materials, skills, and goals are very different. One could regard billionaire Elon Musk's private spaceflight company SpaceX as an extreme example of frugal innovation, given that even a billionaire is a poor man compared to the superpower government space programs that previously had a monopoly on space technology. Who is resource-rich and who is resource-constrained is a relative assessment.

More down to earth examples of frugal innovation in developed economies, solving high-tech problems with relatively constrained resources, can be found in the maker movement and its adjacent cultures and organizations such as FabLabs and DIY (do it yourself) prosumers (producer/consumers). Here, we see individuals, companies, and communities hacking manufacturing supply chains, repurposing electronic devices, and even building entire cities using the principles of frugal innovation. Their accomplishments can be instructive for global corporations and developing economies alike.

Examples of frugal innovation in the developed world include:

- Briago braille printer (braigolabs.com). Young inventor Shubham Banerjee used the Lego Mindstorms EV3 kit ($349) and a few parts from a hardware store to create a Braille printer that costs just $350 (compared to $2000 for a conventional machine).

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

- BrickPi Bookreader (tinyurl.com/zgrtpkm). Invented by John Cole, the BrickPi opens and scans the pages of physical books in order to ensure that even old and rare books will be preserved and accessible. His digitizer uses the $30 Raspberry Pi computer, and overall costs $450 compared to $16000 for conventional equipment.

- Foldscope (foldscope.com). Foldscope is a 2,000X magnification optical microscope that can be printed, cut, and assembled from a flat sheet of paper – for less than $1.

In this section, we examine three innovations that use frugal principles of design and engineering to change products and processes normally found in developed economies. In each of the cases, the goals are environmental, social, or economic to various degrees, but each case has used ingenious ways to address the challenges of limited resources and turn them into an advantage.

Case study 4: Local Motors microfactory

The Rally Fighter by Local Motors' is a high performance sportscar (Figure 3). But, more important than the product, is how it was designed and manufactured. Local Motors' microfactory in Phoenix, Arizona, is home to an open source, crowd-powered manufacturing startup that took a new vehicle from concept to production in 18 months (vs 60 months for a typical carmaker) and cost about $3 million to develop (vs $1 billion for a traditional carmaker) (Table 4).

Figure 3. Local Motors Rally Fighter sportscar
Source: Local Motors

Table 4. Case summary: Local Motors microfactory

Dimension	Description
Novel product/service offering (including target group)	• High performance sportscar with high degree of customizability and flexible manufacturing
Conventional offering with higher complexity (including target group)	• BMW 5 series, Audi, Mercedes, and other performance sportscars produced in traditional cost-intensive manufacturing process
Approach for reducing complexity compared to conventional offering	• Open source design, reuse of existing parts and supply chain, owner participation, and manufacturing space frame architecture • 3D printed car reduces part count and assembly steps, while offering vastly greater design flexibility
Economic aspects	• Cost of car itself is comparable to other sportscars ($100k), but cost of manufacturing (factory, tools, designs) are about 1000x lower and 3–5x faster than conventional • Produced Rally Fighter in 18 months (vs 60 for OEM) with 50 full-time employees • $3 million on development (vs $1 billion for conventional) • Breaks even at 2,000 units total (compared to 20,000/year for conventional)
Environmental aspects	• Local manufacturing reduces transportation distance, thus reducing emissions and infrastructure from logistics • Prints vinyl skin exterior design – no paint shop, and each car is unique
Social aspects	• Microfactories return manufacturing jobs to local communities. Workers enjoy responsibility for end-to-end processes, and variation in tasks and products expands their skills and motivation

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

Local Motors currently has four microfactories in Phoenix, Las Vegas, Louisville, KY, and Berlin. Each requires about $500,000 in capital equipment and is open as a makerspace "lab" to local schools and inventors. The company aims to have 50 microfactories globally within 5 years, one million participants in its communities, and 1,000 products (not just cars) for sale. It has partnerships with companies such as GE to apply the process to home appliances (see firstbuild.com). Like the "just-in-time" approach from a generation ago, the new, frugal approach to manufacturing could change the way supply chains are planned and how factories are staffed – favouring smaller, local workshops that can profitably produce not tens of products in units of thousands, but thousands of products in units of tens.

Case study 5: Fairwaves GSM base station

Born at Moscow's Neuron Hackspace (neuronspace.ru/wp/), a startup named Fairwaves (fairwaves.co) is making a GSM (global system for mobile communications) base station (Figure 4; Table 5) that will enable $1/month mobile phone subscriptions. The company's GSM network-in-the-box (NITB) base station costs $5000 (vs millions of dollars for traditional equipment), has low power needs (100W), and serves a 10km radius.

Figure 4. Fairwaves GSM base station
Source: Alexander Chemeris

Table 5. Case summary: Fairwaves GSM base station

Dimension	Description
Novel product/service offering (including target group)	• GSM base station "in a box" for rural villages in developing economies and temporary large gatherings in developed ones
Conventional offering with higher complexity (including target group)	• Base station from Alcatel-Lucent, Ericsson, Motorola
Approach for reducing complexity compared to conventional offering	• In the company's own words, "In contrast to traditional mobile network solutions that are highly centralized, dependent upon backhaul and making heavy use of this, the Fairwaves solution is built upon a distributed VoIP core that benefits from local switching and is resilient to network failure" (Fairwaves, 2015).
Economic aspects	• Conventional base station costs millions of dollars • Enables $1/month mobile phone subscriptions • Lower operating (power network) and maintenance costs
Environmental aspects	• Because the system is low-power and compact, it does not require large amounts of energy, equipment, or new open space (e.g., clearing of trees) to establish • Can be powered from off-grid energy sources such as solar
Social aspects	• Brings data and conductivity to people who would otherwise not have access or would not be able to afford it • In 2011, the United Nations declared Internet access a basic human right (UN General Assembly, 2011)

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

It uses the Osmocom (osmocom.org) GSM stack, an open source initiative developing free software for mobile telephony, from the handset to the network.

Fairwaves has already deployed several networks, including a private network at the Walk of the World festival in the Netherlands and a community network in the rural village of Yaviche, Mexico.

Building on the core base station technology, Fairwaves is now working to help entrepreneurs become a full service telecommunications company. In the company's own words:

"Fairwaves is a new kind of full-stack telecom vendor, tailored to serve mobile operators in low-income areas. You could be a company of just few guys to start a mobile operator. No special skills and no expensive engineers needed. We provide everything you need to build a mobile network which is profitable even at $2/month revenue per user. It scales from a single site to a country-wide network, offers free calls and roaming inside global Fairwaves network and can be controlled from your laptop" (Fairwaves, 2014).

Case study 6: Burning Man Festival, Black Rock City
Cities are arguably our largest technologies – being built constantly, lasting for centuries, rigidly planned, and yet unplannable. Can a city be an example of frugal innovation? Black Rock City, Nevada, in western United States might be exactly that (Figure 5):

"Black Rock City, Nevada is an ephemeral town that exists for only one week each year, during Burning Man, a radical arts festival. At its maximum occupancy, the town has about 60,000 citizens and a post office, an emergency services crew, a volunteer police department, roads, houses, bars, clubs, restaurants, and hundreds of art installations and participatory "theme camps". After a week, the city is completely disassembled – much of it burned – leaving the stark, white desert exactly as bare as it had been when the event started" (Wikitravel, 2016).

Black Rock City displays many of the simplicity and sustainability characteristics of frugal innovation (Table 6). First, it reduces the concept of a city to the bare minimum: streets and avenues are laid out as a clock face radiating from the centre, and in concentric circles with names in alphabetical order. Every camp is expected to bring in everything – even water – for its inhabitants to survive for the week, and to take out everything, even wastewater. The "Ten Principles" embody many "frugal" ideas, in particular "leave no trace". The city infrastructure (streetlights, art installations, and public facilities) is all removed by staff and volunteers after participants have left.

Another key principle of Burning Man is "no spectators," or "you are part of the art". In that sense, it embodies the frugal innovation idea that anyone can make the things they need to solve a problem, and that everyone has skills and abilities that can be helpful to others. Outside the festival, the Burners Without Borders organization (burnerswithoutborders.org) "promotes activities around the globe that support a community's inherent capacity to thrive by encouraging innovative approaches to disaster relief and grassroots initiatives that make a positive impact" (Burning Man, 2016).

Figure 5. Satellite image of the Burning Man Festival in Black Rock City, 2005. Source: NASA

Conclusion: Lessons Learned

The case study analyses presented above highlight characteristics of corporate and grassroot frugal approaches. Considering the three pillars of sustainability has helped us to understand and contrast the cases. In conclusion, we offer a summary of key points and potential lessons to be learned between the two streams.

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

Table 6. Case summary: Burning Man Festival, Black Rock City

Dimension	Description
Novel product/service offering (including target group)	• A "pop-up" city of 70,000 people built for one week each year, and then completely removed again
Conventional offering with higher complexity (including target group)	• Conventional cities are permanent structures built over centuries, obliterating the natural environment. • Festival sites offer little of the culture, comforts, and infrastructure of a city
Approach for reducing complexity compared to conventional offering	• Cultural rules such as "radical self-reliance" and "leave no trace" require each participant to contribute, making for a modular and resilient physical and social infrastructure
Economic aspects	• Participants pay ($400) for labour and materials that establish the city infrastructure and remove it after use • Larger features of the city are art projects, sponsored by artists backers or given freely • Each camp is a self-contained supply chain, responsible for its own power, food, water, and even trash disposal
Environmental aspects	• All water and food is brought in by each participant, and each participant must leave their camp empty of trash • No plants or animals are allowed, in case they would disturb the austere desert ecology; even pouring wastewater onto the ground is prohibited • Considerable work goes into professional and volunteer cleanup after the event.
Social aspects	• Participants ("burners") strive to apply festival principles in everyday life • Burners Without Borders organization runs social benefit projects based on principles and solutions developed for the festival

Comparing corporate and grassroot frugal approaches

First, findings presented in this article highlight the specifics of corporate and grassroot frugal solutions, including areas of overlap (Table 7). Both innovation streams set a clear focus on a specific price-sensitive customer group and restrict the features of the solution to its core needs. This focus may entail features that even go beyond the current status if these are considered a necessity from the customers' point of view. All frugal solutions have a comparatively low price compared to high-end solutions. And, they have a profitable business model with varying definitions of profitability from a company and an inventor's perspective.

The differences between corporate and grassroot frugal innovations result from their origins and ultimate goals (Table 8). Corporate frugal solutions are driven by companies that have identified a profitable market opportunity. They use an elaborate development process (and dedicated R&D teams) to carefully design a mass-producible solution. Economies of scale help to achieve a high economic sustainability despite small profit margins. A good understanding of their target customers' needs is the key success factor of corporate frugal solutions. Challenges include the cannibalization of the company's existing high-end offering and damages to its brand if the frugal offering does not match its quality.

Grassroot frugal innovations are driven by individual inventors, who are part of or close to the target group. They start the development of the frugal offering because they perceive a problem faced by this group and have a clever idea how to solve it. Their solution has to meet the needs of this group but not a certain quality standard, and it does not have to make a lot of profit – social and environmental aims come first. They have to rely on restricted resources to develop single items or small series and usually do not use specific methods for it but an improvised process with many prototypes designed and re-designed in trial-and-error loops. Collab-

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

Table 7. Overlaps in corporate versus grassroot frugal innovation

Category	Corporate Frugal	Grassroot Frugal
Target customers	Clearly defined price-sensitive customer group	
Features	Restriction of solution features to core needs of target customers	
Price	Comparatively low price compared to high-end solutions	
Business model	Profitable business model	
Sustainability focus	Sustainability mentioned as a general motivation but with different focus (see Table 8)	

Table 8. Differences between corporate versus grassroot frugal innovation

Category	Corporate Frugal	Grassroot Frugal
Driver	Companies	Individual inventors, who are part of or close to the target group
Impulse	Market opportunity	Clever idea to solve a problem
Sustainability		
Economic	Primary motivation, high profitability targeted	Secondary motivation, low economic profitability accepted
Environmental	Secondary motivation	Secondary motivation
Social	Secondary motivation	Primary motivation
Quality	In line with brand	Good enough for target customers
Production scale	Mass-manufacturing	Single items and small series
Development process	Complex, resource-intensive	Simple, resource-restricted
	Structured, method-based	Improvised
	Elaborate prototypes	Early, fast, frequent prototyping
Success factors	(Dedicated) corporate R&D teams, close collaboration with customers	Input from other designers, collaborative/crowd design
Challenges	Cannibalization of existing offering, brand damages	Upscaling

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

oration with other designers, for example through crowd-based approaches, is key to their success; their main challenge is upscaling.

In the case studies presented here, sustainability was mentioned as the main objective for developing and implementing the frugal solution. In many of the cases, positive environmental or social impacts were obtained and are actively promoted when communicating to customers and the general public, while the main goal of their products or solutions was to gain a competitive advantage and make profit.

In most cases, to achieve a sustainable product in the full sense was not a main strategic goal when initiating the innovation process. The corporate frugal cases primarily focused on economic sustainability; the grassroot cases focused on social sustainability. Environmental sustainability seems to be more of a side-effect than an upfront impulse for frugal initiatives. Especially from the corporate perspective, frugal innovation principles are applied to achieve a high profitability and thus contribute mainly to economic sustainability.

Common to all approaches is a need to rethink conventional assumptions about materials, processes, and designs in order to do more with less, and in the process, to exceed current expectations of value creation.

Sustainability as a general lever for and benefit of frugal innovations

In general, the requirement for applying a "resource-constraint" product development approach leads to the hypothesis that frugal innovations provide the potential of contributing to more sustainable products with a smaller ecological footprint than usual. Given that frugal innovations are (by definition) more affordable than conventional solutions, they can also be used by a broader part of society and hence a positive social impact is often seen. Some solutions explicitly target social objectives, for example by supplying affordable technologies to provide clean drinking water or offer solar cooking stoves. Thus, they offer people with a low income access to life-improving technologies (see Basu et al., 2013; Brem & Ivens, 2013; Jänicke, 2014; Schrader, 2011; Prahalad, 2010).

Possible indirect effects, however, have to be considered taking all three pillars of sustainability into account. For instance, frugal innovations could be attractive for existing customers of high-price products from the same company and reduce their sales volume (i,e., cannibalization). Also, if more people can afford the now more affordable products with reduced functionalities, the total number of products would rise and thus overall material and energy use would increase (i.e., the rebound effect).

A holistic assessment of products and services can be supported by lifecycle thinking. This perspective looks at the whole process chain from "cradle" (i.e., extraction of raw materials) over manufacturing of intermediary and final products and the use phase to "grave" (i.e., end-of-life, disposal, recycling). Lifecycle assessment is the most common method and can be used to assess environmental and social aspects (see ISO 14040, 2006; Weidema, 2004). However, such detailed studies about the sustainability impact of frugal innovations have so far not been conducted. It would be interesting, for example, to take a closer look at the possibility to dismantle or refurbish grassroot frugal innovations, given that this aspect will have a strong impact on the related waste. The distributed production of many grassroot frugal innovations is a benefit to be taken into account, especially given that the transport distances involved in the global supply chains of high-end products often have a significant environmental impact.

