Technology Innovation Management Review

November 2017
Volume 7 Issue 11
http://doi.org/10.22215/timreview/1114

Insights

Welcome to the November 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

November 2017
Volume 7 Issue 11

Publisher

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

ISSN

1927-0321

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: Insights

Chris McPhee, Editor-in-Chief

Welcome to the November 2017 issue of the *Technology Innovation Management Review*. The authors in this issue share insights on developing value propositions for the Internet of Things (IoT), understanding Industry 4.0 from a social innovation perspective, leveraging third-generation living labs for collaborative innovation in cities, designing business models based on open data, and the impact of open access models on academic publishing.

In the first article, **David Hudson** provides practical guidance to help technology entrepreneurs understand and express a specific and compelling value proposition for their enterprise IoT offer. Given the diverse and broad opportunities in the IoT space, Hudson cautions against trying implement too broad a vision. Rather, he argues that entrepreneurs should focus specifically on "who is buying and what they will pay for", and he provides a set of pragmatic steps they can take to develop, test, and communicate a compelling IoT value proposition for these buyers.

Next, **Rabeh Morrar**, **Husam Arman**, and **Saeed Mousa** examine the fourth industrial revolution (Industry 4.0) from a social innovation perspective. They argue that the transformation resulting from Industry 4.0 – in which "physical systems can cooperate and communicate with each other and with humans in real time, all enabled by the IoT and related services" – will bring vast opportunities but also substantial socioeconomic challenges. In the article, they propose a framework that can facilitate the ongoing interaction between technological and social innovation to yield proactive, timely, and sustainable strategies.

Then, **Seppo Leminen**, **Mervi Rajahonka**, and **Mika Westerlund** describe next-generation living labs in the city context. Based on 118 interviews with participants in six Finnish cities, they developed a framework for collaborative innovation networks in cities and propose a typology of third-generation living labs. Through their analysis, the authors reveal how cities can encourage collaborative innovation by leveraging platforms and participation approaches. They describe four collaborative innovation modes that characterize different types of third-generation living labs and explain how they can be exploited to encourage collaborative innovation activities in cities.

The fourth article is by **Tuomo Eskelinen**, **Teemu Räsänen**, **Ulla Santti**, **Ari Happonen**, and **Miika Kajanus**, who used action research methods to discover new business opportunities for an environmental monitoring service relying on open data. They applied a four-stage innovation process for industry, which included context definition, idea generation, and selection, and produced multi-criteria decision support (MCDS) data to help design a new business model. Their business model creation process can help businesses find new ideas based on open data, turn them into business models, and then improve those models using a participative approach.

Finally, **Haven Allahar** analyzes the role of open access in the domain of academic publishing from the perspective of disruptive innovation. Following a characterization of the traditional journal publishing system, Allahar describes the evolving phenomenon of open access models on journal publishing, the nature and extent of open access as a disruptive innovation, and the implications for key stakeholders.

In December, we feature articles based on papers presented at the 2017 ISPIM Innovation Conference in Vienna. ISPIM (ispim-innovation.com) – the International Society for Professional Innovation Management – is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management.

For future issues, we are accepting general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions.

Chris McPhee
Editor-in-Chief

Editorial: Insights

Chris McPhee

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. He holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. Chris has nearly 20 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. 2017. Editorial: Insights. *Technology Innovation Management Review*, 7(11) 3–4. http://doi.org/10.22215/timreview/1115

Keywords: Internet of Things, IoT, value propositions, entrepreneurship, Industry 4.0, fourth industrial revolution, social innovation, living labs, open innovation, cities, collaboration, open data, business models, open access, academic publishing

Value Propositions for the Internet of Things: Guidance for Entrepreneurs Selling to Enterprises

David Hudson

> *It's easy to get sidetracked with technology, and that is the danger, but ultimately you have to see what works with the music and what doesn't. In a lot of cases, less is more. In most cases, less is more.*
>
> Herbie Hancock
> Musician, composer, and actor

This article provides entrepreneurs with guidance to help understand and express the specific and compelling value proposition for their Internet of Things (IoT) offer. IoT enables such a wide range of possible short- and long-term opportunities that IoT entrepreneurs may fall into the trap of considering IoT generally rather than positioning their offer to a buyer in a specific manner that helps win deals. The process of understanding and expressing a compelling value proposition will help the IoT entrepreneur focus their offer, understand who the real buyer is, and demonstrate tangible value to that buyer in a manner that is directed towards winning deals.

Introduction

The Internet of Things (IoT) can be defined as "a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual 'things' have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network." (Vermesan et al., 2009). This and other definitions of IoT are very broad in scope with enormous technology, commercial, societal, and other value chain implications. Such breadth provides the opportunity for innovation, as there are many points where an entrepreneur might apply assets in a novel manner to establish a position in the new value chains that IoT will opportune. Such breadth also creates a pitfall in that IoT entrepreneurs may position their offers as tackling a full vision of IoT-enabled transformation. Moreover, because IoT solutions involve the physical and the virtual, and both operations and information networks, there can be multiple stakeholders involved in procurement. Therefore, it is critical that the entrepreneur knows who is buying and what they will pay for.

Consider an example of an IoT offering for theft prevention for a goods delivery service. Such an offer might use a global positioning system (GPS) receiver linked to a satellite or cellular communication network. A device with these technologies could be mounted on a delivery vehicle and used to locate that vehicle, on demand, should that vehicle be reported as delayed or missing. This is a straightforward IoT-enabled offer.

Such on-demand tracking could be enhanced with geofences whereby the IoT system would immediately raise an alarm should the vehicle deviate from its expected routing. Given real-time knowledge of potential theft, automatic communication with law enforcement agencies could be added. This loss-prevention system could be linked to the real-time routing of a large fleet of vehicles, and it could be used to manage the fleet, to optimize routes and deliveries, to implement service tiers, and even to plan vehicle maintenance. With additional sensors on the doors and packages, an even more sophisticated end-to-end monitoring of high-value cargo could be provided. Other sensors could be introduced to ensure that refrigerated goods were kept at the appropriate temperature throughout shipping and never opened, for example.

Monitoring of acceleration, time of day, and the odometer could be used to assess driver performance, to maintain driver logs, and to conform to legislation governing the number of consecutive hours that a driver is permitted to operate their vehicle. All of the above IoT-derived data could be exposed through portals and other interfaces to provide visibility to end customers and other stakeholders in the goods-delivery value chain. Furthermore, the potential exists to monetize this data through the fleet owners, the producers of the goods, shipment brokers, insurers, vehicle vendors, and even the end consumers of the goods.

This example illustrates how a simple IoT use case – asset protection – can be extended to have a set of values that might appeal to a wide variety of potential buyers and operate under a variety of business models. The IoT data is valuable because it can optimize the delivery service, it can be used to improve customer experience, it can be used to monitor directly related aspects of the delivery value chain such as the vehicles and drivers, and it can be used to upsell other products or services. All this is possible because the data provides insight into the operations of the delivery service as well as the habits of that service's users. In this example, a delivery service can ultimately be more valuable because of the IoT data generated than because of the goods moved from one loading dock to another.

IoT entrepreneurs can be tempted to position such a wide vision because it allows so many conversations with so many potential buyers. This wide vision also conforms to the IoT definition above. Indeed, broad claims can be found on many vendors' websites. Tackling a piece of a broader technological and value disruption is a wise move for an entrepreneur, but focusing too much on the wider vision and not enough on specifics leads to a positioning that is neither clear nor compelling relative to the many other IoT vendors competing for deals. Moreover, the entrepreneur must be focused on determining who among the various stakeholders is the decision maker for the initial purchase and what problem that decision maker wishes to solve.

Startups focused on a beachhead or initial entry into the market are unlikely to deliver all the capabilities like those described in the example above, at least not at once or even on their own. Although their target buyers are likely to be interested in such a vision of IoT and business transformation, they will hear "vision" from analysts and other vendors. More importantly, buyers interested in business operations are likely to make purchase decisions based on specific operational outcomes. The IoT entrepreneur must resist the temptation and stay focused on sustainable differentiation and customers willing to pay for such value.

In the author's experience, entrepreneurs operating in the hype-filled IoT space can lose focus or include more and more technology futures and business vision in their value propositions leading to ambiguous and general positioning. As a simple test to check whether they have fallen into this trap, entrepreneurs should ask themselves: What are the two or three value points about my IoT offer that a customer must hear, believe, and remember? What makes those points compelling compared to my competitors' value points?

This article reviews the value proposition literature for approaches to best answering those test questions. The approaches summarized here are most relevant to those IoT entrepreneurs looking to position themselves as delivering clear and compelling value to customers who making purchase decisions for specific capabilities and to understand what makes a value proposition compelling. The focus here is on enterprise rather than consumer applications of IoT insofar as the article addresses transactions where customers procure IoT offers to address business opportunities.

This article includes a review of tools and provides guidance that can assist the IoT entrepreneur to refine their value proposition to make it specific and compelling. These tools can be applied during the development of a venture and periodically during the process of engaging and learning from early customers.

Background

There is considerable market analysis of the size and type of opportunities for IoT vendors. This data reinforces the potential breadth of IoT applications as well as the magnitude of the customer spending in the enterprise market. Analysts have also provided insight into how the overall enterprise IoT market may be parsed into addressable segments. Columbus (2016), for example, highlights that, although IoT does include the potential for game-changing approaches to delivering media, healthcare, financial services, and so on, the areas where there are highest levels of commercial activity include inventory management, mobile/in-transit asset management, industrial equipment maintenance, and remote management of installations. Such analysis emphasizes the extent to which IoT consumption is driven by business operations requirements that tend to be consistent within traditional market verticals. There are common IoT technologies used across verticals, however, buying is often operations driven within a vertical. Market analysis is important, but an IoT entrepreneur will transact with a customer – or just a critical few initially – not with an entire market. Some of the market analysis therefore highlights that some customers will be operationally focused in their use of IoT.