Lessons learned between the two frugal streams

Our case study analyses suggests that the different frugal streams can profit from each other in some way. The resource-constrained development processes of grassroot frugal innovators can teach companies how to radically re-think innovation. Methods and tools from both approaches can be valuable.

Industrial companies use elaborate development processes supported by methods such as value curves and morphological boxes in order to obtain deep understanding of the specific requirements of target customers' needs and translate them into suitable concepts. Some of those methods offer very hands-on practical support that can also be very helpful for grassroot frugal startups. Know-how transfer could be done, for example, by mentoring programs or seminars offered by chambers of industry and commerce or regional economic development organizations.

Grassroot frugal entrepreneurs also often struggle to scale up manufacturing of their solutions because the products were not initially designed to be mass manufactured, and the inventors often do not have access to manufacturing assets. Corporate know-how can help

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

them to make their concepts profitable on a large scale. A more recent means for the inventors to access these skills are "maker movement" accelerators (e.g., Dragon Innovation or Lemnos Labs), which teach these skills to inventors.

Grassroot frugal approaches are often based on personal experiences and problems of inventors and entrepreneurs, who come up with ideas on how to improve everyday life with a new product or solution. People involved in grassroot frugal innovations usually have a strong entrepreneurial spirit that enables them to come up with radically new product or service ideas and to successfully re-think the traditional way business models work. Industrial companies can simulate this attitude by collaborations with frugal startups or new organizational forms such as corporate startups.

Other potential approaches for enhancing a grassroot mentality include setting up dedicated R&D teams that are located in the country targeted by frugal solutions. Being close to the end user helps innovators to come up with simplified technical approaches that perfectly match user requirements.

Applying additional methods is also a potential way forward. Tools such as design thinking leverage the idea of (bottom-up) DIY approaches to tightly include customers in (top-down) design processes of industrial companies.

About the Authors

Liza Wohlfart (MA) works as a Scientist and Project Manager at the Competence Center R&D Management of Fraunhofer IAO in Stuttgart, Germany. She has long-term experience with national and international research and consulting projects. Topics of specific expertise include innovation management, business development, frugal innovation, and the human side of R&D. She has been the manager of large international projects, both EU- and industry-funded, where she has been responsible for the development of Community of Interests among Russian SMEs and the establishment of an Innovation Audit Tool for South-Australian SMEs. She is the editor of two books on knowledge management and business development, and she is the author of several scientific publications. She has delivered seminars and intermediary training sessions related to innovation as well as lectures on project management. Her international experience includes several European countries as well as Brazil, Russia, Australia, and Malaysia.

Mark Bünger is Vice President of Research at Lux Research. Since joining Lux in 2005, Mark Bünger has seeded, launched, and led many of the company's intelligence services and consulting work, ranging from bio-based fuels and chemicals to big data in agriculture and healthcare. Mark previously worked at Forrester Research, Accenture, and several successful startups. His business education at Mälardalen Polytechnic (Sweden) and the University of Texas (United States) focused on market research, complemented by studies and lab work in neurology and bioengineering at the University of California (Berkeley and UCSF). He is a standing guest lecturer at UC Berkeley and collaborates widely on studies of innovation with Fraunhofer Institute (Germany), LUMS (Pakistan), Masdar (Abu Dhabi), and the Moscow State University of Mechanical Engineering, among others.

Claus Lang-Koetz is Professor for Sustainable Technology and Innovation Management at Pforzheim University in Pforzheim near Stuttgart, Germany. His research interests are management methods and tools that help companies to deal with innovation ideas and implement them into resource efficient products and solutions – while using new technologies where appropriate.Claus studied Environmental Engineering (Dipl.-Ing.) and Water Resources Engineering and Management (MSc) in Germany and the United States. He worked in applied research at University of Stuttgart and Fraunhofer Institute for Industrial Engineering from 2000 until 2009 and obtained a doctorate in Engineering Science (Dr.-Ing.) at the University of Stuttgart in 2006. From 2009 through 2014, he was Head of Innovation Management at Eisenmann SE, a plant engineering and equipment firm supplying, for example, systems for surface finishing technology worldwide.

Frank Wagner is Head of the Competence Centre R&D Management at Fraunhofer IAO and a lecturer in Technology Management at the University of Stuttgart, Germany. Based in Brisbane, Australia, as a Professor at Queensland University of Technology (QUT), Frank is working on R&D and innovation projects mostly relating to the Innovation Manufacturing CRC and Assistive Technologies. He has over two decades of experience in implementing numerous innovation and technology management, corporate development, and organizational design projects across various sectors in Australia, Asia, America, and Europe.

Corporate and Grassroot Frugal Innovation

Liza Wohlfart, Mark Bünger, Claus Lang-Koetz, and Frank Wagner

References

Brem, A., & Ivens, B. 2013. Do Frugal and Reverse Innovation Foster Sustainability? Introduction of a Conceptual Framework. *Journal of Technology Management for Growing Economies,* 4(2): 31–50.

Burning Man. 2016. Burners Without Borders. *BurningMan.org.* Accessed April 1, 2016: http://burningman.org/culture/civic-programs/burners-without-borders/

Fairwaves. 2014. Fairwaves: Bringing Mobile Communication to the Next Billion. *Venture Capital for Africa.* Accessed April 1, 2016: https://vc4a.com/ventures/fairwaves/

Fairwaves. 2015. Our Solution: Profitable Networks Anywhere. *Fairwaves.com.* Accessed April 1, 2016: https://fairwaves.co/our-solution/

Fraunhofer IAO. 2014. *Low-Cost Innovation. Frugale Innovationen als Weg zur Erschließung kostensensitiver Märkte.* Presented at Fraunhofer IAO seminar: Low-Cost Innovation. Frugale Innovationen als Weg zur Erschließung kostensensitiver Märkte, November 12.

Fraunhofer IAO. 2012. *Wenn weniger mehr ist. Durch Low Cost Innovationen neue Kundengruppen gewinnen.* Seminar. 28 June 2012.

Glemser, D. 2013. *Low-Cost Innovationen: Charakteristika und Erfolgsfaktoren.* Master's thesis at the University of Stuttgart, Institute for Work Science IAT.

Grallert, A. 2014. *Konsequentes Innovationsmanagement durch Strategiewechsel: Eine Hotelmarke erfindet sich neu.* Presented at Fraunhofer IAO seminar: Low-Cost Innovation. Frugale Innovationen als Weg zur Erschließung kostensensitiver Märkte, November 12.

ISO 14040. 2006. *Environmental Management – Life Cycle Assessment – Principles and Framework.* Berlin: Beuth Verlag.

Jänicke, M. 2014. Frugale Technik. *Ökologisches Wirtschaften,* 29(1): 30–36. http://dx.doi.org/10.14512/OEW290130

Prahalad, C. K. 2010. *The Fortune at the Bottom of the Pyramid.* New Jersey: Wharton School Publishing.

Schrader, C. 2011. Beiträge multinationaler Unternehmen zur nachhaltigen Entwicklung in Base of the Pyramid-Märkten. In J. Freimann (Ed.), *Schriften zur Nachhaltigen Unternehmensentwicklung.* Munich: Rainer Hampp Verlag.

Strotz, M. 2014. *Low Cost Innovations. R&D in China – Lessons Learned.* Presented at Fraunhofer IAO seminar: Low-Cost Innovation. Frugale Innovationen als Weg zur Erschließung kostensensitiver Märkte, November 12.

UN General Assembly. 2011. *Report of the Special Rapporteur on the Promotion and Protection of the Right to Freedom of Opinion and Expression.* New York: United Nations General Assembly.

Weidema, B. P. 2004. The Integration of Economic and Social Aspects in Life Cycle Impact Assessment. *The International Journal of Life Cycle Assessment,* 11(Suppl. 1): 89–96. http://dx.doi.org/10.1065/lca2006.04.016

Wikitravel. 2016. Black Rock City. *Wikitravel.org.* Accessed April 1, 2016: http://wikitravel.org/en/Black_Rock_City

Zeschky, M., Wiedenmayer, B., & Gassmann, O. 2011. Frugal Innovation in Emerging Markets. *Research Technology Management,* 54(4): 38–45. http://dx.doi.org/10.5437/08956308X5404007

Citation: Wohlfart, L., Bünger, M., Lang-Koetz, C., & Wagner, F. 2016. *Corporate and Grassroot Frugal Innovation: A Comparison of Top-Down and Bottom-Up Strategies. Technology Innovation Management Review,* 6(4): 5–17. http://timreview.ca/article/977

Keywords: frugal innovation, sustainability, corporate frugal innovation, grassroots frugal innovation, case studies, startups

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

> *"The belief that human cultures in the workplace should resemble the laws of physics and engineering is a cultural, not a scientific belief."*
>
> Fons Trompenaars and Charles Hampden-Turner
> In *Riding the Waves of Culture* (1998)

Over a period of decades, a substantial body of knowledge has accumulated that correlates national culture and socially and economically important behaviour, including innovation practice. National culture is an interconnected web of mental models that is shared by national groups and transcends the individual. It is highly influential in moderating the cognition and behaviour of groups and individuals. Different resources, including cognition and behaviour, are required at the different stages of the innovation process, and the context, including national culture (within which innovation is practiced), is an important consideration in designing strategy. Because innovation is a psychological and social process, understanding how national culture moderates that cognition and behaviour within the different stages of the innovation process and how the wider innovation ecosystem impacts innovation practice is central to understanding, strategizing and managing the innovation process. However, there has been limited application of this knowledge by practitioners. Therefore, this article examines the importance of national culture from a practitioner perspective, distilling the managerial implications and providing a list of questions that serve as a checklist to enable practitioners to analyze the implications of their own national and organizational context.

Introduction

There is a popular misconception that there is a universal innovation model that can be applied to all strategy and policy without translation across cultures, but "one best way is a yearning not a fact" (Trompenaars & Hampden-Turner, 1998). This misconception may arise in part from the domination of the academic and especially the popular literature by an American cultural paradigm that is based on an assumption of "maximizing", that is, the pursuit of the best possible outcome given the prevailing constraints which themselves are favourable to this pursuit. This paradigm includes factors such as attitudes to risk and failure (e.g., as reflected in bankruptcy laws), positive attitudes to venture financing, and the pursuit of economic objectives ahead of social ones. It is in contrast to a satisficing paradigm (as exists in New Zealand, for instance) where people settle for a "good enough" outcome and have punitive bankruptcy laws, constrained attitudes to venture finance, and pursue social objectives ahead of economic ones (Crocombe et al., 1991; Morrison & Conaway, 2006). To counterbalance this misconception, this article argues that the impact of national culture on cognition and behaviour through various channels should be taken account of in the practice of innovation management.

The creation of wealth is, according to NESTA (2007), the only valid measure of innovation performance. However, being creative or inventive is no guarantee of achieving this desired outcome (Baumol, 2004; Freeman, 2002), nor is grouping highly creative people together any guarantee of inventiveness (Trompenaars, 2007). Rather, in this article, it will be established that there are two key stages of the innovation process, that different "resources" including cognition and behaviour are required for each stage, and that different na-

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

tions have relative strength or weakness in these two stages, to some statistically significant degree attributable to national culture.

Spolaore and Wacziarg (2010) reported that institutional design is, in part, a function of national culture. Consequently, institutions, processes, policies and the like, as well as cognition and behaviour, in the absence of compensatory strategies and policies, will be designed with a bias towards national culture. The key argument advanced here is that, because some nations and firms naturally favour one or other stage of the innovation process, strategies must be designed accordingly. This article therefore explores the role of national culture in innovation outcomes and argues that there is sufficient evidence to warrant inclusion of national culture considerations in designing innovation strategy and policy. It concludes with a checklist to assist practitioners in incorporating considerations of national culture into their strategizing and management.

National Culture: Definition and Role

Distinct cultures evolved as different groups adapted to their respective challenges, as they "solved problems and reconciled dilemmas" (Trompenaars & Hampden-Turner, 1998). That is, national culture evolved as a consequence of differences in ancient innovation strategies. Accordingly, the most comprehensive and useful definition of national culture may be: "a learned, socially transmitted set of behavioural standards. It is held, expressed, and shared by individuals through their personal values, norms, activities, attitudes, cognitive processes, interpretation of symbols, feelings, ideas, reactions and morals" (Morris et al., 1994). National culture moderates cognition and behaviour by filtering the data received by the brain and providing mental models and heuristics for the interpretation of what data makes it through the filtering process. Such mental models "are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action" (Senge, 2006).

Ultimately, however, the greatest practical impact of national culture likely comes from the interface between the individuals, groups, and institutions involved in innovation and the wider groups and national environment they function within and the prevailing attitudes to risk, failure, collaboration and sharing of resources, funding, creativity, entrepreneurship, discovery, and adventure. These aspects are all of significance to the innovation process and are all moderated by national culture. This impact can be profound when a cultural fit is absent.

The impact of national culture on how individuals and groups think and behave is substantial and can even influence the development of neural pathways (Zaltman, 2003), a process "which in turn impacts the way the individual approaches problem solving and day-to-day work" (Livermore, 2011). National culture is more influential in how we process data, draw conclusions, and decide upon our actions than age, race, gender, religion, education, or occupation (Livermore, 2011; Trompenaars & Hampden-Turner, 1998). There is also evidence that, even in science, interpretation of apparently objective data is impacted by national culture (e.g., Fanelli & Ioannidis, 2013; Hofstede, 1994; Senge, 2006).

As in any complex system, the individual elements do not function in isolation and instead form a complex web that waxes and wanes in its influence depending on context (Trompenaars & Hampden-Turner, 1998). The challenge for practitioners therefore is to attempt to understand that complex web and its interaction with the contextual environment and then reconcile the strategy and organizational culture design with the conflicts or dilemmas that represents.

National culture and socially and economically important behaviours

Work by various authors, in particular Hofstede (2001), House and colleagues (2001), Schwartz (1999), and Trompenaars and Hampden-Turner (1998), has established that differences in cognition and behaviour moderated by national culture exist between national groups in material and predictable ways and can be ranked and compared using dimensions such as femininity/masculinity, individualism/collectivism, power distance index, uncertainty avoidance, and universalism/particularism. The works are not without detractors, not the least of which is bitter disagreement between the principle exponents in the field with Hofstede (2001) describing the typologies of Trompenaars and Hampden-Turner or Schwartz as no more than "categories" of culture or "intercorrelated flavours". Although the typologies of the authors listed above vary in the description of their dimensions, they show clear-cut differences between, for example, northwest Europe (analysis, logic, systems, and rationality) and the Euro-Latin region (more person related, intuitive, and sensitive) and even between neighbouring Dutch

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

and Belgians (Trompenaars & Hampden-Turner, 1998). At the very least, the typologies offer different insights of use to practitioners. For example, Schwartz's affective autonomy provides a useful predictor of a preference for individual adventure, inquiry, and discovery, which might reasonably be associated with initiation.

The published rankings of national culture dimensions (e.g., Hofstede, 2001; House et al., 2001; Schwartz, 1999; Trompenaars & Hampden-Turner, 1998) are often (but not always) averaged for entire countries, and it is acknowledged that there are significant regional differences, for example, between northern and southern Italy or the east and west coasts of the United States. But, irrespective of these findings, each subset tends to share common biases (Trompenaars & Hampden-Turner, 1998). Concern is also sometimes expressed about the stability of culture. Some dimensions such as masculinity/femininity do appear to be changing relatively rapidly, but the evidence points to extremely slow overall change in national culture. Hofstede (2001) claims that the values held by a culture in the year 1900 were already evident in 1700 and Trompenaars and Hampden-Turner (1998) make reference to tracing culture to the Roman period. Spolaore and Wacziarg (2012) go further, claiming that the roots of modern European cultures can be traced to the Neolithic period. Nonetheless, if change should occur, it reinforces rather than detracts from the need for practitioners to be fully cognizant of the role and impact of cognition and behaviour moderated by national culture.

Psychological and social processes

National culture moderates cognition and behaviour is salient because "creativity, innovation, and initiative are psychological [and social] processes" (Rank et al., 2004). That is, national culture is a function of how individuals and groups of people think and behave. Innovation should therefore be analyzed, planned, and managed from a series of perspectives including national culture. There is no suggestion that narrower analyses and conclusions are wrong, but they are incomplete and risk overlooking the complexities of systemic thinking.

Stages of the innovation process

The literature describes, across different models, as many as 13 stages of the innovation process (INNOCULT, 2006; Nakata & Sivakumar, 1996). However, one model in particular that adopts two stages – initiation and implementation (INNOCULT, 2006; Marino, 1982; Rank et al., 2004; Scott & Bruce, 1994; Zmud, 1982) – is particularly salient for this discussion. Initiation is the process of engaging in and supporting new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes (Lumpkin & Dess, 1996). Implementation is the development, sale, and adoption of those new products, services, and processes to achieve entry into new or existing markets with new or existing products or services with the aim, in this context, of creating new value and wealth/prosperity.

Different "resources" required at different stages

The literature establishes that different resources, skills, cognition, and behaviours and even "ecosystems" are needed to optimize each of the stages and that progression from one stage to the next is not automatic (e.g., Jaumotte & Pain, 2005; Pisano & Teece, 2007; Shane, 1992).

Correlation between innovation and national culture

Empirical research has established statistically significant correlations and attributed causality between national culture and economic development and innovation:

1. Economic development (e.g., Hull, 2003; Lundvall, 2006; Schuendeln & Hassan, 2015; Spolaore & Wacziarg, 2010; Pohlmann, 2005): Spolaore and Wacziarg (2010) report that national culture may be more influential than "institutional arrangements".

2. Innovation, including differentially both initiation and implementation (e.g., Nakata & Sivakumar, 1996; Rank et al., 2004; Shane, 1992, 1993, 1995). Various authors argue that human dynamics and national culture play a major role in the efficacy of the innovation process (e.g., Frederick & Chittock, 2006; Hofstede, 2001; Shane, 1992, 1993, 1995), whereas Rank, Pace, and Frese (2004) and Pohlmann (2005) observe that creativity and innovation are culturally moderated responses to environmental stimuli. Furman, Porter, and Stern (2002) note that "innovative capacity" is a product of both the innovation infrastructure and the environment for innovation as well as the strength of linkages between them. Trompenaars (2007) writes at length on the importance of factoring national culture into the management of "creativity and innovation". It is possible therefore to use this information to predict which national groups will have relative strengths in innovation and will provide supportive cultures for the respective stages of the innovation process.

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

Trompenaars (2007) establishes that the same dimensions and correlations can be used to rank and compare both organizational and national cultures. This approach facilitates ready mapping of the two types of culture for easy visual comparison, or at least an approximation. Figure 1 shows examples of dimensions associated with the two stages of innovation alongside an example of two countries possessing dimensions that predict a preference for initiation (New Zealand) and implementation (Japan) respectively. Organizational culture can be mapped and overlaid on the same grid if desired. The first map was constructed by plotting the reported correlations between national culture dimensions and the two stages of innovation as reported by Covin and Slevin (1991); Lumpkin and Dess (1996); Lee and Peterson (2000); Nakata and Sivakumar (1996); Rank, Pace, and Frece (2004); and Shane (1992, 1993).The second map is constructed by mapping those same dimensions for the ratings for the two countries respectively, as reported by Trompenaars and Hampden-Turner (1998), Schwartz (1999), Hofstede (2001), and House, Javadin, and Dorfman (2001).

Of considerable salience to innovation practitioners is Nakata and Sivakumar's (1996) integrative review that clarified the correlations between national culture and initiation and implementation; it showed that the correlations are effectively inverse and mutually exclusive. That is, cultures are spread across a continuum from a strong preference for the cognition and behaviour associated with initiation – many countries with Anglo-Saxon roots are at this end of the continuum – through to those with an inclination to the detail and discipline of implementation. Most Asian and Middle Eastern cultures fall into the latter category. This pattern can be referred to as *innovation orientation.*

Not prisoners to culture

A key consideration here is that firms and nations are not prisoners of their national culture provided they devise their strategies accordingly. For example, when research by Helmreich and Merrit (1998) established the role of national culture in disastrous safety record of Korean Airlines from the 1970s to the 1990s , new international safety rules to deal with what is now referred to in the airline industry as "gradient" quickly saw the airline become a paragon of aviation safety. In the past, many nations and firms have, apparently by serendipity, developed compensatory innovation strategies. According to Gareth Chaplin, Chief Economist New Zealand Trade and Enterprise (personal communication, 2012), China recently appears to have implemented a more deliberate strategy to complement its existing implementation-biased culture with strategies to augment initiation by investing heavily in research, science, and technology education and institutions, and in acquiring highly inventive foreign businesses.

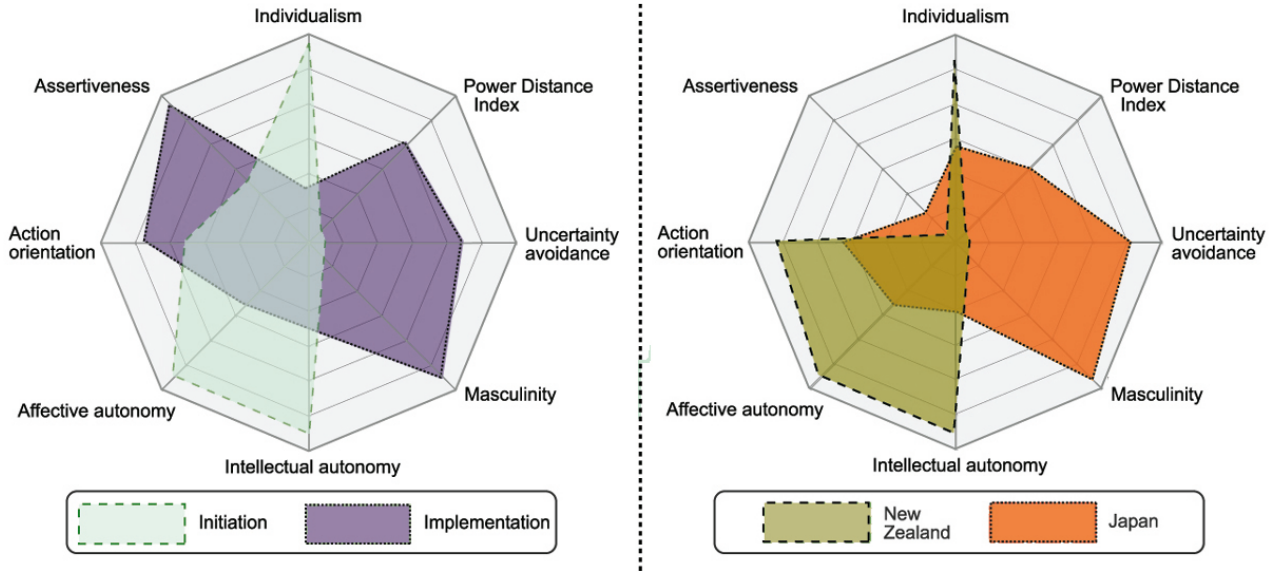

Figure 1. Culture maps showing (left) the comparative "shape" of cultures favouring initiation and implementation respectively and (right) two country examples showing equivalent preferences.
Note: Low assertiveness is not a barrier to initiation although high assertiveness favours implementation.

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

How National Culture Impacts the Innovation Process

National culture impacts the innovation process in two principal ways:

1. Although we cannot predict the innovation-related cognition and behaviour of any individual from their national culture, because cultures overlap, we can as a matter of probability conclude the likelihood of them being biased in one direction or the other. We can assume that they will be more comfortable and familiar with environments aligned with their own national culture. Conversely, they are likely to experience some cognitive dissonance when there is neither alignment nor support.

2. Because institutional arrangements, financial systems, attitudes to risk and failure, and so on are all functions of national culture (Spolaore & Wacziarg, 2010), institutions performing the innovation process are inevitably impacted by that environment. When goals, strategies, organizational culture, and national culture are not coincident, there will be tensions, dissonance, conflict and dilemmas. When they are aligned, the opportunity for synergies is created.

Consider the following example in which national culture is, in the author's experience, a plausible contributor to New Zealand's position in the innovation landscape. New Zealand's national culture comprises an array of cultural dimensions such as high affective autonomy, high individualism, and low uncertainty avoidance that favour the cognition and behaviour associated with initiation. As a result, we can predict that it will have a strong bias towards initiation and that appears in practice to be the case. This bias may explain why i) the country spends less on research, science, and technology than most of the nations that it compares itself with; ii) it publishes science at twice the OECD average; and iii) it patents at one quarter the OECD average (OECD, 2010). New Zealand institutions are examples of high-level initiation not translating into innovation outcomes. The OECD has described this and similar situations as "The New Zealand paradox" (OECD, 2003), because its economic fundamentals, including its forward-facing innovation indicators suggest it should perform much better than it does. For whatever reason, the net effect is that New Zealand does not generate the yield from its creativity that it potentially could. The Ministry of Economic Development (MED, 2007) described this as a "wedge" or "barrier". Drummond (2011), in his paper entitled "Confessions of a Serial Productivity Researcher", makes a similar lament for Canada and the parallels he reports between the two countries are remarkable.

Why Understanding National Culture Is Increasingly Important

As recently as twenty five years ago, many workplaces, especially those outside of academia, were comparatively culturally homogenous. Everyone looked and sounded familiar. They shared familiar values and similar life goals. Historically, even where firms operated in foreign lands, a head office's cultural paradigm tended to prevail irrespective of where the operation was located (Trompenaars & Hampden-Turner, 1998). Firms from the Netherlands led and continue to lead in the adoption of national culture into strategizing, not coincidentally as a result of Hofstede and Trompenaars' Dutch roots. The net effect of increasing heterogeneity is not some sort of averaging where the significance of national culture is diluted but is rather the exact opposite. Paradoxically, as Ang, Van Dyne, and Tan (2010) state, "although technology is often a force for convergence, deep-seated cultural differences and cultural diversity present critical challenges to people all over the world. In sum, globalization increases intercultural interactions and also increases the probability of cultural misunderstandings, tensions and conflicts." That is, a greater proportion of the workforce is operating outside of their own national culture context and are managed by and work with people from different cultural backgrounds (Livermore, 2011). Along with rising nationalism (Trompenaars, 2007), this mean that the potential for inter-cultural misunderstandings and resulting performance issues is increasing. Consequently, the need for managers in all disciplines to accommodate within their strategies the variety of national cultures and contexts is heightened.

Implications for Practitioners

But, in practice, how can organizations reconcile national culture with strategy? Below, we list the implications and associated recommendations for practitioners and then offer a checklist of required information and possible actions:

1. Attempting to directly replicate strategies and policies across different firms and nations, without proper consideration of national culture, carries a considerable risk. Learn from others but do not imitate without cultural translation.

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

2. Practitioners need to be fully cognizant of the national, organizational, and personal cultural paradigms at play, their relationship with strategy, and the potential conflicts and dilemmas that represents.

3. When strategy, organizational culture, and national culture are reconciled, or at least not in conflict, then synergies are likely. When they are not, friction points arise (recognizing that friction points themselves may give rise to new initiation) and returns may be compromised. Strategy is overwhelmed by culture.

4. Resources are invested in the initiation stage. Value is created and harvested in the implementation phase.

5. In order to create and harvest value, firms and nations must have access to both initiation and implementation.

6. Initiation can be exogenous but the point of value harvest (part of the implementation stage) cannot be.

7. An abundance or surplus of capability and capacity in one stage cannot substitute for a deficit of the other.

8. If a firm or nation has comparative strength in one or other of the innovation stages, further investment in that stage will not deliver optimal returns.

9. Woodhouse (2006) found that moderate levels of both bonding and bridging social capitals produced superior results compared to high levels of one or the other. There are significant parallels between the role of the two types of social capital in economic development and cognition and behaviour associated with the two stages of the innovation process. This is key in developing strategy and policy. Firms and nations must first determine their innovation goals (do they need to foster initiation, implementation, or both?) and reconcile that with their comparative strength in each of the two major innovation stages, including the moderating effect of national culture. If a firm or nation wants an end-to-end innovation process then it must, like China, strategize achieving adequate and balanced levels of both initiation and implementation. If the intended strategy is to use exogenous initiation (open innovation), then culture should be aimed towards implementation. For a part of an organization (a whole organization rarely has this goal) that has the sole goal of generating inventions and or discoveries with no responsibility for converting those into and harvesting value, then the culture should be biased towards initiation.

10. Although it is widely accepted that workforce cultural diversity is associated with increased creativity, the findings of Milliken and Martins (1996) support the author's own experience: in the absence of specific management strategies, the beneficial effects are lost due to groups and organizations systematically driving out individuals who are different from the majority, that is, those that do not have a cultural fit.

11. The national culture of team members is therefore important. It provides a pointer as to their innovation comfort zone. It will also provide an indication of how robust managing diversity will need to be.

12. Managers must be fully cognizant of the impacts of national culture on the pursuit of their innovation goals and fully factor consideration into their strategizing.

Checklist for practitioners

1. Does the national culture of the country that we are operating in have a bias towards initiation or implementation?

2. What are our nation's and firm's relative performance in the two stages of the innovation process?

3. What is the implication of the national culture in which we operate in for funding, risk taking, collaboration, relationships with government, competition, etc.?

4. What are our innovation goals – drive initiation, implementation, or balance both, outsource/in-house initiation?

5. To what degree do our organizational and national cultures align and complement or hinder our goals and strategies?

6. What culture or cultures do we need to promote and which strategies do we need to adopt?

7. Is our organizational culture aligned with the national culture in which we operate? If not, what are the implications for the organization and its staff?

8. Where in the innovation process is the point that value is created and available for harvest?

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

9. Do we "own" that point?

10. What is the diversity of our team? How does this diversity relate to our organizational culture and the national culture in which we operate?