The industry hype concerning IoT has also lead to considerable academic discussion. Some of the literature is technology centric, elaborating on architecture and standards (e.g., Uckelmann et al., 2011). Inquiry into the technology is important, of course, because the technology must work if it is to deliver value. The sophistication and complexity of the underlying technology create challenges for realizing worthwhile business models (e.g., Lee & Lee, 2015).

Indeed, innovation in the business model rather than the technology itself is a potential area for entrepreneurs to exploit. Tuber and Smiela (2014) propose several innovative business models. The literature also describes how IoT business models function at an ecosystem level. For example, Westerlund, Leminen, and Rajahonka (2014) examined business model design "under the transition from company-specific business models towards networked and more comprehensive ecosystem business models". The ecosystem effects of IoT reinforce the potential breadth and reach of a wide view of IoT.

As with the market opportunity data, IoT technology and ecosystem contexts are important. However, the IoT entrepreneur looking for that first customer must find their own unique and specific value proposition within the architectures, standards, ecosystems, test beds, and the like. Other vendors, by definition, will be able to lay claim to technology and ecosystem compliance value points.

Just as the Internet itself or industrial revolution did not have a singular value proposition or business case, neither does IoT. As an Internet-enabled capability, end-to-end IoT has and will have multiple transactions or nodes in a value chain to deliver a complete solution. The technology components include the network, sensors, analytics, archives, analytics, etc. The actors include the end customer or customers; the owners of the equipment that provides the raw IoT data; those that gather, store, analyze, and possibly enhance the data; as well as those that monetize the data. Westerlund and colleagues (2014) note that the IoT ecosystem business models are diverse and immature. The breadth of IoT potential can be tempting to the IoT entrepreneur, however, the diversity and immaturity can make reaching a real buyer difficult if there is too much focus on broad positioning or a lack of focus on the correct portion of the value chain.

Within such a value chain view, consider one node or instance of value exchange in the ecosystem. Specifically, consider the enterprise buyer who wants to address a pain point where an IoT solution may apply. An IoT startup may wish to serve this need with an offer. Multiple suppliers are likely to be involved in delivering an IoT solution given that the solution will involve some aspects of the enterprise's operational technology – for example, in manufacturing, healthcare, energy and so on – as well as its networks and other information technologies. Solutions that span multiple enterprise locations and use cases with data captured and stored over long periods of time are likely to involve even more suppliers. An IoT startup must be able to demonstrate its specific and compelling value within the value chain and in the context of essential architectures, standards, and the like.

In the earlier example, there is a full vision of transportation transformation that includes a specific point where GPS and other technology create a node where the value exchange centres on loss prevention. The business model at such an IoT node can be understood as an architecture that identifies the key actors and basis for exchange of value (Glova et al., 2014).

There are different types of actors such as buyers and sellers as well as types of exchange – product sales, service subscriptions, products as services, customizations, and so on. The literature, therefore, guides us from a broad understanding of IoT as an orchestrated set of technologies to the notion of specific value exchanges transacted within the broad vision of industrial change. These types of transactions are considered below.

IoT Business Model Types

Dijkman and co-authors (2015) developed an IoT business model framework based on a literature review, interviews, and surveys. They describe a range of business models with underlying value propositions that include convenience/usability, getting the job done operationally, improving performance of the operation, creating the possibility of later updates, reducing cost, mitigating risk, customization, and so on. Even at the level of specific IoT customer needs and supplier offers, there is a range of underlying value propositions. In other words, two IoT customers might consume the same IoT offer for different reasons, or the same IoT offer might be positioned in different use cases because of a common underlying value proposition.

Value Propositions for the Internet of Things: Guidance for Entrepreneurs Selling to Enterprises *David Hudson*

Uckelmann and colleagues (2011) also identify a range of value propositions underlying IoT use cases that include business innovation, creation of new services, creation of new, purpose-built IoT devices and interfaces, management of resources, development of new applications, real-time analytics and business intelligence, and supply chain visibility. They describe how the initial customer need for an IoT offer often centres on optimization of current processes and cost reduction leading to a later need to drive new revenue opportunities in IoT – from saving money to making money. Examples of new revenue opportunities are IoT platforms as a service, IoT information service providers, improving the quality of an end-to-end user experience, and real-time analytics. The "making money" aspects of the new revenue opportunities extend to monetizing data outside of what would have been the customer's traditional business model. An IoT offer can optimize current business and enable later opportunities – it "enables incremental business transformation as well as radical business changes" (Uckelmann et al., 2011).

Nagji and Tuff (2012) describe how offers (products or services) may be core, adjacent, or transformational. Core offers incrementally improve existing capabilities and expand existing markets; adjacent offers expand from existing business into "new to the company" business; and transformational offers are breakthroughs for markets that do not yet exist. Taking the core, adjacent, and transformational typography of offers in general as well as the market and academic writing describing ranges of IoT offers, the author proposes an IoT offer may fall into one of three categories:

1. *Core IoT:* operationally focused offers that deliver cost reduction or other business performance improvement through the use of IoT sensors, actuators, and data. Such offers improve the customer's current business.

2. *Adjacent IoT:* offers that allow the customer to leverage the data that their business operation generates to provide new offers themselves. These new offers address a recognized market need and may include selling products as services – for example, selling machine hours as a service versus selling the machines as a product.

3. *Transformational IoT:* offers that allow the customer to create breakthrough offers. As breakthroughs, a new market is to be created, and the offers are likely to depend on novel use of the data generated by IoT. As an example, a traditional product vendor may monetize the data on customer experience of their product or machine learning applied to the IoT data stream may identify new relationships and untapped needs.

A given IoT business offer should fall into one, and possibly more, of these types. There is also a progression inherent in these types, and hence, an offer may initially address a core opportunity but, over time, can be applied to adjacent or transformational opportunities as technologies and customer-adoption progress. This notion of a range or spectrum or apparent and latent customer needs is important to how an IoT startup might position against the opportunity. The startup must position knowing that the customer may make its vendor selection against one set of buying criteria but later recognize and address other needs.

Compelling Value Propositions

Muegge (2012) explains how entrepreneurs can systematically discover their business models. One component of this systematic approach is the development of the stakeholder value propositions. There may be multiple stakeholders involved in any given business and there must be a compelling value proposition for each to participate. The compelling aspect of the value proposition is the basis for the selection of one supplier over the competition.

According to Anderson, Narus, and Van Rossum (2006), compelling value propositions have three attributes:

1. *Distinctive:* the value delivered is superior to the competition.

2. *Measurable:* the value delivered can be quantified in monetary terms.

3. *Sustainable:* the superior, measurable value can be preserved and enhanced for a period of time.

Anderson and co-authors (2006) also provide a method for developing and refining a value proposition so that it is compelling. The central idea in their approach is that suppliers cannot simply list every possible benefit from their offer because competition exists, because customers are skeptical, and because customers often make choices based on specific needs rather than general and broad requirements.

Value Propositions for the Internet of Things: Guidance for Entrepreneurs Selling to Enterprises *David Hudson*

Discovering the compelling value proposition is done iteratively (Anderson et al., 2006). The entrepreneur identifies, in sequence:

1. *All benefits:* These are all benefits customers may receive from the entrepreneur's offer, considering what is distinctive, measurable, and sustainable about each benefit.

2. *Favourable points of difference:* This is a subset of all benefits and includes only those that are superior to the next best alternative to the entrepreneur's offer. Note that the next best alternative may be status quo – the customer selects no offer or no new offer.

3. *Resonating focus:* This is the shortest subset of the favourable points of difference and includes only those that deliver the greatest value to the customer relative to the next best alternative. Greatest is characterized by the distinctiveness, measurability, and sustainability of the benefits.

Application of this method (Anderson et al., 2006) to an IoT offer can begin with an understanding of market needs as expressed in analyst or other data as well as a broad set of changes that are enabled by IoT technologies. Refinement to the favourable points of difference requires an understanding of what competitors will do over the same timespan as the entrepreneur's plan. Reaching the resonating focus subset requires customer engagement. The entrepreneur should expect to iterate through this process.

The literature on focusing an offer in the IoT space so that it has a compelling value proposition is summarized in Table 1.

Application

The relevance to the entrepreneur of classifying the IoT offer and how to express its most compelling value proposition can be seen by revisiting the earlier example of an IoT offer that minimizes losses due to theft. This offer delivers business performance improvement through prevention of losses and recovery in the event of theft and, hence, is a core IoT offer. The buyer for such an offer is likely to be intensely operational and will understand current (status quo) operations and the cost of loss. The value proposition for such an offer can be expected to have specific measurable performance arguments supported by data such as successful delivery rates. The return on investment for such an offer can also reasonably be linked to the rate at which customers deploy the offer. Customers may also perceive value in that they can charge more for IoT-assured delivery.

Consider a second example where additional data from the process of shipping goods is used to observe real-time customer usage and measure customer experience. Customer experience of a product or service could be inferred using data gathered from the shipping and receiving enterprise resource management systems and the end-to-end shipping process. This customer experience data can be used to understand cus-

Table 1. Key considerations when developing a compelling IoT value proposition

IoT Offer Types		
Core IoT	**Adjacent IoT**	**Transformational IoT**
• Business performance improvement • Cost reduction • Performance improvement	• New offers • Recognized by market	• New offers • New market
Attributes of a Compelling IoT Value Proposition		
Distinctive	**Measurable**	**Sustainable**
How is the IoT offer superior to competing offers and to the status quo?	How is the value of the IoT offer measured in terms of specific operations or business performance improvement, addressable market, or market making?	How is the IoT offer's distinctiveness kept superior to the next best alternative over time?

tomer habits to drive a sales campaign to focus on highest-value customers. The data could also be used in training of the customers themselves to increase consumption of the shipping service or to create customized shipping offers to meet the needs of specific segments or even customers. Alternatively, such data could be made available to a third party that specializes in such professional services. The core offer to customers would continue to be operationally focused in its value. However, the adjacent offer to create customized service would be new to the market and would likely be of interest to marketing and sales decision makers. The value proposition for this adjacent IoT-enabled offer would depend on measurable attributes; however, decision makers here would pay attention to the distinctiveness and sustainability of the offer.