11. How robust does our diversity management need to be to ensure the desired cognition and behaviour are facilitated and cognitive dissonance minimized?

Conclusion

In designing innovation strategies, managers must be fully cognizant of the different stages of the innovation process; their relative personal, organizational, and national strengths or biases towards those stages; and the implications of organizational and national culture. This awareness will provide insights to the dilemmas and conflicts that they will need to reconcile or resolve and where the opportunities for creating synergies exist. They must, in order to apply the available knowledge connecting national culture and innovation performance, case by case, design strategy that is context specific where goals, institutional culture, staff traits, and national culture are aligned and work in unison. The alternative risks under-performance and sub-optimal returns on investment in innovation.

About the Author

Tony Smale is a Principal Management Consultant with Forté Management, an independent thinking New Zealand business, consulting, coaching, and training practice. Tony began life as a laboratory scientist and manager. He holds an MBA from Henley Business School at the University of Reading, United Kingdom, and is accredited as an Economic Development Professional. Tony's MBA dissertation was entitled *The Impact of National Culture on New Zealand's Innovation Outcomes.* Since then, he has complemented that work by nearly a decade exposing and testing the arguments in the dissertation with innovation, management, and economic development professionals across many nations and especially working with them to explain and reconcile the dilemmas and conflicts that they encounter in their work and personal lives, both living and working in their home countries and especially as immigrants in foreign cultures. He is an experienced speaker and has completed a number of international engagements including at the UNFCCC, the OECD LEED Forum, and subsequently serving on an OECD Expert Panel.

References

Ang, S., Van Dyne, L., & Tan, M. L. 2010. Cultural Intelligence. In R. J. Sternberg & S. B. Kaufman (Eds.), *The Cambridge Handbook of Intelligence:* 582–602. Cambridge, UK: Cambridge University Press.

Baumol, W. J. 2004. Entrepreneurial Cultures and Countercultures. *Academy of Management Learning and Education,* 3(1): 316–326. http://dx.doi.org/10.5465/AMLE.2004.14242240

Covin, J. G., & Slevin, D. P. 1991. A Conceptual Model of Entrepreneurship as Firm Behaviour. *Entrepreneurship Theory and Practice,* 16(1): 7–25.

Crocombe, G. T., Enright, M. J., & Porter, M. E. 1991. *Upgrading New Zealand's Competitive Advantage.* Auckland: Oxford University Press.

Drummond, D. 2011. Confessions of a Serial Productivity Researcher. *International Productivity Monitor,* 22: 3–10.

Fanelli, D., & Ioannidis, J. P. A. 2013. US Studies May Overestimate Effect Sizes in Softer Research. In *Proceedings of the National Academy of Sciences of the United States of America,* 110(37): 15031–15036. http://dx.doi.org/10.1073/pnas.1302997110

Frederick, H. H., & Chittock, G. 2006. *Global Entrepreneurship Monitor Aotearoa New Zealand: Executive Report.* Auckland, NZ: New Zealand Centre for Innovation and Entrepreneurship.

Freeman, C. 2002. Continental, National and Sub-National Innovation Systems – Complementarity and Economic Growth. *Research Policy,* 31(2): 191–211. http://dx.doi.org/10.1016/S0048-7333(01)00136-6

Furman, J. L., Porter, M. E., & Stern, S. 2001. The Determinants of National Innovative Capacity. *Research Policy,* 31(6): 899–933. http://dx.doi.org/10.1016/S0048-7333(01)00152-4

Helmreich, R. L., & Merrit, A. C. 1998. *Culture at Work in Aviation and Medicine: National, Organisational and Professional Influences.* Farnham, UK: Ashgate Publishing.

Hofstede, G. 1994. Management Scientists are Human. *Management Science,* 40(1): 4–13. http://dx.doi.org/10.1287/mnsc.40.1.4

Hofstede, G. 2001. *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations across Nations* (2nd ed.). Thousand Oaks, CA: Sage Publications.

House, R., Javadin, M., & Dorfman, P. 2001. Project GLOBE: An Introduction. *Applied Psychology: An International Review,* 50(4): 489–505. http://dx.doi.org/10.1111/1464-0597.00070

Hull, L. 2003. *A Promotion of Enterprise Culture – Theory and Practices Working Paper.* Wellington, NZ: Ministry of Economic Development.

Why National Culture Should Be at the Heart of Innovation Management

Tony Smale

INNOCULT. 2006. *Deliverable D5: Literature Review – Analysing National Research Systems.* Vienna: Comparative Research in the Social Sciences (ICCR)

Jaumotte, F., & Pain, N. 2005. *Innovation in the Business Sector.* OECD Economics Department Working Paper No. 459. Paris: OECD Publishing.

Lee, S. M., & Peterson, S. J. 2000. Culture, Entrepreneurial Orientation and Global Competitiveness. *Journal of World Business,* 35(4): 401–416.
http://dx.doi.org/10.1016/S1090-9516(00)00045-6

Livermore, D. 2011. *The Cultural Intelligence Difference.* New York: AMACOM.

Lumpkin, G. T., & Dess, G. G. 1996. Clarifying the Entrepreneurial Orientation Construct and Linking It to Performance. *Academy of Management Review,* 21(1): 135–172.
http://dx.doi.org/10.5465/AMR.1996.9602161568

Lundvall, B. 2006. *Nation States, social Capital and Economic Development – A Systems Approach to Knowledge Creation and Learning.* Working Paper No.13. Copenhagen, Denmark: Institute for History, International and Social Studies, Aalborg University.

Marino, K. E. 1982. Structural Correlations of Affirmative Action Compliance. *Journal of Management,* 8(1): 75–93.
http://dx.doi.org/10.1177/014920638200800105

MED. 2007. *Growth Through Innovation – Sustainable Economic Growth for All New Zealanders.* Wellington, NZ: Ministry of Economic Development (MED), New Zealand Government.

Milliken, F. J., & Martins, L. L. 1996. Searching for Common Threads: Understanding the Multiple Effects of Diversity in Organizational Groups. *Academy of Management Review,* 21(2): 402–433.
http://dx.doi.org/10.5465/AMR.1996.9605060217

Morris, M. H., Davis, D. L., & Allen, J. W. 1994. Fostering Corporate Entrepreneurship: Cross-Cultural Comparisons of the Importance of Individualism versus Collectivism. *Journal of International Business Studies,* 25(1): 65–89.
http://dx.doi.org/10.1057/palgrave.jibs.8490849

Morrison, T., & Conaway, W. A. 2006. Kiss, Bow, or Shake Hands (2nd ed.). Avon, MA: Adams Media.

Nakata, C., & Sivakumar, K. 1996. National Culture and New Product Development: An Integrative Review. *Journal of Marketing,* 60(1): 61–72.
http://dx.doi.org/10.2307/1251888

NESTA. 2007. *Hidden Innovation: How Innovation Happens in Six 'Low Innovation' Sectors.* London: National Endowment for Science, Technology, Arts (NESTA).

OECD. 2003. *Economic Surveys: New Zealand.* Paris: OECD.

OECD. 2010. *Science, Technology and Industry Outlook.* Paris: OECD.

Pisano, G. P., & Teece, D. J. 2007. How to Capture Value from Innovation: Shaping Intellectual Property and Industry Architecture. *California Management Review,* 50(1): 278–296.
http://dx.doi.org/10.2307/41166428

Pohlman, M. 2005. The Evolution of Innovation: Cultural Backgrounds and the Use of Innovation Models. *Technology Analysis & Strategic Management,* 17(1): 9–19.
http://dx.doi.org/10.1080/09537320500044396

Rank, J., Pace, V. L., & Frese, M. 2004. Three Avenues for Future Research on Creativity, Innovation, and Initiative. *Applied Psychology: An International Review,* 53(4): 518–528.
http://dx.doi.org/10.1111/j.1464-0597.2004.00185.x

Schuendeln, N., & Hassan, P. A. 2015. *Natural Experiments in Macro-Economics.* National Bureau of Economic Research Working Paper 21228. Cambridge, MA: National Bureau of Economic Research.

Schwartz, S. H. 1999. A Theory of Cultural Values and Some Implications for Work. *Applied Psychology: An International Review,* 48(1): 23–47.
http://dx.doi.org/10.1111/j.1464-0597.1999.tb00047.x

Scott, S. G., & Bruce, R. A. 1994. Determinants of Innovative Behaviour: A Path Model of Individual Innovation in the Workplace. *Academy of Management Journal,* 37(3): 580–607.
http://dx.doi.org/10.2307/256701

Senge, P. 2006. *The Fifth Discipline – The Art & Practice of the Learning Organisation.* London: Random House Business Books.

Shane, S. A. 1992. Why Do Some Societies Invent More than Others? *Journal of Business Venturing,* 7(1): 29–46.
http://dx.doi.org/10.1016/0883-9026(92)90033-N

Shane, S. A. 1993. Cultural Influences on National Rates of Innovation. *Journal of Business Venturing,* 8(1): 59–73.
http://dx.doi.org/10.1016/0883-9026(93)90011-S

Shane, S. A. 1995. Uncertainty Avoidance and the Preference for Innovation Championing Roles. *Journal of International Business Studies,* 26(1): 47–68.
http://dx.doi.org/10.1057/palgrave.jibs.8490165

Spolaore, E., & Wacziarg, R. 2012. *How Deep are the Roots of Economic Development?* National Bureau of Economic Research Working Paper 18130. Cambridge, MA: National Bureau of Economic Research.

Trompenaars, F., & Hampden-Turner, C. 1998. *Riding the Waves of Culture.* New York: McGaw-Hill.

Trompenaars, F. 2007. *Riding the Whirlwind: Connecting People and Organisations in a Culture of Innovation.* Oxford, UK: The Infinite Ideas Company.

Woodhouse, A. 2006. Social Capital and Economic Development in Regional Australia: A Case Study. *Journal of Rural Studies,* 22(1): 83–94.
http://dx.doi.org/10.1016/j.jrurstud.2005.07.003

Zaltman, G. 2003. *How Customers Think.* Boston, MA: Harvard Business School Publishing.

Zmud, R. W. 1982. Diffusion of Modern Software Practices: Influence of Centralization and Formalization. *Management Science,* 28(12): 1421–1431.
http://dx.doi.org/10.1287/mnsc.28.12.1421

Citation: Smale, T. 2016. Why National Culture Should Be at the Heart of Innovation Management. *Technology Innovation Management Review,* 6(4): 18–25. http://timreview.ca/article/978

Keywords: national culture, creativity, innovation, initiation, implementation

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

> *"We believe that ideas only become great when they are challenged and tested."*
>
> Ed Catmull
> President of Pixar Animation Studios
> In *Creativity, Inc.*

Novel and useful ideas and creative behaviours originate in varied work environments, yet the characteristics of work environments that stimulate and foster such creative behaviours are not well defined. The aim of this study was to identify the influences that contribute to creative behaviours in the work environment of a global project-based professional service organization. This article is based on an investigation of the work environment of one project team undertaking interdisciplinary work in the construction of a processing plant in a remote location. This multi-disciplinary team encouraged creative behaviours through regular team meetings, ensuring the presentation of diverse views and commitments to regular interaction and collaboration in co-located environments. In addition, a technology manager dedicated to identifying potential opportunities for patenting and commercialization further extended the creative behaviours of the team by focusing on the best solution for each situation. The study contributes new knowledge to research regarding work environments that facilitate creative behaviours.

Introduction

Organizational creativity is the creation of a valuable and useful new product, service, idea, procedure, or process by individuals working together in a complex social system (Woodman et al., 1993). Broadly defined, innovation is the successful application of ideas (Matthews, 2002). Innovation depends on ideas generated through creativity and the knowledge and research that make it possible to put ideas to work (Naggar, 2015). Companies that can develop and implement creative ideas perform better in changing operating situations, with CEOs recognizing the value of empowering and mobilizing the collective brainpower of the workforce for innovation (IBM, 2010). Further research into creative processes and their antecedents across different types of organizations, jobs, and teams is confirmed as an obvious priority (Gilson & Shalley, 2004).

The study described in this article was framed to gain insight into these antecedents in work environments. It features an investigation of the characteristics of work environments that generate creative behaviours within one project team in a medium-sized, global, consulting engineering, project-based organization.

This study contributes new knowledge to research regarding work environments that facilitate creative behaviours by highlighting the processes used when diverse, interdisciplinary employees meet in regular design review meetings, which stimulate individual and collective creative behaviours. These behaviours, further extended by a technology manager, support the creation and capture of innovative solutions that also deliver commercial value for the company.

We begin by considering extant research regarding links between creative behaviours and work environments, before outlining methodology and describing findings and concluding with practical implications.

Work Environments and Creative Behaviours

Work environments that encourage creative behaviours have previously been defined in R&D teams (Amabile, Hadley, & Kramer, 2002) and in the animation and film

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

industry (Catmull, 2008), but less attention has been given to other work environments. The research question we are addressing is: What are the characteristics of work environments that encourage creative behaviours in a project-based organization? A review of literature across work environments and creative behaviours follows.

Creative behaviours appear to result from the complex interactions between the person and situation (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Woodman et al., 1993). They emerge in response to challenging work, openness to new ideas, and an experimental mindset (Woodman et al., 1993). Creative behaviours focus on the initial phases of the innovation process, that is the idea generation, exploration stage to the exclusion of the implementation stages (Kanter, 1988; Shalley & Gilson, 2004). Examples of creative behaviours include searching out new technologies and suggesting new ways to achieve objectives (West, 2002). Results of creative behaviours could range from suggestions for incremental adaptations in procedures, to radical and major breakthroughs in the development of new products (Mumford & Gustafson, 1988).

Major contributions to understanding work environments have come from Amabile and colleagues (1996) through their work on the KEYS model for measuring environmental components that work as either stimulants or obstacles to creative behaviours. An interactional perspective of the complex social systems influencing organizations was developed by Woodman, Sawyer, and Griffin (1993). Team climate factors influencing team behaviours were investigated by Anderson and West (1998) and Isaksen and Ekvall (2010), while Dul and Ceylan (2011) considered influences on a work environment to have personal, social-organizational and physical factors. Recent research emphasizes the importance of synthesizing divergent perspectives in the idea-generation process focusing on the nature of the team work environment (Hackman, 2011).

Previous research indicates several characteristics and mechanisms that influence creative behaviours in team-based work environments, including i) the behaviour of the manager (Hennessey & Amabile, 2010), ii) design of work (Shalley, 2004), iii) provision of time for creativity (Dul & Ceylan, 2011), iv) attitude to risk (Dulaimi et al., 2002; Hartmann, 2006), v) existence of positive versus negative tensions (Isaksen et al., 2001; Shalley & Gilson, 2004), vi) effective management of different types of conflict (Jehn, 1995; Pelled, 1996), vii) extent of collaboration within and across teams (Taylor & Greve, 2006; Thompson & Choi, 2005), vii) level of participation in decision making (Harvey & Kou, 2013), ix) existence of an effective process for creativity management (Smith et al., 2008), and x) positive social relationships (Amabile & Gryskiewicz, 1989; Hennessey & Amabile, 2010), among others. Many factors appear to be operating together in a cumulative and complex manner within the work environment. An understanding of the nature and characteristics of these factors invites further research, and a project-based organization provides a new context (Stanley et al., 2014).

The nature of work environments has previously been investigated through a variety of methods. These include semi-structured interviews using the critical incident technique to explore best and worst team environments (Amabile et al., 2002), examination of daily diaries (Amabile et al., 2004), ethnographic studies (Sutton & Hargadon, 1996), and work environment questionnaires (Amabile et al., 1995). This study employed qualitative data collection processes within a single case study, as described in the following section.

Methodology

Investigation of the generation of creative behaviours was undertaken using qualitative research within a case study. A case study is the strategy of choice when the focus is on understanding the dynamics present within single settings, and when existing theory seems inadequate (Eisenhardt, 1989). Internet research was used to identify an organization with a commitment to innovation and a history of commercial success through innovation for this study.

The team discussed in this article, (renamed "Team Delta" to maintain confidentiality), was the management team within a new project, and employed some thirty staff. Management team members were highly experienced engineers. Half had more than 10 years' experience with the company and several members possessed advanced academic qualifications. Team Delta was working on the delivery of a large and highly specialized plant in the Middle East in a joint venture, using technology patented by the organization. The project required teams with diverse expertise and skills in areas of design, mechanical, structural, and electrical engineering, as well as piping, scheduling, and project management. The discipline expert managers from each of these specialist teams, known as "leads", were among the managers interviewed for this study.

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

Eight of the ten members of the management team were interviewed face-to-face in semi-structured interviews for the study and were present when observations of meetings were undertaken. Eight team members interviewed represented seven nationalities; seven were male and one was female; and they represented diverse skillsets and ethnic origins. Observations were made in two of the weekly project status meetings. No observations were undertaken of the design review meetings. Data collection in this team occurred over a three-month period and data were thematically analyzed and coded for categorization using the qualitative data analysis program software NVivo.

Findings

Work was undertaken within a staged project management framework with key milestones. Within a project-based organization, agreements with key stakeholders largely define the scope of work, the project deliverables, and project outcomes. The leads then established planning and procedures for implementation with their respective teams, working closely with other teams through the design review meetings for all interdisciplinary-related impacts. Frequent design review meetings provided a forum for discussing and agreeing on all design-related matters and weekly project status meetings reviewed achievements against the project plan. A dedicated technology manager provided technical process expertise and ensured a specific focus on identification of patent-creation opportunities. The team was based in two locations for the duration of the three-year project with regular visual electronic communication between sites during team meetings.

Findings regarding creative behaviours and the work environment related to the nature of the work itself, manager behaviours, team processes, and the physical work environment. Challenges arising in the project were related both to the nature of the work and to relationships between team members. From a task perspective, the nature of work undertaken was multifaceted, requiring significant interdisciplinary integration and collaboration. From a relationship perspective, managing a large team in a joint venture with a competitor added complexity in terms of confidentiality and the generation and protection of intellectual property. This team had a clear focus on identifying and formalizing innovations through patents to achieve commercial organizational benefits.

Nature of work

The characteristics found to most consistently contribute to creative behaviours throughout the build included the presence of a challenging problem or task. For example, challenges could arise because of the space limitations at the plant site or from the need for careful integration between the disciplines while ensuring compliance with scope and safety standards. Team members reported that many solutions to problems or current challenges emerged when they were jointly investigating problems in regular design review meetings or reporting on project completion activities in the project status meetings. However, the design review meeting was the principal forum for exploring and agreeing on all design-related aspects of the build:

> *"Well, the new ideas come from design reviews. I have a minimum of three design reviews at the moment. As we get busier, I'll be having five, six, seven, eight design reviews. This is around the model, talking about different aspects. You have multi-disciplinary teams and we talk about specifically drilling down to problems: How can we operate this? What's he doing? Why is he doing it? Can we do it any better? Is there another product which we can use which is better?"* (Lead 1)

The team used both formal and informal processes for responding to challenges, collaborating, and getting the work done. Collaboration occurred in multiple settings, including informal discussions in the workplace and specifically in meetings such as the team's design review meeting. Some of the creative behaviours inherent in the idea generating and shaping process are illustrated in Figure 1.

New ideas were particularly welcomed in the design review meetings during the early stages of the project when there was a greater capacity to explore new approaches, test them out, and implement workable solutions. As the project progressed, the nature of work became more tightly defined, with less possibility for exploring new approaches. The frequency of design review meetings compared to the weekly status meetings may have been related to the early stage of the project and the importance of idea generation, testing, and refinement.

The staged project management framework, with flexibility for exploration and refinement of ideas at design review meetings and the constraints of key milestones, encouraged rich discussion and enforced debate and

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

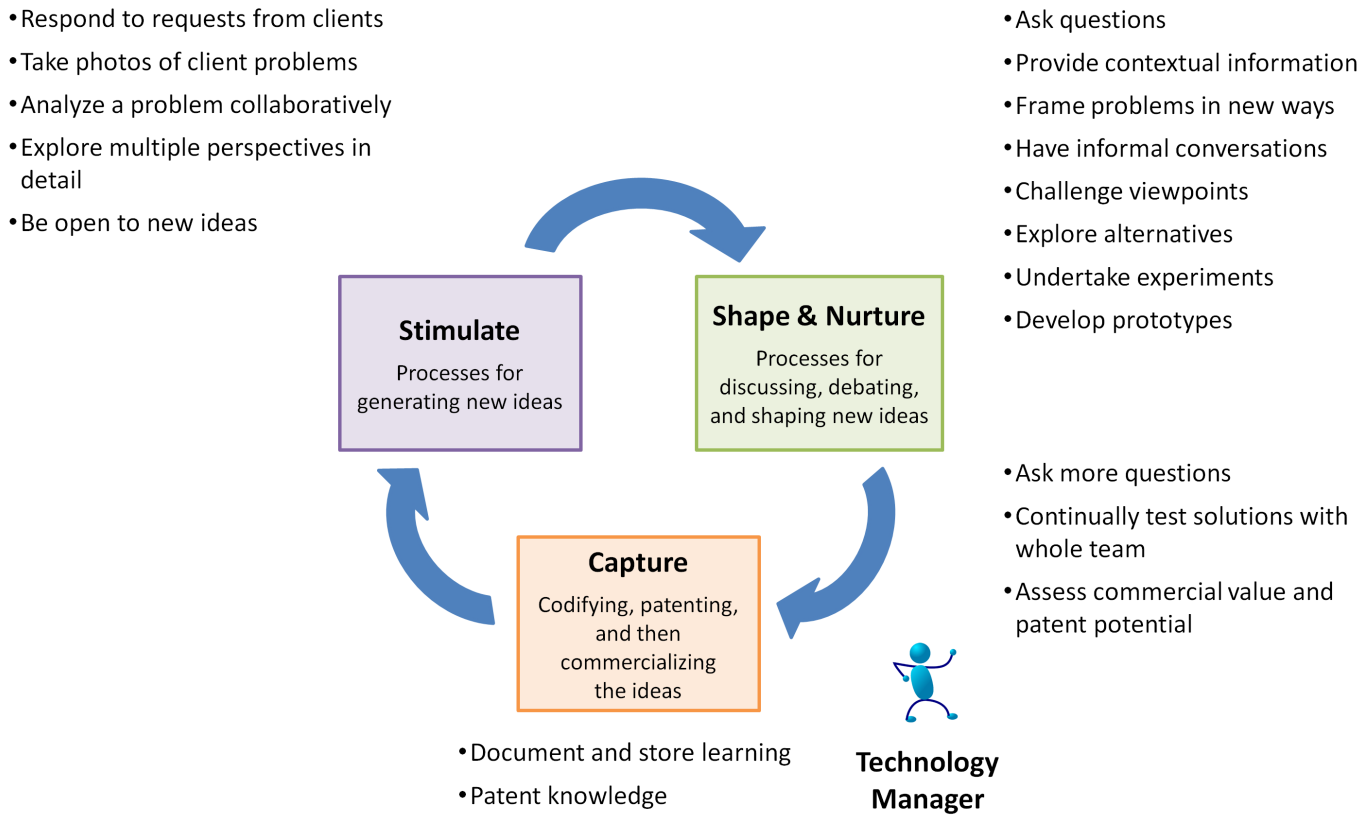

Figure 1. Creative behaviours and idea development process

agreement between key stakeholders. The idea management process starts with ideas and suggestions in the "stimulate" phase. Ideas are floated, discussed, debated, and evaluated in the "shape and nurture" phase before a final decision is made at the point of "capture". At the beginning of the project, there is greater latitude for all build options. However, as decisions are made, future decisions become constrained by previous decisions. The idea management process becomes more focused as the project develops, with the milestone reviews putting pressure on all team members to come to agreement on all design-related aspects that need to be finished by these points. The development of ideas is clearly an iterative process that aligns with models for incorporating learning in project teams (Davidson & Rowe, 2009). The idea-shaping process is mapped in Figure 2.

Relationships, roles, and behaviours

Team Delta demonstrated mixed levels of collegiality and cohesiveness. Furthermore, a shared sense of professionalism and of valuing working on this project appeared to help to move the project along. Decisions where specific disciplines had expertise and a stake in the outcomes could be a source of friction. Behaviours that contributed to confrontations were sometimes seen as negative by team members, although it was recognized that conflict can facilitate deeper evaluation of alternatives, experimentation and better decision-making processes. This finding confirmed reports in extant literature (Isaksen et al., 2001; Jehn, 1995; Pelled, 1996; Shalley & Gilson, 2004). Indeed, to some extent, disagreement was able to drive higher levels of creativity as team members sought to prove or disprove their own or other team members' technical proposals, leading to productive experimentation and evaluation.

The idea-generation process was influenced by how employees felt about engaging in debate, as well as time constraints. Team members recognized that, for a change of approach to be accepted, getting the "buy-in" of other senior staff and particularly of the techno-

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

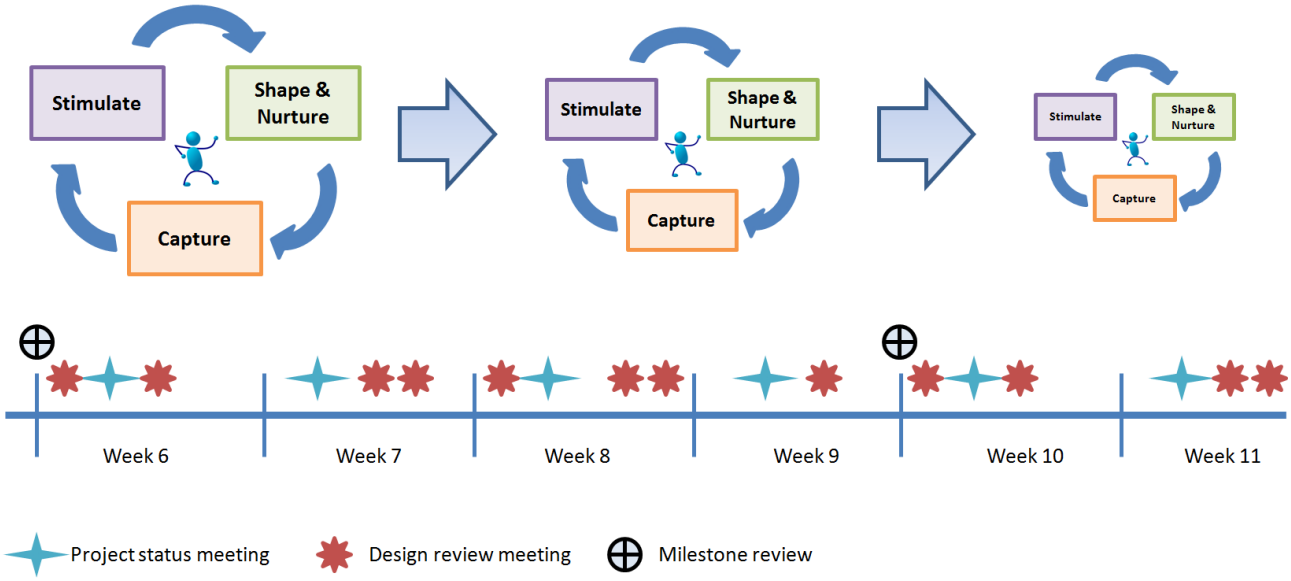

Figure 2. Idea development and shaping process in project management

logy manager, whose role is key in the innovation identification and formalization process, was necessary. In addition to acting as an expert on process, this manager actively looked for opportunities to commercialize knowledge throughout the project and was described as being very forceful in the pursuit of new knowledge:

> *"…Sometimes [the technology manager] comes with the ideas that he wants…. but he doesn't know exactly how to do it. So, we have to come up with the way to do it. And sometimes he's pushing us back. So we say: It can't be done. He says: No, think about it. Think about how it can be done. And then eventually: Oh, yes. Maybe we can do this. So he's pushing, pushing, pushing…"* (Lead 2)

Conclusions

Creative behaviours apparent in Team Delta included the generation of ideas to approach different problems, challenging assumptions based on past experience, seeking new perspectives from team members, rigorous discussion, evaluating of alternatives, disagreement, collaboration, and experimentation. Many characteristics that influence creative behaviours found in this study confirm previous research. Examples include the richness of ideas that emerge from cross-functional teams and the use of multi-disciplinary team meetings to focus on exploration of ideas, discussion, debate, and agreement. Findings are particularly relevant for project-based organizations seeking to achieve project management objectives of quality work that is on time, on schedule, and within budget. In addition, this team was seeking innovative approaches and outcomes that could be patented. Findings also highlight the value of structured approaches to managing discussions and decision-making processes. Distinct processes used in the design review meetings, where many of the creative behaviours were noted, and milestone reviews had different but complementary objectives related to idea management and achievement tracking.

The role of a technology manager with a dedicated focus on the identification and commercialization of new knowledge was an initiative that appeared to demand new ways of working from the team members. Challenging team assumptions and including dissenting opinions can generate energy, which fosters richer discussions, better quality decisions, and an increased capacity to identify unique knowledge that adds value and can possibly be patented.

Practical implications from this research for project managers include the identification of local work processes such as interdisciplinary team meetings for debating and agreeing on all aspects of the build; use of a dedicated role to spot innovation potential opportunities; valuing and management of disagreement/contrary views as a stimulant to creative behaviours such as evaluation of ideas and experimentation; and norms of es-

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

tablishing team cultures with clear expectations of teamwork. The systematic stimulation, testing, and refinement of ideas through design review meetings and weekly progress meetings, with collaboration, collegiality, and well-managed contestation all contributed to a work environment supportive of creative behaviours. This team illustrates the power of learning within knowledge-intensive firms (Starbuck, 1992) where the knowledge, effort, and abilities of diverse perspectives are leveraged (Eisenhardt, 1990).

Acknowledgements

An earlier version of this article was presented at the 2015 ISPIM Innovation Summit in Brisbane, Australia, December 6–9, 2015. ISPIM (ispim.org) – the International Society for Professional Innovation Management – is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management.