Finally, consider a transformational IoT offer where sensors that are embedded within a shipping-solution offer also gather environmental and pollution data from the geographies covered by the shipping firms that use the offer. In this instance, there are many potential customers for such a dataset and many potential business models for monetization – governments for policy purposes, enterprises to sell their own offers or manage their own environmental impact, and so on. The value proposition here goes well beyond operations in any one shipping firm and must emphasize how it is sustainable in the marketplace. A buyer here is likely strategically minded and is likely a C-suite decision maker.

Entrepreneurs or managers of those responsible for IoT offers can apply the approaches summarized above to test whether they are positioning a compelling value proposition. Which type of IoT offer is it? Core offers target operationally minded buyers. Transformational offers target those responsible for new business opportunities. Adjacent offers may depend on both types of decision makers. The value propositions for IoT offers of each type are also likely to be different with core IoT delivering operational value and transformational offers enabling new market creation or entry.

The value propositions for the offer also need testing. What is the compelling value proposition? It is a concise set of measurable and sustainable value points that distinguish the offer from the competition. Because these value points are measurable, they can be tested and demonstrated to customers to win business.

These pragmatic steps will assist IoT entrepreneurs in executing successfully in the shortest period.

Conclusion

Any given IoT offer may be able to address core, adjacent, and transformational opportunities and may therefore appeal to operational, marketing, executive, or other buyers. The breadth and scope of IoT in a full vision can encourage taking such wide views. An IoT entrepreneur must, of course, be able to speak to the short and the long term, to the immediate and adjacent opportunities, to the operational pragmatics and the transformational vision. The IoT entrepreneur must also have a systematically developed understanding of what makes their offering better than the competition's, and they must be able to communicate that compelling value proposition.

The guidance from the compelling value proposition literature, however, is to focus on the shortest possible list of distinctive, measurable, and sustainable points of difference for the target buyer. This guidance is particularly critical for entrepreneurs in the IoT space. Building from an entry point of strength will allow IoT entrepreneurs to address increasingly sophisticated opportunities that may span business process improvement through transformational opportunities as well as multiple use cases that span customers, geography, time, or other dimensions.

About the Author

David Hudson is a technology management professional who has 30 years experience in industry and academia. Most recently he led new business incubation within the Chief Technology Office at Dell EMC. He is an Executive in Residence at the University of New Brunswick's Technology Management and Entrepreneurship program. He has been a Lecturer in technology innovation in the MBA program at Carleton University's Eric Sprott School of Business, a Director of Lead to Win, the Chair of the Ontario Centres of Excellence ICT advisory board, and a consultant to technology firms. Previously, he was the Vice President of advanced research and development at Nortel and has had an extensive career in technology business management as well as R&D. David received his Bachelor's and Master's degrees in Systems Design Engineering from the University of Waterloo, Ontario, Canada. His Doctorate is from Carleton University in Ottawa, Canada, where his research focused on employee innovation on-the-job.

Value Propositions for the Internet of Things: Guidance for Entrepreneurs Selling to Enterprises *David Hudson*

References

Anderson, J. C., Narus, J. A, & Rossum Van, W. 2006. Customer Value Propositions in Business Markets. *Harvard Business Review,* 84(3): 90–99.

Columbus, L. 2016. Roundup of Internet of Things Forecasts and Market Estimates, 2016. *Forbes,* November 27, 2016. Accessed October 26, 2017: https://www.forbes.com/sites/louiscolumbus/2016/11/27/roundup-of-internet-of-things-forecasts-and-market-estimates-2016/

Dijkman, R. M., Sprenkels, B., Peeters, T., & Janssen, A. 2015. Business Models for the Internet of Things. *International Journal of Information Management,* 35(6): 672–678. http://dx.doi.org/10.1016/j.ijinfomgt.2015.07.008

Lee, I., & Lee, K. 2015. The Internet of Things (IoT): Applications, Investments, and Challenges for Enterprises. *Business Horizons,* 58(4): 431–440. http://dx.doi.org/10.1016/j.bushor.2015.03.008

Muegge, S. 2012. Business Model Discovery by Technology Entrepreneurs. *Technology Innovation Management Review,* 2(4): 5–16. http://timreview.ca/article/545

Turber, S., & Smiela, C. 2014. *A Business Model Type for the Internet of Things.* Paper presented at the Twenty Second European Conference on Information Systems, Tel Aviv, 2014.

Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.) 2011. *Architecting the Internet of Things.* Berlin Heidelberg: Springer-Verlag.

Vermesan, O., Friess, P., Guilleman, P., Gusmeroli, S., Sundmaeker, H., Bassi, A., Jubert, I. S., Mazura, M., Harrison, M., Eisenhauer, M., & Doody, P. 2009. *Internet of Things – Strategic Research Roadmap.* Brussels: European Commision, Information Society and Media DG; Cluster of the European Research Projects on the Internet of Things (CERP-IoT). http://hdl.handle.net/11250/2430372

Westerlund, M., Leminen, S., & Rajahonka, M. 2014. Designing Business Models for the Internet of Things. *Technology Innovation Management Review,* 4(7): 5–14. http://timreview.ca/article/807

Citation: Hudson, D. 2017. Value Propositions for the Internet of Things: Guidance for Entrepreneurs Selling to Enterprises. *Technology Innovation Management Review,* 7(11): 5–11. http://doi.org/10.22215/timreview/1116

Keywords: Internet of Things, value propositions, offers, entrepreneurship, guide

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

> *The scale, scope and complexity of how technological revolution influence our behavior and way of living will be unlike anything humankind has experienced.*
>
> Klaus Schwab
> Engineer and Economist; Founder and Executive
> Chairman of the World Economic Forum

The rapid pace of technological developments played a key role in the previous industrial revolutions. However, the fourth industrial revolution (Industry 4.0) and its embedded technology diffusion progress is expected to grow exponentially in terms of technical change and socioeconomic impact. Therefore, coping with such transformation require a holistic approach that encompasses innovative and sustainable system solutions and not just technological ones. In this article, we propose a framework that can facilitate the interaction between technological and social innovation to continuously come up with proactive, and hence timely, sustainable strategies. These strategies can leverage economic rewards, enrich society at large, and protect the environment. The new forthcoming opportunities that will be generated through the next industrial wave are gigantic at all levels. However, the readiness for such revolutionary conversion require coupling the forces of technological innovation and social innovation under the sustainability umbrella.

Introduction

Every industrial revolution brought with it benefits and challenges to the socioeconomic status of the countries that have engaged in such transformation. For instance, Great Britain led the first industrial revolution with the invention of the commercial steam engine, which revolutionized communication and transportation and led to many other industrial developments. In the second industrial revolution, the United States was primarily in the lead, with the telephone revolutionizing communication this time. In the third industrial revolution, the Internet was the key factor and succeeded because it was conceived as a public infrastructure technology rather a proprietary technology (Carr, 2003). The Internet has transformed the world economic landscape, and this transformation is expected to continue with the Internet of things (IoT). Rifkin (2014) confirms this trend in his concept of zero marginal cost, which emphasizes connectivity in his anticipation of a collaborative economy that will replace the capital system in its current form – with the IoT as the main driver. The rapid progress of smart cities is also paving the way to a more collaborative world (Kanter & Litow, 2009).

All these industrial revolutions have resulted in economic growth, increased productivity, and advanced welfare in the countries that managed to reap most of its positive impact, including from high-quality goods and services. However, the wealth distribution within the developed countries who led the industrial revolution was not equitable, certainly not at the global level, where inequality has become one of the key challenges along with climate change and other sustainability issues. The rapid depletion of Earth's resources at the expense of the future of the society and environment has created an epic global challenge. Concepts such as sustainability and social innovation have surfaced and have rapidly attracted global attention as potential resolutions. The United Nations global initiative towards sustainable development goals (SDGs) has sent a strong message committing to inclusive social and economic development (UN, 2014). Innovative efforts in using, for

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

instance, the sustainable livelihood approach to link socioeconomic and environmental issues are also endeavours (Brocklesby & Fisher, 2003).

Industry 4.0 is not an exception to the previous eras of industries, but it is expected to bring immense benefits and many challenges. However, the main challenge that most stakeholders are concerned with is the cybersecurity risk given that the IoT is the backbone of Industry 4.0, which has the potential to enlarge the level risk exponentially from where we are today. Moreover, the rate of the technological development in Industry 4.0 is exponential and, therefore, anticipating the challenges and even the benefits is much more difficult than what the world experienced in the previous industrial revolutions. This increased difficulty is due to the high convergence of technologies that could complement or compete with different possible diffusion scenarios that may result in more frequent breakthroughs that are difficult to forecast. Hence, the policy and regulation due to the speed of progress may lack a remedy for any unexpected consequences or developments if the policy resolutions remain non-global and reactive.

Social challenges are mainly the immense risk of cybercrime due to increased connectivity, and job losses due to the automation of large segments of operations in many industries as part of Industry 4.0. Although new opportunities may appear for high-skill categories, as argued by Drucker (2014), but will the volume of these new jobs meet the supply of labour? In addition to automation, the rapid development and recent successes of artificial intelligence in business domains have raised the bar. IBM has already made leaf frog development of system solutions in different obvious fields, and Watson of IBM is a striking example (Waters, 2016).