About the Authors

Tracy Stanley is currently completing her doctoral thesis at the Queensland University of Technology (QUT) in Brisbane, Australia, where she investigated how the characteristics of team work environments influence creative behaviours and employee engagement in a global project-based organization. The research was undertaken across five teams providing a range of finance, marketing, and engineering services. Tracy has twenty years of international experience in human resources and change management in Asia and Europe across industries including travel technology, government, financial services, education, and health. Her qualifications include an MBA from the University of Melbourne, Australia, and an MBus (Research) from QUT.

Judy Matthews is a Senior Lecturer at the Queensland University of Technology (QUT) Business School, in Brisbane, Australia, where she teaches both MBAs and senior executives on the topics of innovation management, facilitates problem framing and problem solving in complex environments, and uses design thinking to develop and execute new possibilities. Her enthusiasm for the importance of innovation management can be traced to her research into innovation systems in Australia, in public sector research and development, and in the management of change. For the last six years, Judy has been an active researcher and facilitator in the development and application of design mindsets and methods, recognizing that the frameworks, tools, and mindsets of designers can be used to help managers to problem solve and innovate in their businesses and develop new business models. Judy has published articles in a wide range of international journals, including the *Journal of Business Research, International Journal of Technology Management, Innovation: Management, Policy and Practice,* and *Design Management Journal.*

Paul Davidson is an Associate Professor at the Queensland University of Technology (QUT) Business School in Brisbane, Australia. He is a management specialist with over 25 years university teaching experience and 100 academic publications including two major textbooks in management. He has studied and taught at several universities, and in between academic appointments, he has been CEO of a company with 650 employees. At QUT since 1991, he has developed and delivered courses for high-profile corporate organizations in addition to extensive graduate teaching. Paul has received a number of awards for his teaching and academic publishing. He is a former President (2000–2005) of the Australian Human Resource Institute (Queensland). In academic administration, he served the Brisbane Graduate School of Business as Subject Area Coordinator for Management, HRM, and Organisational Behaviour, and managed the school's program for Defence Force students. From 2005 to 2012, he was Deputy Director of the QUT Project Management Academy, a joint initiative of the Science and Engineering faculty and the QUT Business School. He now leads the MBus(HRM) program. His research interests include the development of management competencies, knowledge management, and project management, as well as international human resource management.

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

References

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. 1996. Assessing the Work Environment for Creativity. *The Academy of Management Journal,* 39(5): 1154–1184. http://dx.doi.org/10.2307/256995

Amabile, T. M., & Gryskiewicz, N. D. 1989. The Creative Environment Scales: Work Environment Inventory. *Creativity Research Journal,* 2(4): 37–41. http://dx.doi.org/10.1080/10400418909534321

Amabile, T. M., Hadley, C. N., & Kramer, S. J. 2002. Creativity under the Gun. *Harvard Business Review,* 80: 52–63.

Anderson, N. R., & West, M. A. 1998. Measuring Climate for Work Group Innovation: Development and Validation of the Team Climate Inventory. *Journal of Organizational Behavior,* 19(3): 235–258. http://dx.doi.org/10.1002/(SICI)1099-1379(199805)19:3<235::AID-JOB837>3.0.CO;2-C

Catmull, E. 2008. How Pixar Fosters Collective Creativity. *Harvard Business Review,* 86(9): 64–72.

Dul, J., & Ceylan, C. 2011. Work Environments for Employee Creativity. *Ergonomics,* 54(1): 12–20. http://dx.doi.org/10.1080/00140139.2010.542833

Dulaimi, M. F., Ling, F. Y., Ofori, G., & Silva, N. D. 2002. Enhancing Integration and Innovation in Construction. *Building Research & Information,* 30(4): 237–247. http://dx.doi.org/10.1080/09613210110115207

Eisenhardt, K. M. 1989. Building Theories from Case Study Research. *Academy of Management Review,* 14(4): 532–550. http://dx.doi.org/10.2307/258557

Eisenhardt, K. M. 1990. Speed and Strategic Choice: How Managers Accelerate Decision Making. *California Management Review,* 32(3): 39–54. http://dx.doi.org/10.2307/41166616

Gilson, L. L., & Shalley, C. E. 2004. A Little Creativity Goes a Long Way: An Examination of Teams' Engagement in Creative Processes. *Journal of Management,* 30(4): 453–470. http://dx.doi.org/10.1016/j.jm.2003.07.001

Hackman, J. R. 2011. *Collaborative Intelligence: Using Teams to Solve Hard Problems.* San Francisco, CA: Berrett-Koehler Publishers.

Hartmann, A. 2006. The Role of Organizational Culture in Motivating Innovative Behaviour in Construction Firms. *Construction Innovation,* 6(3): 159–172. http://dx.doi.org/10.1108/14714170610710712

Harvey, S., & Kou, C.-Y. 2013. Collective Engagement in Creative Tasks: The Role of Evaluation in the Creative Process in Groups. *Administrative Science Quarterly,* 58(3): 346–386. http://dx.doi.org/10.1177/0001839213498591

Hennessey, B. A., & Amabile, T. M. 2010. Creativity. *Annual Review of Psychology,* 61(1): 569–598. http://dx.doi.org/10.1146/annurev.psych.093008.100416

IBM. 2010. *Capitalizing Complexity: Insights from the Global Chief Executive Officer Study.* Somers, NY: IBM Global Business Services.

Isaksen, S. G., & Ekvall, G. 2010. Managing for Innovation: The Two Faces of Tension in Creative Climates. *Creativity and Innovation Management,* 19(2): 73–88. http://dx.doi.org/10.1111/j.1467-8691.2010.00558.x

Isaksen, S. G., Lauer, K. J., Ekvall, G., & Britz, A. 2001. Perceptions of the Best and Worst Climates for Creativity: Preliminary Validation Evidence for the Situational Outlook Questionnaire. *Creativity Research Journal,* 13(2): 171–184. http://dx.doi.org/10.1207/S15326934CRJ1302_5

Jehn, K. A. 1995. A Multimethod Examination of the Benefits and Detriments of Intragroup Conflict. *Administrative Science Quarterly,* 40(2): 256–282. http://dx.doi.org/10.2307/2393638

Kanter, R. M. 1988. Three Tiers for Innovation Research. *Communication Research,* 15(5): 509–523. http://dx.doi.org/10.1177/009365088015005001

Matthews, J. 2002. Innovation in Australian Small and Medium Enterprises: Contributions from Strategic Human Resource Management. *Asia Pacific Journal of Human Resources,* 40(2): 193–204. http://dx.doi.org/10.1177/1038411102402004

Mumford, M. D., & Gustafson, S. B. 1988. Creativity Syndrome: Integration, Application, and Innovation. *Psychological Bulletin,* 103(1): 27–43. http://dx.doi.org/10.1037/0033-2909.103.1.27

Naggar, R. 2015. The Creativity Canvas: A Business Model for Knowledge and Idea Management. *Technology Innovation Management Review,* 5(7): 50–58. http://timreview.ca/article/914

Pelled, L. H. 1996. Demographic Diversity, Conflict, and Work Group Outcomes: An Intervening Process Theory. *Organization Science,* 7(6): 615–631. http://dx.doi.org/10.1287/orsc.7.6.615

Shalley, C. E., & Gilson, L. L. 2004. What Leaders Need to Know: A Review of Social and Contextual Factors That Can Foster or Hinder Creativity. *The Leadership Quarterly,* 15(1): 33–53. http://dx.doi.org/10.1016/j.leaqua.2003.12.004

Smith, M., Busi, M., Ball, P., & Van Der Meer, R. 2008. Factors Influencing an Organisation's Ability to Manage Innovation: A Structured Literature Review and Conceptual Model. *International Journal of Innovation Management,* 12(4): 655–676. http://dx.doi.org/10.1142/S1363919608002138

Stanley, T., Davidson, P., & Matthews, J. 2014. Creative Work Environments and Employee Engagement: Exploring Potential Links and Possibilities. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie,* 9(933): 33–51. http://dx.doi.org/10.15678/ZNUEK.2014.0933.0903

Starbuck, W. H. 1992. Learning by Knowledge-Intensive Firms. *Journal of Management Studies,* 29(6): 713–740. http://dx.doi.org/10.1111/j.1467-6486.1992.tb00686.x

Taylor, A., & Greve, H. R. 2006. Superman or the Fantastic Four? Knowledge Combination and Experience in Innovative Teams. *Academy of Management Journal,* 49(4): 723–740. http://dx.doi.org/10.5465/AMJ.2006.22083029

Insights from Stimulating Creative Behaviours in a Project-Based Organization Team

Tracy Stanley, Judy Matthews, and Paul Davidson

Thompson, L. L., & Choi, H.-S. 2005. *Creativity and Innovation in Organizational Teams.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc., Publishers.

West, M. A. 2002. Sparkling Fountains or Stagnant Ponds: An Integrative Model of Creativity and Innovation Implementation in Work Groups. *Applied Psychology,* 51(3): 355–387. http://dx.doi.org/10.1111/1464-0597.00951

Woodman, R. W., Sawyer, J. E., & Griffin, R. W. 1993. Toward a Theory of Organizational Creativity. *Academy of Management Review,* 18(2): 293–321. http://dx.doi.org/10.5465/AMR.1993.3997517

Citation: Stanley, T., Matthews, J., & Davidson, P. 2016. *Insights from Stimulating Creative Behaviours in a Project-Based Organization Team. Technology Innovation Management Review,* 6(4): 26–33. http://timreview.ca/article/979

Keywords: creative behaviours, work environments, teams, problem solving

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

> *"A ship is safe in harbor, but that's not what ships are for."*
>
> William Shedd (1820–1894)
> Theologian

The positive aspects of open innovation projects are widely discussed in innovation management research and practice by means of case studies and best practices. However, enterprises, particularly small and medium-sized enterprises (SMEs) also face miscellaneous challenges in open innovation practice, leading to uncertainty and even renunciation of open innovation project participation. Thus, it is essential for SMEs to find the right balance between possible positive effects and negative consequences – the latter being the less studied "dark sides" of open innovation. However, appropriate methods of finding this balance are still lacking. In this article, we discuss the assessment of open innovation project participation by presenting a weighing and decision process framework as a conceivable solution approach. The framework includes an internal, external, and integrated analysis as well as a recommendation and decision phase. Piece by piece, we investigate the current situation and the innovation goals of the enterprise as an initial point for a decision for or against engaging in open innovation. Furthermore, we discuss the development of a software tool that automatically applies this framework and allows self-assessment by SMEs.

Introduction

The advantages of open innovation projects are widely discussed in innovation management research and practice (e.g., Man & Duysters, 2005). Particularly, small and medium-sized enterprises (SMEs) are expected to gain most from open innovation collaborations due to their inherently limited capabilities (Lee et al., 2010; van de Vrande 2009). However, these enterprises also face manifold challenges in open innovation practice, leading to uncertainty and even renunciation of open innovation project participation. Thus, SMEs often deal with the decision dilemma of having to cooperate with external partners in order to improve their own innovation capacity, regardless of their ability to cope with the correlated risks. Although it is essential for SMEs to find the right balance between positive effects and possible negative consequences (i.e., the "dark sides" of open innovation, cf. Huizingh, 2011) of open innovation project participation, appropriate methods of finding this balance are still lacking.

The research project "Open Darkness" was initiated with the goal of enabling SMEs to weigh the risks and benefits of open innovation participation by developing: i) a weighing and decision process framework and ii) a software tool that automatically applies this framework and allows self-assessment for SMEs. Both solutions aim to structure and support the decision process regarding potential engagement in open innovation projects. In order to tackle these targeted outcomes, an interdisciplinary consortium facilitates a multi-perspective and an integrated holistic research approach. Besides several SMEs, which function as requirement authority and implementer, the consortium consists of three German research institutions: the Chair of Economic Law (University of Paderborn), the Chair of Technology and Innovation Management (University of Aachen), and the Chair of Business Informatics (University of Potsdam).

Given the importance of strategic thinking and of tacit knowledge in decision making, decision outsourcing

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

from a person to a software-based solution is inherently erroneous. Accordingly, it is explicitly not intended within the software tool to automate and process decisions, thereby removing human responsibility. It is envisaged to reduce insecurity in decision making for open innovation participation by providing a support structure that identifies causalities and alternatives and leads to the identification of action alternatives. Furthermore, the use of the tool is beneficial not only for the decision makers: given the fact that "innovation is a team sport" and employees "must be prepared to change their way of thinking" (Valkokari, 2015), it can also provide a basis for deeper understanding regarding the new aspects of the innovation process.

The goal of the present article is to discuss the assessment of potential open innovation project participation against the background of the impossibility to either predict the future or to capture all necessary environmental information as well as the serious need of SMEs for aid in this matter. This discussion will be conducted by explicating a weighing and decision process framework as a conceivable solution approach.

The remainder of the article is organized as follows. First, we emphasize the relevant theoretical aspects of open innovation. Next, we describe the methodological approach used within the study. Then, we describe the solution approach. Finally, we provide conclusions.

The Bright and Dark Sides of Open Innovation

According to conventional understanding, the primary success factors in innovative enterprises are their employees, R&D divisions, and fault-tolerant corporate cultures. This kind of innovation refers to the closed innovation paradigm (Chesbrough, 2003). Due to an increasing trend towards globalization, new market participants, and simultaneously shorter product lifecycles with correspondingly increasing R&D costs, the closed innovation paradigm was superseded last century (Gerybadze & Reger, 1999) by the theory of open innovation, which emphasizes the significantly higher importance of external resources (Chesbrough, 2003).

Open innovation is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation" (Chesbrough et al., 2006). Thus, open innovation can be described as an interactive and collaborative innovation process with external partners (Veer et al., 2013). The positive aspects of open innovation for SMEs are widely discussed (Lee et al., 2010). Table 1 depicts some of the "bright sides" of open innovation structured into organizational, knowledge management, and legal aspects.

Comparatively, the so-called "dark sides" of open innovation processes – as shown in Table 2 – have thus far been neglected. Notably, the legal aspects are typically not structured or placed under the umbrella of open innovation research (Müller, 2013).

Evaluation in innovation management

Broad evaluation is a crucial challenge of innovation management (cf. Adams et al., 2006), particularly for assessing an enterprise's situation and developing suitable improvement measures. Existing approaches focus either on isolated aspects of innovation management, such as idea evaluation, or they consider the innovation process as an internal activity (Afuah, 2003). They can, however, be adapted for open innovation processes.

Business modelling with a focus on knowledge-intensive processes (such as innovation processes) provides another path to analyze and evaluate the current situation in an enterprise. Although the open innovation literature describes innovation processes with specific phases, in reality, SMEs innovation processes are often

Table 1. The bright sides of open innovation (Chesbrough et al., 2006; Lee et al., 2010; Veer et al., 2010)

Organizational	Knowledge Management	Legal
• Diversification of R&D investments • Easier market entry • Resource acquisition advantages	• Broader base of ideas • Technological synergy effects • Improvement of the internal learning capacity through the transfer of external knowledge and learning routines	• Use of intellectual property as strategic assets • Monitoring of the uncertainty of value and protection level of others' patents

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

Table 2. The dark sides of open innovation (Enkel et al., 2009; Müller, 2013; Veer et al., 2013)

Organizational	Knowledge Management	Legal
• Process coordination costs • Implementation costs • More faults in routine workflows	• Strong dependence on external knowledge • Loss of key knowledge control • Loss of flexibility, creativity, and strategic power	• Lack in legacy for additional tasks • Intellectual property spillover • Different levels of contractual experience compared to big enterprises (as potential partners)

unstructured. Thus, such an analysis is an essential starting point for evaluating knowledge and information flows, business processes and personnel interactions (Gronau, 2012).

Research Approach

The openness of innovation processes is associated with uncertainty regarding positive and negative consequences of the project design. Thus, enterprises often need methodical support within the decision process of open innovation project participation. However, according to our review of the literature, no approaches exist for weighing the risks and benefits of open innovation project participation.

The lack of a decision support framework for weighing benefits and risks of open innovation participation leads to the contributions' underlying question:

In terms of the development of a self-assessment software tool for SMEs – to evenly capture, analyse, and weigh chances and risks of open innovation projects – how should a weighing and decision process framework be designed?

Methodological approach within the study

To ensure theoretical and practical relevant aspects within the weighing and decision process framework and the software tool are not neglected, our research design includes a combination of qualitative, quantitative, and software development methods:

1. A literature review on the following topics: phases and evaluation of open innovation processes in SMEs, internal and external knowledge interfaces, conditions of participation, measures for participation and risk reduction, and positive and negative aspects of open innovation.
2. Modelling and analysis of existing open innovation processes for 15 SMEs, on the basis of more than 35 interviews with decision makers and employees. The main result of this second step, combined with the first step (i.e., the literature review) is the identification of open innovation process assessment indicators for SMEs including knowledge management, organizational, and legal aspects.
3. Indicator evaluation, through a survey and interviews with open innovation experts. Part of this step is the establishment of a community of open innovation experts, which acts as a supervisory body and validation group.

Applying the results of these three theoretical steps, the following conceptual tasks are addressed:

4. Development of a methodological procedure in the form of a weighing and decision framework with the aid of an evaluation catalogue, ratio systems, and implementation procedure models for SMEs.
5. Implementation of the methodological procedure within a self-assessment tool. This step includes a determination of requirements based on the results of the previous and the actual development of the tool based on the scrum software development framework. Scrum (Sutherland & Schwaber, 2013) is an agile software development framework that is based on rules that define five activities (sprint planning, daily scrum, sprint review, sprint retrospective, product backlog refinement), three artefacts (product backlog, sprint backlog, product increment), and three roles (product owner, development team, scrum master) (cf. Beedle & Schwaber, 2002). Due to ongoing group discussion and reflection at the end of each work phase, a continuous improvement process ensures a positive effect on the technical results.

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

Approaching a Solution

Besides the theoretical outcomes that result from the first three steps of the methodology as a state-of-the-art extension, the second main emphasis of the project lies in the implications of the results on enterprise practice. This second aspect is addressed by the development of the software tool on the basis of the weighing and decision process framework. Due to the wide heterogeneity of open innovation situations and innovation processes, it would be foolhardy to assume that a software tool (as a main outcome) could take the entrepreneurial decision and, thereby, simply solve the complex decision problem of open innovation participation. However, the special value of the tool is the possibility to assist SME innovation managers by guiding them through the self-assessment weighing and decision process in the run-up of a potential new open innovation project.

In the given situation, decision makers and innovation managers are confronted with strategic and operative challenges, such as:

- What are our (innovation) goals?
- To what extent are we willing to take risks?
- How structured is the current (open innovation) process?
- How open could and should the innovation process be?
- What specific risks exist regarding potential partners and knowledge and information losses?
- What is the level of preparation required to avert these risks?
- What kind of improvement can be expected from cooperation with external partners?

These and further questions are addressed by the weighing and decision process framework. The process can be structured in five steps, which are described and exemplified below and in Figure 1.

As a starting point of the process, three different aspects are evaluated with the active involvement of the enterprise:

1. *Identification of innovation goal, degree of innovation, risk propensity, and strengths and weaknesses analysis (a general analysis aspect, irrespective of a concrete open innovation project):* Primary and secondary value chain activities constitute the framework to identify enterprises' specific open innovation strengths and weaknesses (e.g., innovation project experience, own innovation process structure, resource allocation). Applying the software tool, profile tables, and process analysis models will be used for these queries. The innovation goal will be divided into output, input, and process goals. The degree of innovation will be assessed as incremental or radical and according to corporations' innovation intensity. The risk propensity categories are: risk seeking, risk averse, and risk neutral. These aspects will be queried by closed direct or indirect questions.
2. *Identification of benefits and risks as well as assessment of their occurrence probability (analysis aspect*

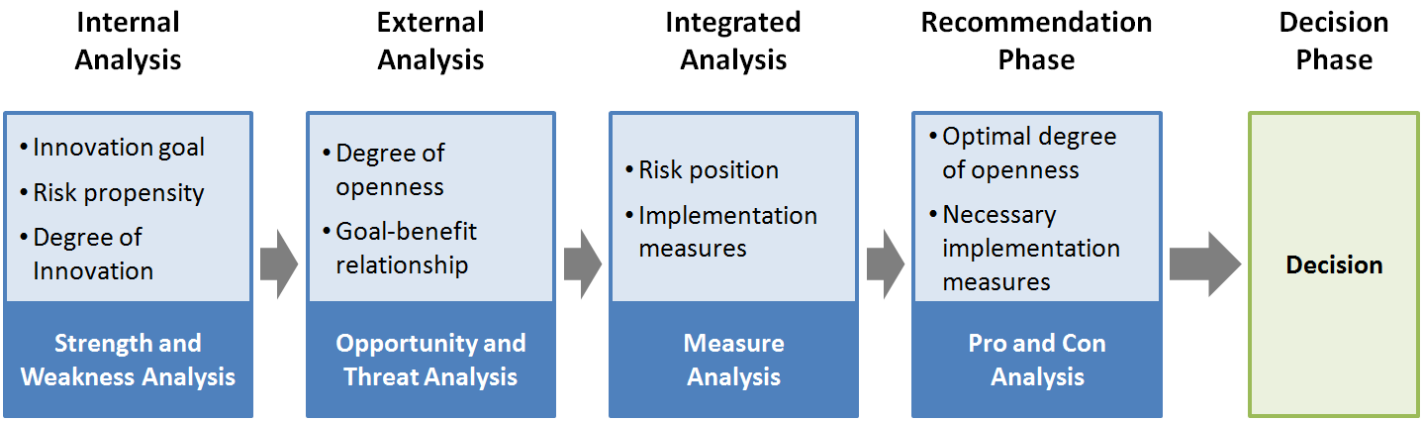

Figure 1. Analysis and decision process framework

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

with regard to a concrete open innovation project): Specific risks and benefits of open innovation cooperation will be prompted using a predefined catalogue. Additionally, their respective occurrence probability will be estimated by indirect closed questions, for example, regarding past experiences with project partners, criticality of knowledge and information, and assessment of their actual situation and existing protection measures.

Within phase 1 and 2, indirect questions will be used to determine the enterprise's ideal degree of openness. In addition, enterprises will be enabled to specify their open innovation goals and relate specific project benefits directly to them.

3. *Assignment of measures to benefits and risks (analysis aspect with regard to a concrete open innovation project):* Analytical findings will be considered to identify potential need for and comparative advantages of protection measures. They provide the basis for the assignment of relevant measures. If each risk and each benefit can be associated with corresponding specific measures in order to either avoid or enable them, then: i) already existing enabling or protection measures within the enterprise will be discovered and ii) missing measures and necessary investments and efforts for their establishment will be revealed. Based on the present innovation process structure, potential partner profiles, knowledge and information flows, and legal situations, the enterprise' risk position will be clarified.

Within the next steps, the enterprise-specific information gained within the three analysis phases will be evaluated automatically by the software and with no need for the active involvement of the enterprise.

4. *Presentation of analysis results:* Based on the evaluation of the aforementioned steps, three major results will be depicted: i) the optimal degree of openness (by the aid of a type classification proximity/formalization [Diener 2015]); ii) expectable efforts for necessary, promising, and risk propensity dependent measures to enable context-specific optimal degrees of openness and innovation; and iii) depiction of advantages and disadvantages of the open innovation corporation project under consideration.

5. *Come to a decision:* Condensed information will be provided as a basis for the decision to be made.

To sum up, the analysis and decision process framework fulfils three functions: i) provision of understanding for the present situation and, within this, ii) reduction of the perceived risk of open innovation project participation, and iii) general recommendation for action, which serves as decision support for the innovation manager. Within the five steps, different information is requested in order to deduce the enterprise specific initial situation and target goals. Part of the information can be used repeatedly within the decision-making process regarding different open innovation projects. However, some analysis content should be estimated *de novo* for every open innovation project.

The framework and the software tool provide a broad, evaluative foundation to assist with the complexity of the decision-making process. However, acting on their own, the software tool *can* prepare the information basis and formulate concrete recommendations but *cannot* provide a definitive answer to the ultimate question of whether or not to participate in an open innovation project.

Conclusions and Outlook

After establishing the theoretical background, approach, and process model, the next steps include their evaluation from the practical point of view. This is ensured by a close collaboration with enterprises (especially SMEs) and innovation experts and includes two evaluation focuses. First, the innovation indicators developed (see step 3 above) will be evaluated according to their importance within open innovation projects. Given the mostly theoretical nature of these indicators, this step is necessary in order to preserve their relevance and applicability within the practice of the enterprise. For this purpose, innovation experts will be asked to estimate and appraise the indicators on the basis of their practical experience. The indicators selected build the base for the development of the weighing and decision framework. After the implementation of the framework into the software tool, a second evaluation of both – the potentiality and functionalities of the tool – will be carried out in form of a test phase.

Whether a decision made in doubt was really good, accurate, or solely sub-optimal, remains highly subjective, simply because of the lack of the opportunity to compare real-world situations. There is only one real-time occurrence and no reliable further information about alternative scenario developments available.

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

Thus, guiding entrepreneurial decision processes is particularly beneficial in order to reduce insecurity (Simon, 1979) as a reason not to participate in an open innovation project. Given that risk awareness is of particular importance for enterprises, it is pivotal to provide an understanding that their "risks are greater if they choose not to innovate" (Valkokari, 2015).

Although there is a plenty of research dealing with the assessment of the positive aspects of open innovation processes as well as some research with emphasis on the "dark sides" of open innovation, the novelty of this approach is the analysis of the interdependencies of both facets and their combined impact on the open innovation project's chances of success.

SMEs are particularly addressed because they are economical backbones and will benefit more than corporations with economies of scale. Although facing similar challenges, each is unique and requires tailored recommendations for improvement.

Acknowledgements

The project Open Darkness (IGF promotion plan 18632 of the Institut für Energie- und Umwelttechnik (IUTA)), is funded by the AiF within the programme for sponsorship by Industrial Joint Research and Development (IGF) of the German Federal Ministry of Economic Affairs and Energy.

An earlier version of this article was presented at the 2015 ISPIM Innovation Summit in Brisbane, Australia, December 6–9, 2015. ISPIM (ispim.org) – the International Society for Professional Innovation Management – is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management.

About the Authors

André Ullrich has worked as a Research Assistant and a PhD Candidate at the Chair of Business Informatics with an emphasis on Processes and Systems at the University of Potsdam, Germany, since graduating there with a Diploma in Business Administration in 2011. Currently, his research interests are open innovation processes, employee qualification, the performance capability of indicators for assessing organizations, and change capability research. Furthermore, he continuously moderates creativity workshops regarding turbulences in business environments. He has published several national and international articles in the research areas of change capability, creativity techniques, seasonality's, and employee qualification.

Gergana Vladova is a Research Assistant and a PhD Candidate at the Chair of Business Informatics with an emphasis on Processes and Systems at the University of Potsdam, Germany. She holds a Master's degree in International Economic Relations from the University of National and World Economy in Sofia, Bulgaria, and a Magister degree from the Freie Universitît Berlin, Germany. She has been working within diverse research projects, and she lectures graduate courses and seminars in the field of knowledge management. Her main fields of research are corporate communication and culture, knowledge management, product counterfeiting, and open innovation management.

Weighing the Pros and Cons of Engaging in Open Innovation

André Ullrich and Gergana Vladova

References

Adams, R., Bessant, J., & Phelps, R. 2006. Innovation Management Measurement: A Review. *International Journal of Management Reviews,* 8(1): 21–47. http://dx.doi.org/10.1111/j.1468-2370.2006.00119.x

Afuah, A. 2003. *Innovation Management: Strategies, Implementation and Profits.* Oxford: Oxford University Press.

Beedle, M., & Schwaber, K. 2002. *Agile Software Development with Scrum.* Upper Saddle River, NH: Prentice Hall.

Chesbrough, H. 2003. *Open Innovation: The New Imperative for Creating and Profiting from Technology.* Boston, MA: Harvard Business Press.

Chesbrough, H., Vanhaverbeke, W., & West, J. (Eds.). 2006. *Open Innovation: Researching a New Paradigm.* Oxford: Oxford University Press.

Diener, K. 2015. *Organizing Collaborative Innovation: Studying the Process of Intermediaries for Open Innovation.* Doctoral Dissertation. RWTH Aachen University.

Enkel, E., Gassmann, O., & Chesbrough, H. 2009. Open R&D and Open Innovation: Exploring the Phenomenon. *R&D Management,* 39(4): 311–316. http://dx.doi.org/10.1111/j.1467-9310.2009.00570.x

Gronau, N. (Ed.) 2012. *Modeling and Analyzing Knowledge Intensive Business Processes with KMDL: Comprehensive Insights into Theory and Practice.* Berlin: GITO Verlag.

Huizingh, E. 2011. Open Innovation: State of the Art and Future Perspectives. *Technovation,* 31(1): 2–9. http://dx.doi.org/10.1016/j.technovation.2010.10.002

Lee, S., Park, G., Yoon, B., & Park, J. 2010. Open Innovation in SMEs – An Intermediated Network Model. *Research Policy,* 39(2): 290–300. http://dx.doi.org/10.1016/j.respol.2009.12.009

de Man, A.-P., & Duysters, G. 2005. Collaboration and Innovation: A Review of the Effects of Mergers, Acquisitions and Alliances on Innovation. *Technovation,* 25(12): 1377–1387. http://dx.doi.org/10.1016/j.technovation.2004.07.021

Müller, S. 2013. *Innovationsrecht – Konturen eines Rechtsgebiets, Zeitschrift für Innovations- und Technikrecht (InTeR),* 1 2, 58–71.