Therefore, technological and business-driven innovative solutions are not going to be enough. Innovation in its broadest sense is the key solution, in particular *social* innovation. The same drive to innovate technologies to increase productivity can also be utilized to improve welfare and societal needs of the world population.

In this article, we use an exploratory approach to discuss how we can tackle Industry 4.0 from a not only economic view but also from social and environmental perspectives. In other words, we discuss Industry 4.0 in the context of social innovation. We seek to bridge some of the theoretical gaps about how Industry 4.0 can be discussed from both technological and social innovation perspectives. And, to facilitate this bridging of gaps, we propose a simple framework to address the above issues using a holistic perspective that aims to ignite an innovative and constructive conversation rather than specific technical solutions.

Literature Review and Theoretical Background

The world is changing very fast thanks to the technological revolution that greatly influences our way of living and the behaviour of both individuals and organizations. Industry 4.0 (also known as Fourth Industrial Revolution) manifests itself in the way data changes, technologies are automated and digitized, and what we now call the Internet of things (IoT).

In this section, we review the relevant literature and discuss the theoretical background of Industry 4.0, social innovation, and the interaction between Industry 4.0 and innovation in general. Our intention is to explore the Industry 4.0 concept, including its economic, social, and environmental interactions.

What is Industry 4.0?

Industry 4.0 is related to what is called the "smart factory" (Dutton, 2014). In a smart factory, a virtual copy of the physical world and decentralized decision making can be developed (Buhr, 2015). Also, physical systems can cooperate and communicate with each other and with humans in real time, all enabled by the IoT and related services.

The debate about Industry 4.0 and its global impact is growing rapidly due to intense discussions about digitization, the Internet of things, and smart knowledge and systems (Friess & Ibanez, 2014; Vermesan et al., 2014). The debate is driven by uncertainty about the best way to exploit the fast pace of technological innovation to improve various aspects of human life .

The concept of Industry 4.0 has its origins in Germany and has been recognized by other leading industrial nations, although it is known as "Connected Enterprise" in the United States and the "Fourth Industrial Revolution" in the United Kingdom. In any case, Industry 4.0 is built on three preceding technological transformations: steam power, which was the transformative force of the nineteenth century; electricity, which transformed much of the twentieth, and the era of the computer beginning of 1970s (Cordes & Stacey, 2017). We

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

expect that the impact of Industry 4.0 will be more profound, irreversible, and much more rapid than the previous three generations. The high growth in the demand of technologies (mainly information and communication technologies) by industrial firms can fuel the future of Industry 4.0 and may result in positive spillover effects to different areas.

The term "Industry 4.0" was originated in 2011 at the Hanover Fair in Germany as a strategy to mitigate the increasing competition from overseas and to differentiate German and European Union industries from other international markets (Pascall, 2017). Also, the German government sought to use intelligent monitoring in production processes in order to aid decision making and machine maintenance to reduce costs and increase the competitiveness of German industries. In order to understand what is meant by Industry 4.0, PwC (2017) proposed a framework, which also was adopted by the Flemish Government. The idea of the framework arose by asking leading companies to determine their priorities among a group of concepts. Smart systems, humans in Industry 4.0, smart production, and people skills were identified as the highest priorities.

Schmitt (2015) confirmed five reasons why Industry 4.0 is important and is seen to be revolutionary in the era of information technology and open market operations. First, Industry 4.0 mitigates the burden of current challenges for manufactures in order to make the companies more flexible and responsive to business trends. Among these challenges are the ones of increasing market volatility, shorter product lifecycles, higher product complexity, and global supply chains. For example, smart items will bring stronger integration of top floor and shop floor and thus more intelligence and flexibility to production. Second, Industry 4.0 enables the transformation of modern economies to become more innovative and hence increase productivity. It is expected that the use of modern technologies such as digital chains, smart systems, and the industrial Internet will speed up innovations as new business models can be implemented much faster. Third, it highlights the role of consumer as a co-producer and puts them in the centre of all activities. The customization of products is the most important activity in the product value chain, and digitization will facilitate crowdsourcing, which in turn will lead to a faster design process. Industry 4.0 puts humans in the centre of production. Workers will be assigned where help is needed, hence there will be higher demands in the workforce for skills in managing complex projects, yet more flexible work will also become available. Finally, we argue that it will enable sustainable prosperity through the use of modern technologies to find solutions to the challenges related to energy, resources, environment, and social and economic impacts. Innovative solutions can reduce energy consumption, help companies to sustain their business with existing and new business models, and use new technologies to produce all over the world (even at high-cost locations) close to the markets utilizing the domestic workforce skills.

Acatech (2014) described Industry 4.0 as the IoT: data and services that will change future production, logistics, and work processes. This means that the evolution of the IoT has gone beyond Internet-connected applications in recent years with the integration of different technologies such as machine learning, embedded systems, and wireless connection. The European Research Cluster on the Internet of Things (IERC) (Vermesan et al., 2009) stated that the IoT is " an integrated part of Future Internet and could be defined as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual 'things' have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network." IERC added that "things" in the IoT "are expected to become active participants in business, information and social processes where they are enabled to interact and communicate among themselves and with the environment by exchanging data and information 'sensed' about the environment, while reacting autonomously to the 'real/physical world' events and influencing it by running processes that trigger actions and create services with or without direct human intervention". Vermesan and colleagues (2014) confirmed that the main goal of the IoT is to "enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service".

What is social innovation?

Social innovations are known as new practices used to tackle social challenges; they have a positive influence on individuals, society, and organizations (Hahn & Andor, 2013). Social innovations have also been defined as new models, services, and products that simultaneously meet social needs (Marolt et al., 2015). They can be expressed by one or a combination of the following: law, regulation, behaviour, service, business model, perception, organization, or technology (Abott, 2014). Based on these broad definitions, many innovations

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

can be classified as social innovations, including self-help health groups and self-build housing; Wikipedia and the Open University; complementary microcredit and consumer cooperatives; charity shops and the air trade movement; zero carbon housing schemes; and community wind farms (Mulgan et al., 2007).

The concept of social innovation denotes the processes and factors that lead to a sustained positive transformation to the network society (Mulgan, 2006; Phills et al., 2008). It is defined as an innovative solution to the increasing challenges that face society – one that is more effective, more efficient, more sustainable, or more equitable than existing practices (Phills et al., 2008). Phills and co-authors (2008) confirm that social innovation should express both the newness and improved responses to societal needs. Society's appreciation of the resulting benefits of social innovation exceeds the traditional model, which usually benefits the innovators themselves. Many known innovations can be classified as social innovations, for example, sustainable solutions to environment problems, health insurance, new learning models, and transportation facilities. Social innovation flourished recently as a promising mechanism to tackle the inefficiency of the existing policies and models targeting the most pressing global issues such as chronic diseases, climate changes, and inequality (Murray et al., 2010).

Industry 4.0 and innovation

Industry 4.0 is highly connected with innovation. In the last decade, innovation added further ingredients to the mix – mobile, cloud, social media, and big data – which together might build a perfect symbiosis, create new concept for the industrialization process, and shift the market into new era of competition and differentiation of products (Geiger & Sá, 2013). Industry 4.0 represents a shift toward an innovation-based economy with knowledge, data, and the IoT as central concepts. This will affect the current structure, markets, and business processes of the industrial age and pave the way to a new age of digitization, "smarter" networking of production systems, and interlinked business processes.

In the new industrial revolution, traditional competitive factors such as market share, economies of scale, and access to resources are now linked or joined with other factors such as innovation, intellectual property rights, smart technology, and access to knowledge (Geiger & Sá, 2013). Furthermore, the role of the consumer is changing in the production process; the availability of relevant information for both consumers and business units allows for more interactive relationships between them so that the consumer needs can be better fulfilled. The consumer's role in the production process is vital: they are now a co-producer. Meanwhile, radical process innovation is associated with the technological revolution; tailored production series will replace industrial or mass-manufacturing facilities (Buhr, 2017).

Also, customers have become more outcome oriented (Geiger & Sá, 2013), and the "make-for-me" approach represents a new business model. These trends have contributed to the emerging concept of mass customization in manufacturing (Da Silveira et al., 2001), where many firms started to introduce new marketing interfaces and manufacturing processes to meet the customized customers requirements who are willing to pay for customized features of the goods and services. For example, consumers now choose their education approach and define exactly what they need from courses and knowledge rather than passing through the traditional and formal teaching approach, which leads to incremental and radical innovation in the education system that consider project-based and research-based learning and interactive learning as the top priority. Companies are expected to modify the business models for their innovation and insert flexible value chains to increase responsiveness to the changes in consumer behaviour. A smart factory with smart production systems will cope with such demand while maintaining high-quality products and services.

Discussion

Most of the recent literature about the Fourth Industrial Revolution focuses on the technological innovation nature of Industry 4.0. There is concern about whether the fast growth in technological development and digitization is leaving a positive influence on the individuals and society (Luppicini, 2012). Thus, when considering how technological progress can be exploited to solve society problems, we must also view technological innovations through a social perspective.

Industry 4.0 represented by the high growth in technology-enabled platforms has disrupted the existing industry structures and created new ways of consuming goods through the combination of demand and supply. It also organizes how people work and consume, it changes the nature of assets, and it affects how data is obtained and manipulated. Moreover, it lowers the barriers for people and businesses to invest and create wealth, which in turn alters the surrounding personal and professional environments (Schwab, 2015).

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

Since the 2016 World Economic Forum, which set Industry 4.0 on its agenda as a global issue, this new buzzword has been associated with rapid technological breakthroughs that lead to the transformations in all aspects of our socioeconomic lives. In this view, one of the key questions is how countries can create the conditions for the fourth industrial revolution and associated emerging technologies to bring new opportunities and benefits to the people and society, to help remedy the damage to the society that the last three revolutions caused, as well as enabling a sustainable fourth industrial revolution.