Simon, H. A. 1979. Rational Decision Making in Business Organizations. *The American Economic Review,* 69(4): 493–513. http://www.jstor.org/stable/1808698

Sutherland, J., & Schwaber, K., 2013. The Scrum Guide: The Definitive Guide to Scrum – The Rules of the Game. *ScrumGuides.com.* Accessed April 1, 2016: http://www.scrumguides.org/scrum-guide.html

Valkokari, K. 2015. Q&A. In the Innovation Game, Why Do So Many Companies Stay on the Sidelines? *Technology Innovation Management Review,* 5(11): 35–39. http://timreview.ca/article/944

van de Vrande, V., de Jong J. P. J., Vanhaverbeke, W., & de Rochemont, M. 2009. Open Innovation in SMEs: Trends, Motives and Management Challenges. *Technovation,* 29(6–7): 423–437. http://dx.doi.org/10.1016/j.technovation.2008.10.001

Veer, T., Lorenz, A., & Blind, K. 2013. *How Open Is Too Open? The "Dark Side" of Openness along the Innovation Value Chain.* Paper Presented at the 35th DRUID Celebration Conference, Barcelona, Spain, June 17–19.

Citation: Ullrich, A., & Vladova, G. 2016. *Weighing the Pros and Cons of Engaging in Open Innovation. Technology Innovation Management Review,* 6(4): 34–40. http://timreview.ca/article/980

Keywords: open innovation, open innovation participation, self-assessment tool, risks, benefits, entrepreneurship, SMEs

TIM Lecture Series

Startup Life: Lessons Learned in Entrepreneurship

Andrea Baptiste

> *"Luck is a big part of startup life. But, you have to be ready for when luck knocks at your door. If you aren't listening or if you aren't ready, then you will miss the opportunity."*
>
> Andrea Baptiste
> President and CEO, Benbria Corporation

Overview

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

The third TIM lecture of 2016 was held at Carleton University on March 22nd and was sponsored in partnership with the Institution of Engineering & Technology (IET) Ottawa Local Network (theiet.org). The lecture was presented by Andrea Baptiste, President and CEO of the Benbria Corporation (benbria.com), who shared lessons learned in her career journey, particularly her entrepreneurial experiences and transition from engineer to executive.

Summary

Baptiste's objective in this lecture was to help others take the leap into an entrepreneurial career, which has suited her skills an interest in working in a fast-pace, ever-changing environment. However, the startup life is not without its downsides and its lessons can sometimes be painful to learn. With the benefit of hindsight, Baptiste shared her experiences in the hopes of encouraging others to take the leap into entrepreneurship while avoiding some of its common pitfalls.

Ten of Baptiste's key lessons are summarized below:

1. *Formulas don't always work:* Although an engineer may understand the principles and theory behind a particular technology, putting a design into practice may yield unexpected results and require instinctive actions through trial and error before a prototype functions as intended. It can help to expect the unexpected as a matter of habit in an entrepreneurial environment.

2. *Keep in simple:* When creating exciting new technology, it can be tempting to overly complicate a product through "cool" new features. Advice to "keep it simple" is often repeated, but often ignored. In a startup, where the pace of change is high, simplicity is particularly important.

3. *Leverage partnerships to reach customers:* The right partners can help you reach customers faster and with more credibility.

4. *Consider a professional services model before developing a product:* In the early days of a startup, offering professional services can bring in much-needed revenue while helping develop a strong sense of the target market and insights into customer needs.

5. *Learn to say "No":* Focus is key, so it is important to avoid tangents and distractions. It can be difficult to say no, particularly when in a startup environment and there are significant dollars involved. But, sometimes, saying "Yes" can take you off track and is not worth the short-term benefits.

TIM Lecture Series – Startup Life: Lessons Learned in Entrepreneurship

Andrea Baptiste

6. *Experience in a startup is an education in itself:* For some, graduate studies can help them specialize in research and be beneficial to their careers. But, the educational experience of working in a startup environment should not be underestimated, particularly if your career goals involve executive roles. An Executive MBA is another valuable option.

7. *Do not ignore training:* In the startup world, training is usually ignored – and that is a big mistake.

8. *Take advantage of advisory boards and mentors:* They are valuable sources of insight and advice. Do not take them for granted; take advantage of them. Know your strengths and weaknesses and build a diverse network of complementary people.

9. *Take a step rather than stand still:* In a startup environment, it is important to fail fast, fail often, and recover quickly. This is common advice, but many startups still end up refining and perfecting, but never get anywhere.

10. *Look for opportunities to gain experience:* In your career, do not always seek out the highest paying roles; go for a role that gives you the experience you need and the opportunities to learn.

About the Speaker

Andrea Baptiste is the President and CEO of Benbria Corporation. She is a veteran executive with more than 20 years of experience in telecommunications and network/service management. Prior to joining Benbria, Andrea was co-founder and CEO of Atreus Systems, where she successfully led the company's growth resulting in its acquisition by Sonus Networks in 2008. Prior to co-founding Atreus Systems, Andrea was responsible for business development at Cambrian Systems, a metro DWDM equipment vendor that was acquired by Nortel Networks in 1998. Andrea's experience in business leadership includes heading up venture capital financing rounds, merger and acquisitions, as well as establishing strategic partnerships with some of the world's largest hardware and software companies. Andrea's prior experience includes management positions at Cross-Keys Systems, TeleSat Mobile Inc., and Newbridge Networks. Currently, Andrea is a member of the Queen's Innovation Connector Advisory Board. Baptiste holds a BA Sc (Honours, Applied Science in Electrical Engineering) from Queen's University in Kingston, Ontario, Canada, and has achieved accreditation as a Professional Engineer of Ontario.

This report was written by Chris McPhee.

Citation: Baptiste, A. 2016. TIM Lecture Series – Startup Life: Lessons Learned in Entrepreneurship. *Technology Innovation Management Review*, 6(4): 41–42. http://timreview.ca/article/981

Keywords: entrepreneurship, startups, lessons

TIM Seminar

Transforming a Desert City into an International Cybersecurity Hub and Ecosystem

Roni Zehavi

> *"In cybersecurity, time is of the essence. We are very much behind schedule. Collaboration is the only way to catch up, to condense the desperately needed learning and development."*
>
> Roni Zehavi
> CEO, CyberSpark

Overview

In this special seminar, Roni Zehavi, CEO of CyberSpark (cyberspark.org.il), introduced efforts to build an international cybersecurity hub and ecosystem in Beer-Sheva, Israel. Fifty-four organizations were represented by the attendees, many of whom were from large and small Canadian companies. The purpose of the event was to explore how Canadian and Israeli firms and universities could collaborate to address specific challenges in cybersecurity.

The event was held on April 4, 2016 at Carleton University in Ottawa, Canada, and was jointly hosted by:

- The Technology Innovation Management (TIM; timprogram.ca) program at Carleton University
- The Embassy of Israel in Canada (embassies.gov.il/ottawa/)
- The VENUS Cybersecurity Corporation (venuscyber.com)

Summary

In introducing the speaker, the Ambassador of Israel to Canada, Rafael Barak, highlighted the potential for collaboration between Israel and Canada to better understand the cyber-threat environment and how countries can cooperate to overcome current and future challenges.

Then, Zehavi (Figure 1) began his seminar by explaining why a cyber-ecosystem is essential, particularly given the scale of the challenges and how little time we have to learn and develop the novel approaches needed to address the challenges posed by social and mobile networks, the Internet of Things, increased sharing of data, etc. He argued that the only way to catch up and condense the required learning into a very short amount of time is for academic organizations, industry, and governments to share information and work together, both within and between countries around the world.

In Israel, the awareness of the cybersecurity challenges and the need to address them is particularly acute. As Zehavi explained, Israel accounts for only 0.1% of the world's population, but about 10% of the total global investments in the cybersecurity industry have been

Figure 1. Roni Zehavi, CEO of Cyberspark, introduces the ecosystem in Beer-Sheva, Israel

Transforming a Desert City into an International Cybersecurity Hub and Ecosystem

Roni Zehavi

made in the country. Furthermore, the Israeli government has been mounting massive efforts into building the country's cyber-defense capabilities – cybersecurity is recognized as both essential for the protection of the country and a way of re-inventing and re-invigorating its economy. Industry in Israel has also recognized cybersecurity as a new frontier. Israel is home to more than 270 cybersecurity-related companies, 25 of which are multinational companies dealing only with cyber-related solutions. As Zehavi emphasized, "there really is something going on with cyber in Israel".

Israel's emphasis on cybersecurity is now physically represented by CyberSpark, a high-tech park that also serves as the hub for an ecosystem of international members that collaborate on cybersecurity projects. CyberSpark also refers to the non-governmental organization at the centre of the ecosystem, which is jointly owned by the for-profit members of the ecosystem. Its mission is to "leverage the Israeli cyber-ecosystem into the global cyber-capital centred in Beer-Sheva" to become "unprecedented the world over in terms of innovation and perspective."

To materialize the CyberSpark mission, the ecosystem depends on its four diverse stakeholder groups coming together – literally, as co-located collaborators:

1. Government

- the national government plays a substantial role in building and nurturing the ecosystem through a dedicated unit covering all governmental issues
- it coordinates a national effort through investment, research centres, education, regulation, inter-ministry synchronization, benefits policies, profession definitions, tax incentives, etc.
- it operates the educational system upon which the nation and ecosystem depend, and it enables multi-national engagements
- local government also plays a vital role

2. Industry

- the ecosystem requires a critical mass of companies, including a mix of small and medium-sized companies and multi-nationals (e.g., Deutsche Telekom, PayPal, Oracle, Lockheed Martin, EMC, and IBM)
- member companies benefit from joint facilities, coopetition (i.e., working together on areas of common benefit, but also competing where they can differentiate), and knowledge sharing (without exposing intellectual property)

3. Academia

- the role of academia is primarily represented by Ben-Gurion University of the Negev, Israel's youngest university, which focuses on industry-friendly applied research and includes PhD studies in cybersecurity. Ben-Gurion physically hosts the CyberSpark hub and its shared research facilities.
- the university benefits from having up-to-date syllabuses coordinated with industry
- the university provides high-quality graduates to the ecosystem and offers accreditation for industry employees

4. Human capital

- the ecosystem depends on a critical mass of talents: people who educated, experienced, innovative, creative, motivated, dedicated, and capable of becoming leaders
- the entire spectrum of associated professions is represented, as are all seniority levels
- key inputs of new human capital to the ecosystem are the university and the military

The environment also plays a key role. As examples, Zehavi listed the importance of support from the city and Mayor, the need for facility management, dedicated plans to encourage talent, openness to the needs of the designated audience, a local perspective of a "global city", and a culture that embraces innovation.

As a dedicated execution platform, CyberSpark provides strategy, education, projects, test ranges, an affiliates club, and community events. The platform enables linkages between potential collaborators, offers executive courses on cybersecurity, provides services to enable global players to smoothly transition into the ecosystem. Today, the CyberSpark ecosystem boasts a long list of founders and current tenants, and it continues to grow, in terms of its facilities, membership, and extent of global collaborations.

Transforming a Desert City into an International Cybersecurity Hub and Ecosystem

Roni Zehavi

Natural partnership between Israel and Canada

Following the presentation, the participants discussed the design and operation of CyberSpark and explored opportunities for collaboration between Israel and Canada. As a starting point, the common ground between the two countries was discussed: in particular, given their first and second rankings among the most educated populations in the OECD (2011), Canadians and Israelis share an understanding of the value of education, research, and innovation. Both countries are at the cutting edge of technology and their academic institutions are some of the best in the world. The two countries also boast strong people-to-people ties with daily flights between Tel Aviv and Toronto, extensive commercial relations supported by a modernized free trade agreement to meet the demands of today's digital economy, and a deep connection through Canada's vibrant Jewish community. In addition, organizations such as the Canada–Israel Industrial Research & Development Foundation (ciirdf.ca), which was established in 1994, serve as important conduits between small and medium-sized enterprises (SMEs) in both countries that want to forge joint projects in innovation.

Within this context, it was felt that there is a basis for several natural partnerships in cybersecurity between Israel and Canada. Such efforts would build upon a burgeoning network of ties in cybersecurity. For example, several Canadian companies including BlackBerry (blackberry.com) and Magna International (magna.com) have acquired or partnered with Israeli startups. On the other hand, Israelis are reciprocating by looking to Canada for solutions – Israel's Check Point Software Technologies Ltd. (checkpoint.com), one of the top cybersecurity companies in the world, has established offices in Canada to take advantage of the unique skillsets of Canadians. And, just recently, Israel's Magal Security Systems (magal-s3.com) acquired Waterloo's Aimetis (aimetis.com) for $14 million.

The audience identified great potential for even more partnerships between companies, research institutions, governmental agencies, and industry associations, especially in key sectors such as banking, telecommunications, energy, transportation, and other critical industries. There was strong interest in strengthening ties between Beer-Sheva and Ottawa, and other Canadian cities, in step with the growth of each country's cybersecurity ecosystems. Institutional arrangements were seen as a key way to spur close connections between entrepreneurs, researchers, and others engaged in finding cybersecurity solutions.

About the Speaker

Roni Zehavi is the CEO of CyberSpark, the industry initiative created to advance research and development of cyber-solutions in Beer-Sheva, Israel. He has more than 10 years of experience in the entrepreneurial hi-tech arena, integrating highly-innovative and multidisciplinary technologies into sellable products. His range of experience includes stewarding ideas through the development process into the marketplace. His most recent company, "To-Be-Education", is creating a platform upon which teachers and students can upload content that can be transformed into dilemma-based learning games with multiple users, facilitating the development of global learners' communities. An experienced test engineer and pilot from ETPS UK and an Aeronautical Engineer from the Technion, Roni is a well-known expert in the aviation professions, including their operational, methodological, and technological aspects. In 2004, Roni founded Rontal Applications, a leading provider of a 3D-based application for simulations and real-time command-and-control systems. Under his leadership, the company achieved successful results before being acquired by an American corporation.

This report was written by Chris McPhee.

References

OECD. 2011. *Education at a Glance 2011: OECD Indicators.* Paris: OECD Publishing. http://dx.doi.org/10.1787/eag-2011-en

Citation: Zehavi, R. 2016. TIM Seminar – Transforming a Desert City into an International Cybersecurity Hub and Ecosystem. *Technology Innovation Management Review*, 6(4): 43–45. http://timreview.ca/article/982

Keywords: cybersecurity, CyberSpark, Israel, Canada, collaboration, cooperation

Author Guidelines

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

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
2. Indicate if your submission has been previously published elsewhere. This is to ensure that we don't infringe upon another publisher's copyright policy.
3. Do not send articles shorter than 1500 words or longer than 3000 words.
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.
5. Include a 2-3 paragraph abstract that provides the key messages you will be presenting in the article.
6. Provide a 2-3 paragraph conclusion that summarizes the article's main points and leaves the reader with the most important messages.
7. Include a 75-150 word biography.
8. List the references at the end of the article.
9. If there are any texts that would be of particular interest to readers, include their full title and URL in a "Recommended Reading" section.
10. Include 5 keywords for the article's metadata to assist search engines in finding your article.
11. Include any figures at the appropriate locations in the article, but also send separate graphic files at maximum resolution available for each figure.

Issue Sponsor