This new economic paradigm makes the Internet (and data) a way to create value for people and societies and not only serve as a communication channel. Industry 4.0 makes the world more digital, more connected, more flexible, and more responsive. Well-known social relationships are changing beyond recognition; we are moving from business-to-consumer relationships to peer-to-peer modes (Arroyo et al., 2017).

The engineer and economist Klaus Schwab, Founder and Executive Chairman of the World Economic Forum declared during the World Economic Forum in 2016 that to the world should have a comprehensive and globally shared understanding about how the technology change dramatically our social, economic, ecological, and cultural lives. Schwab posed some questions that highlight the ways technological innovation can interact with social innovation to shape the future of our societies and benefits our societies: How will Industry 4.0 transform the healthcare sector, education, and many other industries? How we can leverage technological innovation in ways to benefit both rich and poor? How can technological innovation contribute solutions to international public health problems? How should the role of government be redefined in this technological revolution to promote transparency in economic, social, and environmental reform?

Schwab (2015) also confirms that, in the fourth industrial revolution, the social impact of technological changes on the economic sectors, labour market, production, and innovation is better understood now than during previous industrial revolutions. Meanwhile, governments and policy makers need to adapt and react quickly to the rapid evolution of the Industry 4.0 landscape by providing the enabling environment, safeguards, and policies that can guide the future for sustainable economic and social development and that harness the promise that the technologies arising from Industry 4.0 hold for people and societies.

Brynjolfsson and McAfee (2014) emphasized that, in order to take advantage of the opportunity that the new industrial revolution presents, it is important to recognize its impact on the whole society. Therefore, we have to consider social innovation alongside the technological revolution. In other words, we have to focus on the alignment between technical development (diffusion and dissemination) in one hand and the new practices required to deal with social challenges facing people and organizations on the other hand. In this view, Buhr (2017) confirms that the impact of social innovation is prominent on a system-wide level, which means that there is a mutual relationship between the technical and social innovation Technical innovations and fast technological development can positively affect the diffusion and dissemination of social innovation, and technical innovation often develops its true potential in combination with social innovation. The digitized nature of Industry 4.0 innovative products is likely to lead to both economic outcome as well as social benefits, if managed under the umbrella of sustainable development.

Industry 4.0 has huge potential to make positive impacts on our economies and societies. Uschi Schreiber, Chair of Global Accounts Committee & Global Vice Chair of Markets at EY (Schreiber, 2017) confirmed that the multiplication of data volume available through web-connected systems accompanied by increasingly sophisticated artificial intelligence are expected to fundamentally change how society operates by providing entirely novel solutions to existing problems, including solutions and harmful systems that might not be expected. Schreiber added that Industry 4.0 introduces new possibilities or prospects for breakthroughs in healthcare, the ability to empower more people worldwide to become entrepreneurs, and increased access to education. These opportunities come about by adopting a holistic approach or enabling mechanism for Industry 4.0 in order to meet the social and environmental challenges that face societies, to mitigate or minimize unintended consequences of the rapid technological innovations, and to maximize the positive social benefits and protect public interests.

The discussion of social innovation in the context of Industry 4.0 is important to happen at early stages to address the growing concern of any possible negative externalities on individuals and society at large. This is important due to the increasing possibilities of the substitution of the human role by new technological innovations in the form of artificial intelligence, robotics, drones, virtual reality, and the IoT. As a result, certain

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

jobs may be made redundant or obsolete through automation and the digitization of production process, the qualification requirements of new jobs will be more strict, and new skills and knowledge will be required.

Industry 4.0 might lead to an unprecedented surge of technical, industrial, and social innovations, which increasingly casting doubt on the adaptive capacity of individuals and institutions with regards to threats to human identity, social stability, and economic security. As Schreiber claims, it could disrupt every industry; reshape how we work, relate, communicate, and learn; and reinvent institutions from education to transportation.

In a similar view, the growth of Industry 4.0 highlights one of the common challenges posed by the rapid growth in information and communication technology: privacy. The sharing and tracking of our information, the loss of control over our data, and the disclosure of information about our private lives are consistent with the new connectivity (Anderson & Mattsson, 2015). For example, the revolution in biotechnology redefines what it means to be human by changing the threshold of life period, health, and cognition, which also forces us to redefine our moral and ethical boundaries (Schwab, 2015). Thus, one of the most important challenges for government, policy makers, and society is how to shift the culture of the industry and society to tackle the set of technology disruptions associated with this new industrial era. In the following section, we propose a framework to facilitate policy debates and explore innovative solutions while ensuring a sustainable future.

A Framework for a Sustainable Industry 4.0

The impact of technology has increasingly made an impact beyond industrial and economic perspectives, and it could play a critical role in speeding up the realization of a paradigm shift, as Rifkin (2014) anticipates. However, there is a need to address the various unexpected consequences of the rapid pace of technological developments. The challenges that are caused by the technological innovations need to be addressed by complementary and innovative approaches to provide innovative solutions that include radical methods that can be deployed to anticipate the future emerging technologies and their impact – from a holistic perspective.

A useful base to start with is using the sustainability concept in its totality, which exceeds the emphasis of meeting the requirements of present generations without compromising the ability of future generations. However, three key pillars – economic, social, and environmental –form the bases of our simple framework (Adam, 2006). Technological and social innovation are key drivers in providing sustainable solutions that meet the three key criteria of sustainability and can act as an assessment mechanism to any related developments of Industry 4.0, as shown in Figure 1.

Including sustainability in the framework acts as a filter and provides guidance to scrutinize technology developments coming out of Industry 4.0. It also emphasizes the reciprocal roles of technological and social innovations.

The critical success factor in such an inclusive approach is designing a creative platform. This creative platform would include experts from different disciplines including engineers, economists, social scientists, environmentalists, futurists, artist, and other creative people who can work together as part of this framework and come up with novel solutions. A specific example that could result from such an arrangement and set of competencies would be in the development of advanced and integrated simulation systems to create, for instance, a virtual environment where people and emerging technologies can interact and behave naturally. As a result, several studies can be conducted to accurately anticipate the impact of various scenarios before populating technological breakthroughs. In this example, the timely development of augmented reality and virtual reality could play a critical role if such initiatives are pursued.

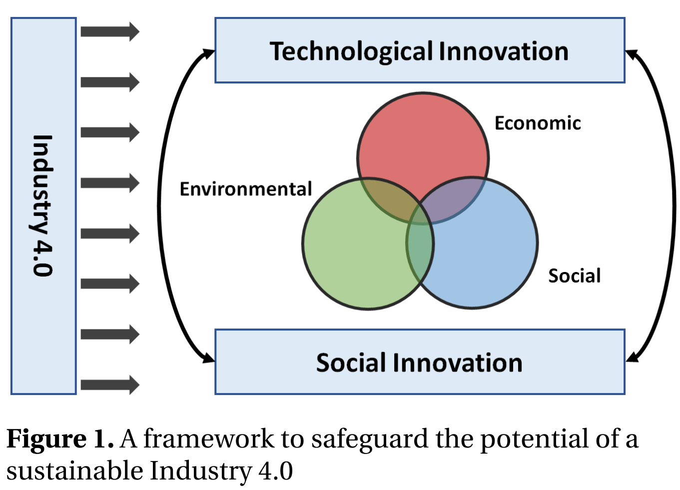

Figure 1. A framework to safeguard the potential of a sustainable Industry 4.0

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

Conclusion

This exploratory work aimed to develop an understanding of the social aspects of the Fourth Industrial Revolution by demonstrating how the interaction between technological innovation and social innovation can solve current societal and socioeconomic problems with an emphasis on sustainability. One of the most important criticisms for the previous three industrial revolutions and their associated policies is the failure to solve the most pressing issues that continue to face modern societies. These include climate change, chronic diseases, and inequality. With the transition to Industry 4.0, policy makers should think its global impact on current and potential social problems through the social dimensions of new technologies. Society at large should benefit from such industrial transformation, because consumer and producer are largely connected and both can participate in the production and consumption process.

This study confirms the importance of the duality between social and technological innovation, which can be achieved only if the Industry 4.0 is recognized simply in the form of technical and social innovation. The discussion of social innovation in the context of Industry 4.0 sheds light on the bright side of its potential instead of focusing on the potential dark side of job losses, human substitution by technological innovations, end of privacy, and potential loss of human control. The social perspective demonstrates that technical innovations are likely to positively affect the diffusion of social innovation, and vice versa. The technological revolution that accompanies the Industry 4.0 achieve its true potential in combination with social innovation. Hence, businesses that succeed in Industry 4.0 will be those that offer both social progress and economic benefits.

About the Authors

Rabeh Morrar is an Assistant Professor in Innovation Economics and Head of the Department of Economics at An-Najah National University in Nablus, Palestine. He received and PhD degree in Innovation Economy from Lille 1 University for Science and Technology, Lille, France. His current research interests include innovation networks, the knowledge-based economy, economic development in developing countries, the labour economy, and the service economy. Dr. Rabeh is a Fellow of the Economic Research Forum (ERF), the Turkish Economic Research Forum, the American Economic Association (AEA), the Middle East Economic Association (MEEA), and the European Association for Research in Services (RESER). He is a member of the Advisory Committee of Economic Statistics, the Palestinian Central Bureau of Statistics (PCBS), the Palestinian National Committee of Trade in Services, the National Team for Developing National Export Strategy, the Business Innovation and Partnership Centre in Palestine, the ESCWA Team for ICT and Innovation, and the National Team for Public Procurement Capacity Building Strategy. Rabeh has published more than 15 scientific papers, reports, and policy papers in different disciplines related to innovation economics, Palestinian economics, trade, and the service economy.

Husam Arman is an Associate Research Specialist at the Kuwait Institute for Scientific Research. Dr. Arman is currently engaged in work related to competitiveness and innovation and SME development. He studies and works in the leading edge subjects of strategic technological innovation and R&D management. During his Research Fellow posting and PhD studies at The University of Nottingham, United Kingdom, he developed methodologies to optimize technology investments strategies within large firms such as Rolls-Royce. He has worked for more than five years in universities in teaching and research. His work has appeared in the *International Journal of Innovation and Technology Management, R&D Management Journal*, the *International Journal of Industrial and Systems Engineering,* the *International Journal of Technology Intelligence,* and *Clean Technologies and Environmental Policy,* and he has presented at conferences such as PICMET and IAMOT.

Continued on next page...

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

About the Authors *(continued)*

Saeed Mousa is a Lecturer in Innovation and Entrepreneurship at the Palestinian Technical University Kadoorie (PTUK), where he teaches Innovation, Technology and business related courses. In addition, is Head of the Studies & Development Division at PTUK, where he conducts research regarding improving the university, such as strategic and implementation planning through preparing and submitting development proposals, as he is responsible for developing and driving innovation roadmap through encouraging creativity in R&D team. He holds a master's degree in Innovation Economics from Friedrich Schiller University in Germany. Saeed's current research interests span a wide range of topics regarding innovation, such as social innovation, technology innovation, and non-technical innovation.

References

Abbott, D. 2014. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst. Hoboken, NJ: John Wiley.

Adams, W. M. 2006. The Future of Sustainability: Re-Thinking Environment and Development in the Twenty-First Century. Report of the IUCN Renowned Thinkers Meeting. Gland, Switzerland: The World Conservation Union (IUCN).

Almada-Lobo, F. 2016. The Industry 4.0 Revolution and the Future of Manufacturing Execution Systems (MES). Journal of Innovation Management, 3(4): 16–21.

Andersson, P., & Mattsson, G. L. 2015. Service Innovations Enabled by the Internet of Things. IMP Journal, 9(1): 85–106. http://doi.org/10.1108/IMP-01-2015-0002

Arroyo, L., Murillo, D., & Val, E. 2017. Trustful and Trustworthy: Manufacturing Trust in the Digital Era. Barcelona: ESADE Roman Llull University Institute for Social Innovation; EY Fundación Espana.

Bauer, H., Patel, M., & Veira, J. 2014. The Internet of Things: Sizing up the Opportunity (Technical Report). McKinsey Insights, December 2014. Accessed November 1, 2017: http://www.mckinsey.com/insights/high_tech_telecoms_internet/the_internet_of_things_sizing_up_the_opportunity

Brynjolfsson, E., & McAfee, A. 2014. The Second Machine Age: Work Progress, and Prosperity in a Time of Brilliant Technologies. New York: W. W. Norton & Company.

Brocklesby, M. A., & Fisher, E. 2003. Community Development in Sustainable Livelihoods Approaches – An Introduction. Community Development Journal, 38(3): 185–198. https://doi.org/10.1093/cdj/38.3.185

Buhr, D. 2015. Social Innovation Policy for Industry 4.0. Tübingen, Germany: Eberhard Karls University of Tübingen.

Carr, N. 2003. IT Doesn't Matter. Harvard Business Review, 81(5): 41–49.

Cordes, F., & Stacey, N. 2017. Is UK Industry Ready for the Fourth Industrial Revolution? Boston, MA: The Boston Consulting Group.

Da Silveira, G., Borenstein, D., & Fogliatto, F. S. 2001. Mass Customization: Literature Review and Research Directions. International Journal of Production Economics, 72(1): 1–13. https://doi.org/10.1016/S0925-5273(00)00079-7

Drucker, P. 2014. Innovation and Entrepreneurship. New York: Routledge.

Dutton, H. W. 2014. Putting Things to Work: Social and Policy Challenges for the Internet of Things. Info, 16(3): 1–21. https://doi.org/10.1108/info-09-2013-0047

Gallouj, F., Weber, M., Metka, S., & Rubalcaba, L. 2014. The Futures of the Service Economy in Europe: A Foresight Analysis. Technological Forecasting & Social Change, 94: 80–96. https://doi.org/10.1016/j.techfore.2014.06.009

Friess, P., & Ibanez, F. 2014. Putting the Internet of Things Forward to the Next Level. In O. Vermesan & P. Friess (Eds.), Internet of Things Applications – From Research and Innovation to Market Deployment: 3–6. Gistrup, Denmark: Rivers Publishers.

Geiger, R., & Sá, C. 2013. Tapping the Riches of Science: Universities and the Promise of Economic Growth. Cambridge, MA: Harvard.

Goldenberg, B. 2015. The Definitive Guide to Social CRM: Maximizing Customer Relationships with Social Media to Gain Market Insights, Customers, and Profits. Upper Saddle River, NJ: Pearson Education.

Hahn, J., & Andor, L. 2013. Guide to Social Innovation. Brussels: European Commission.

Jacobsen, J. 2011. Sustainable Business and Industry: Designing and Operating for Social and Environmental Responsibility. Milwaukee, WI: ASQ Quality Press.

Lee, J., Kao, H.-A., & Yang, S. 2014. Service Innovation and Smart Analytics for Industry 4.0 and Big Data Environment. Procedia CIRP, 16: 3–8. https://doi.org/10.1016/j.procir.2014.02.001

Kagermann, H., & Wahlster, W. 2014. Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Final Report of the Industrie 4.0 Working Group. Munich: National Academy for Science and Engineering.

Luppicini, R. 2012. Ethical Impact of Technological Advancements and Applications in Society. Hershey, PA: Information Science Reference.

Marolt, M., Pucihar, A., & Zimmermann, D. H. 2015. Social CRM Adoption and Its Impact on Performance Outcomes: A Literature Review. Organizacija, 48(4): 260–271. http://doi.org/10.1515/orga-2015-0022

Morelli, N. 2007. Social Innovation and New Industrial Contexts: Can Designers "Industrialize" Socially Responsible Solutions? Design Issues, 23(4): 12–15. http://dx.doi.org/10.1162/desi.2007.23.4.3

Moss Kanter, R., & Litow, S. S. 2009. Informed and Interconnected: A Manifesto for Smarter Cities. Harvard Business School Working Paper 09-141. Boston, MA: Harvard Business School

The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective

Rabeh Morrar, Husam Arman, and Saeed Mousa

Mulgan, G. 2006. The Process of Social Innovation. Innovations: Technology, Governance, Globalization, 1(2): 145–162. http://dx.doi.org/10.1162/itgg.2006.1.2.145

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. 2007. Social Innovation: What It Is, Why It Matters and How It Can Be Accelerated? Oxford: Skoll Centre for Social Entrepreneurship, Oxford SAID Business School.

Murray, R., Caulier-Grice, J., & Mulgan, G. 2010. The Open Book of Social Innovation. London: National Endowment for Science, Technology and the Art.

Pascall, T. 2017. Innovation and Industry 4.0. Disruption, April 19, 2017. Accessed November 1, 2017: https://disruptionhub.com/innovation-industry-4-0/

Phills, J. A. Jr., Deiglmeier, K., & Miller, D. T. 2008. Rediscovering Social Innovation. Stanford Social Innovation Review, 6(4): 34–43.

PwC. 2017. Industry 4.0: The Current State of Play in Flemish Manufacturing. Press Release. PwC, March 31, 2017. Accessed November 1, 2017: https://www.pwc.be/en/news-publications/press/2017/industry-4-0-the-current-state-of-play-in-flemish-manufacturing.html

Rifkin, J. 2014. The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism. New York: St. Martin's Press.

Schmitt, K. 2017. Top 5 Reasons Why Industry 4.0 Is Real And Important. Digitalist Magazine, October 15, 2013. Accessed July 26, 2017: https://www.digitalistmag.com/industries/manufacturing-industries/2013/10/15/top-5-reasons-industry-4-0-real-important-0833970

Schreiber, U. 2017. EY Women. Fast Forward. An Interview with Uschi Schreiber. Leaders, 39(1): 40.

Schwab, K. 2015. The Fourth Industrial Revolution. Geneva: World Economic Forum.

Seyfang, G., & Haxeltine, A. 2012. Growing Grassroots Innovations: Exploring the Role of Community-Based Initiatives in Governing Sustainable Energy Transitions. Environment and Planning C: Politics and Space, 30(3): 381–400. http://doi.org/10.1068/c10222

Seyfang, G., Park, J. J., & Smith, A. 2013. A Thousand Flowers Blooming? An Examination of Community Energy in the UK. Energy Policy, 61: 977–989. https://doi.org/10.1016/j.enpol.2013.06.030

Vermesan, O., Friess, P., Guilleman, P., Gusmeroli, S., Sundmaeker, H., Bassi, A., Jubert, I. S., Mazura, M., Harrison, M., Eisenhauer, M., & Doody, P. 2009. Internet of Things – Strategic Research Roadmap. Brussels: European Commission, Information Society and Media DG; Cluster of the European Research Projects on the Internet of Things (CERP-IoT). http://hdl.handle.net/11250/2430372

Vermesan, O., Friess, P., Guillemin, P., & Sundmaeker, H. 2014. Internet of Things Strategic Research and Innovation Agenda. In O. Vermesan & P. Friess (Eds.), Internet of Things Applications – From Research and Innovation to Market Deployment: 7–142. Gistrup, Denmark: Rivers Publishers.

Waters, R. 2016. Artificial Intelligence: Can Watson Save IBM? Financial Times, January 5, 2016. Accessed November 1, 2017: https://www.ft.com/content/dced8150-b300-11e5-8358-9a82b43f6b2f

Citation: Morrar, R., Arman, H., & Mousa, S. 2017. The Fourth Industrial Revolution (Industry 4.0): A Social Innovation Perspective. *Technology Innovation Management Review*, 7(11): 12–20. http://doi.org/10.22215/timreview/1117

Keywords: Industry 4.0, fourth industrial revolution, social innovation, Internet of Things

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

> *All the evolution we know of proceeds from the vague to the definite.*
>
> Charles Sanders Peirce (1839–1914)
> Philosopher, logician, mathematician, and scientist

Many cities engage in diverse experimentation, innovation, and development activities with a broad variety of environments and stakeholders to the benefit of citizens, companies, municipalities, and other organizations. Hence, this article discusses such engagement in terms of next-generation living lab networks in the city context. In so doing, the study contributes to the discussion on living labs by introducing a framework of collaborative innovation networks in cities and suggesting a typology of third-generation living labs. Our framework is characterized by diverse platforms and participation approaches, resulting in four distinctive modes of collaborative innovation networks where the city is: i) a provider, ii) a neighbourhood participator, iii) a catalyst, or iv) a rapid experimenter. The typology is based on an analysis of 118 interviews with participants in six Finnish cities and reveals various ways to organize innovation activities in the city context. In particular, cities can benefit from innovation networks by simultaneously exploiting multiple platforms such as living labs for innovation. We conclude by discussing implications to theory and practice, and suggesting directions for future research.

Introduction

Living labs are increasingly accepted as a prominent form of open innovation (e.g., Bergvall-Kåreborn et al., 2015; Brankaert et al., 2015; Guimont & Lapointe, 2016; Hakkarainen & Hyysalo, 2016). The roots of the concept may be traced back to Knight (1749), who referred to "living laboratory" as the elements and conditions of a body and an environment of an experiment. More recent studies apply living labs in heterogeneous fields and suggest that this phenomenon provides ample research opportunities (cf. Leminen, 2015). Following the definition of Westerlund and Leminen (2011), the present study views living labs as: *"physical regions or virtual realities, or interaction spaces, in which stakeholders form public–private–people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders, all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts."*

Although the literature on living lab is rich with various concepts, methodologies, research streams, and tools (Dutilleul et al., 2010; Følstad, 2008; Leminen & Westerlund, 2016, 2017), studies increasingly document the plurality of living labs using different conceptualizations (e.g., Leminen et al., 2012; Rits et al., 2015; Savelkoul & Peutz, 2017; Schuurman et al., 2016; Ståhlbröst & Lassinantti, 2015). Among them, Leminen and colleagues (2012) classify living labs as user-, enabler-, utilizer-, or provider-driven. Moreover, the outcomes of innovation activities are linked with the characteristics of the living lab, its driving party, and the selected strategy – and the living lab's structure is that of an open innovation network (Leminen & Westerlund, 2013; Leminen et al., 2016; Steen & van Bueren, 2017; Veeckman et al., 2013). Similar to the notion of open innovation networks (Jarvenpaa & Wernick, 2012), living labs typically comprise different stakeholders, such as suppliers, customers and users, competitors, research units of universities, and other institutions and organizations, all of whom brings their interests to the collaboration and innovation.

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

Living labs also may be classified by stakeholder roles (Leminen et al., 2014; Leminen, Turunen, & Westerlund, 2015; Nyström et al., 2015). A city or an urban environment as well as involved stakeholders and their roles are encompassed in many recent living lab studies (e.g., Juujärvi & Lund, 2016; Steen & van Bueren, 2017). Previous research is unified in that cities have a crucial role to support plurality of innovation activities in the urban context (e.g., Leminen & Westerlund., 2015; Markkula & Kune, 2015; Tukiainen et al., 2015; Tukiainen & Sutinen, 2015). Given that various types and modes of collaborative innovations are flourishing in the city context (Sutinen et al., 2016), cities have drawn increasing attention from both innovation scholars and practitioners. Experimentation, innovation, and development activities in cities include a variety of modes of collaborative innovation, including hackathons, innovation labs, innovative purchasing, open spaces, participatory budgeting, makerspaces, fablabs, co-working places, and innovation spaces (e.g., Bogers et al., 2017; Hyysalo et al., 2014, 2016; Kohtala & Hyysalo, 2015, Schuurman & Tõnurist, 2016).

Acknowledging the categorization of living labs phenomenon by Leminen (2015) – in other words, viewing living labs as a context, a method, and a conceptualization – the present study contributes to this perspective and labels the variety of collaborative innovation as "third-generation living lab networks". The first of generation living labs focused on the landscape(s) of living labs as real-life environments intertwined with users and stakeholder activities. The second generation of living labs considered methods and methodologies as a part of innovation activities in the real-life environment. The third-generation living labs portray different modes of collaborative innovation, where different stakeholders and particularly users have crucial roles in innovation on platforms. Following Habib, Westerlund, and Leminen (2015), the present study defines third-generation living labs as: *"platforms with shared resources, which organize their stakeholders into a collaboration network(s), that relies on representative governance, participation, open-standards, and diverse activities and methods to gather, create, communicate, and deliver new knowledge, validated solutions, professional development, and social impact in real-life contexts."*

Numerous studies document innovation activities in the smart city context (e.g., Khomsi, 2016; Ojasalo & Kauppinen, 2016; Ojasalo & Tähtinen, 2016), where various types of collaborative innovations and platforms have emerged in practice and that have been discussed in the scholarly literature (Bollier, 2016; Raunio et al., 2016; Walravens & Ballon, 2013).

Among the many definitions of "platforms" provided in the literature, Raunio and colleagues (2016) propose that a platform refers to *"any operating environment, technology, system, product or service, whose development has been systematically opened up to outside developers, and whose key aims are the benefit produced by the platform's users to each other and the network effect brought by participation."* The platform-based operating method is a key to digitalized participatory urban development, which significantly increases the innovation impact and participatory nature of development (Raunio et al., 2016). One of the key concepts used in this connection is "innovation platform", which requires that a city can shift its mindset from government to governance so that its focus will shift to the development and realization of development goals instead of regulation and enforcement of decisions. In other words, the city should adopt the role of coordinator rather than executor. Similarly, cities have begun to see their citizens as co-designers, co-producers, and co-learners (Bollier, 2016), suggesting that citizens move away from being subjects to being active participants in innovation (Leminen et al., 2014). Simultaneously, cities increasingly rely on expertise and resources on different communities (Anttiroiko, 2010). Moreover, platform orientation arises from profound social changes in cities (Raunio et al., 2016). Taken together, prior research has suggested the importance and role of the city as an enabler of innovation, yet studies on living labs are sparse on various roles that cities can adopt. In particular, there is a need for research on the implications of next-generation living lab networks in the city context. Hence, through this study, we aim to understand collaborative innovation networks in cities, herein referred to as "third-generation living lab networks". Accordingly, we pose the following research questions:

- *What are collaborative innovation networks and their roles in cities?*

- *How can cities exploit such collaborative innovation networks?*

The article is organized as follows. First, we review previous literature to create a framework of collaborative innovation in cities. Then, we describe our research design and research process. Thereafter, we describe the key findings regarding collaborative innovation in

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

cities through six cases resulting in four types of novel third-generation living lab networks. Finally, we discuss the theoretical and managerial implications and provide directions for future research on third-generation living labs.

Towards Third-Generation Living Labs

We propose a framework on collaborative innovation based on two dimensions arising from previous literature on living labs and cities. The dimensions are i) "platform" (Anttitroiko, 2016; Bollier, 2016; Ojasalo & Tähtinen, 2016; Raunio et al., 2016; Walravens & Ballon, 2013) and ii) "participation approach" (Hossain, 2016; Leminen, 2013; Leminen & Westerlund, 2015, 2017; Steen & van Bueren, 2017). The framework demonstrates the differences between collaborative innovation networks in the city context. The platform dimension distinguishes between the city and the neighbourhood, building on the notion that cities or their parts are increasingly documented as *platforms* (Anttiroiko, 2016). A neighbourhood or a suburb could also refer to a smaller entity or unit within a city, such as a school, a hospital, a community house, or a geographical area such as a park.

As to platform as the first dimension, living labs are generally viewed as platforms for innovation (Almirall & Wareham, 2008; Anttiroiko, 2016; Dell´Era & Landoni, 2014; Habib et al., 2015). Ojasalo and Tähtinen (2016) argue that, in the context of cities, the owner of the innovation platform is usually a city, and the platform functions as an innovation vehicle between the city and external actors. Walravens and Ballon (2013) study platform business models for smart cities (in particular, business models of mobile service offerings of cities). The authors put forward a "public business model grid", where they have a dimension of public value, spanning from direct to indirect public value, and a dimension of governmental involvement, spanning from limited to strong. Raunio and colleagues (2016) propose that, through platforms, citizens become an active part of public service development and the city's role changes from being a service provider to a facilitator of innovative services. The authors conclude that platform thinking has also been viewed as the next development stage of conventional cluster policy, suggesting a re-organization of innovation collaboration in the city community. Furthermore, Raunio and colleagues (2016) make a "simplistic but practical division" between platforms, by categorizing them into i) intermediary platforms that create value by conveying the products or services of others (e.g., Uber, Alibaba, eBay); ii) development platforms or platform ecosystems that produce value by co-creating products and services with other companies (e.g., Microsoft, Intel, SAP); and iii) integrated platforms that function as intermediaries but also have a large external developer network (e.g., Google, Facebook, Apple, Amazon) (Gawer, 2009; Evans & Gawer, 2016; Thomas et al., 2014).

The platform owner (usually a city, a higher education institute, or a development company) facilitates, or organizes the facilitation of, the activities and defines the goal(s) of the platform. Platforms can be rather permanent physical or digital environments or less permanent environments, such as pop-up events, co-creation competitions, and hackathons. Anttiroiko (2016) documents participatory innovation platforms of three case cities, and states that, given that the city government facilitates these platforms and that they are integrated with the official planning system and local development policy, they resemble enabler-driven living labs. Furthermore, Anttiroiko (2016) observes three points of business–citizen interaction, namely open data, public services, and urban development. All of Anttiroiko's (2016) case cities support open data and knowledge sharing, focus on the development of public services with platforms within the smart city framework, and utilize innovation platforms in neighbourhood revitalization. He also highlights that citizens are, in most cases, customers or users, but they sometimes play the role of empowered residents or citizens whose needs push the design of local services. Thus, living labs can either span over the whole city (i.e., the "city as a platform") or focus on a specific neighbourhood.

Leminen (2013) classifies living labs into four types based on their coordination approach (i.e., bottom-up versus top-down) and participation approach (exhalation-dominated versus inhalation-dominated). He argues that a top-down approach is led or coordinated in accordance with centralized and official targets, whereas a bottom-up approach focuses on local needs and operates at the grassroots level. Whereas the inhalation-dominated innovation approach aims at fulfilling the needs of the driving party of the living lab, the exhalation-dominated innovation approach aims at fulfilling the requirements of other stakeholders. Leminen (2013) proposes to encourage parties to share their knowledge, expertise, and resources with the open innovation network. The exhalation-dominated approach engages stakeholders in collective action in the open innovation network to fulfill the needs of the others (Leminen, 2013).

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

The second dimension of our framework, "participation approach", depicts the innovation approach either as exhalation-dominated or inhalation-dominated. In this respect, Steen and van Bueren (2017) operationalized a definition of urban living labs, which was used to assess 90 sustainable urban innovation projects in the city of Amsterdam. They summarized the characteristics of living labs as four elements: aims, activities, participants, and context. Living labs are aimed at innovation and formal learning, and activities of living labs include development, co-creation, and iteration. Specifically, urban living labs aim at urban sustainability. Participants are public and private actors, users and knowledge institutes, and all the involved stakeholders have decision-making power. The context of the living lab is that of a real-life, and in many urban living labs, this means a territory or a space-bound place. Notably, Steen and van Bueren (2017) argue that most of the projects that label themselves as living labs do not include all the defining elements of a living lab.

To summarize, our conceptual framework captures the characteristics of collaborative innovation in the city context. Using the bipolar dimensions of platform and participation approach as principal axes in the framework, we can distinguish between four different modes of collaborative innovation networks in cities. We anticipate that the two-dimensional framework, as shown in Figure 1, can help us to identify existing collaborative innovations in cities, and a further analysis of the dimensions enables us to capture differences and similarities between the models.

Research Design

We chose collaborative innovation networks, particularly living labs in cities, by exploring their innovation processes and contexts in order to contribute to the discussion on open innovation networks. The study applies a qualitative, multiple case study approach (Yin, 1989) by analyzing a unique data set encompassing 118 interviews in six cities in Finland. The selected case cities are at the forefront of development of collaborative innovation networks, and they represent a broad variety of collaborative innovation, such as living labs, hackathons, innovative purchasing, participatory budgeting, open spaces, makerspaces, fablabs, co-working places, innovation spaces, and so forth. These various modes or types met the suggested criteria of collaborative innovation networks in cities, where one specific form, a living lab, is associated with a real-life environment, multiple stakeholders, and the pivotal role of users (Almirall & Wareham, 2011; Bergvall-Kåreborn & Ståhlbröst, 2009; Leminen, 2013, 2015; Leminen et al., 2014; Leminen, Nyström, & Westerlund, 2015). As suggested by Jensen and Rogers (2001), we organized the cases as snapshot studies, meaning that the cases represented the diversity of innovation activities driven by different actors in networks (Leminen et al., 2012). In addition, we utilized secondary data consisting of websites, bulletins,

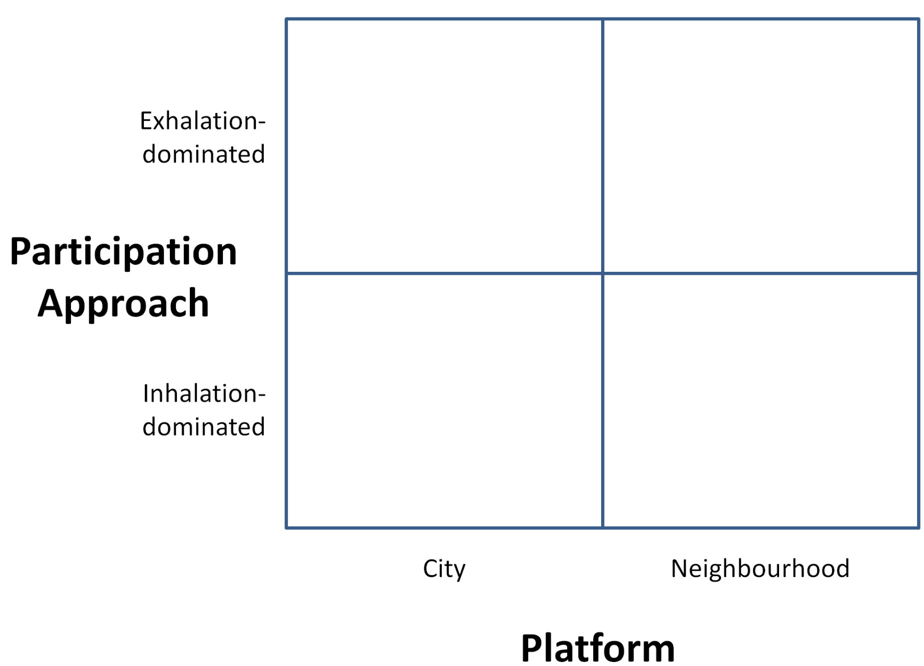

Figure 1. A conceptual framework for collaborative innovation networks in cities

magazines, and reports to gain further understanding of some of the collaborative innovation networks or to resolve arising issues or inconsistencies in the interviews.

Data collection
We collected all of the interview data in 2017. We audio recorded and transcribed all face-to-face meetings and meetings by phone, and followed an interview guide when collecting information from various themes of collaboration innovations (Patton, 1990), and we had the informants verify the findings. Understanding different modes of collaborative innovations in cities and the roles of platform(s) and the gained benefits for different stakeholders in such collaborative innovation networks exemplify the themes of the semi-structured and open-ended questions. Our informants comprised various stakeholders representing different modes of collaborative innovation networks, especially living labs. The selected informants were interviewed because they have in-depth knowledge and first-hand experience of collaborative innovation in cities. The informants included CEOs, civil servants, directors, managers, professors, researchers, project coordinators, technical specialist, and citizens (users as innovators). The names of organizations and the identities of informants are withheld to maintain confidentiality.

Data analysis
An overview of the data analysis and the phases of the study is presented in Table 1. We organized the empirical data according to the informant, the date of interview, the type of informant, and the case. Then, we followed a multi-staged data analysis process consisting of open coding, focused coding, identification of innovation processes, and theorizing the codes. The main unit of analysis was the collaborative innovation: stakeholder activities and the characteristics of collaboration innovation networks. The original transcribed interviews were analyzed and coded by the researchers. We searched the words associated with activities, innovation processes, contexts, methods, methodologies, platforms, stakeholders, and tools using a content analysis technique. For instance, we coded stakeholders as utilizers, enablers, providers, or users to identify the characteristics of third-generation living labs. So doing, we followed the examples of Roberts (1997) and Neuendorf (2002) to understand the cases by coding and content analysis. We first coded the original, word-by-word transcribed empirical material independently and then compared, discussed and agreed on the results.

In the second phase, the first round of coding resulted in describing and identifying participation approaches

Table 1. Data analysis process

Data Analysis Phases	Task	Outcome
1. Open coding	• Organize dataset • Identify collaborative innovation networks and informants	Overview of cities, collaborative innovation networks, informant, type of informant, and time of interview
2. Focused coding #1	• Identify and briefly describe participation approaches and platforms in cities	Overview of innovation activities resulted in identifying participation approaches and platforms in cities
3. Focused coding #2	• Analyze innovation through the identified innovation activities and participation approaches as well as contexts and platforms • Compare data to theory	Detection of previously identified innovation activities and participation approaches (Leminen, 2013; Nyström et al., 2014) as well as contexts and platforms (Anttiroiko, 2016)
4. Theorizing the codes	• Synthesize phases 1 to 3: analyze identified modes in collaborative innovation networks • Identify theoretical implications • Identify managerial implications	Classification of the participation approaches and platforms resulting in four archetypes of collaborative innovation networks in cities (Figure 2)

and platforms in cities. We then analyzed the four archetypes of collaborative innovation networks by categorizing participation approaches and platforms in six cities (Figure 2). We anticipate that the four archetypes of collaborative innovation networks in cities are our key findings.

Findings and Discussion

In this study, we analyze and classify the variety of collaborative innovation activities in six Finnish cities. So doing, we establish a framework based on platform and participation approach, which puts forward four diverse archetypes, or modes, of collaborative innovation in the city context, which are illustrated in Figure 2:

A. The city as a provider
B. The city as a neighbourhood participator
C. The city as a catalyst
D. The city as a rapid experimenter

A. The city as a provider

The mode of *city as a provider* (lower-left corner of Figure 2) represents an inhalation-dominated participation approach where improvements are done to the city's own service provisioning, and an entire city is seen as a platform. In brief, this mode refers to exposing the service provisioning of a city to others in order to improve its services and processes for citizens.

Improvements to services and processes are undertaken with a broad variety of stakeholders such as companies and research institutes by providing expertise for a city. Activities are often initiated by the city's strategic aims to pursue predefined improvements for its services. The city endeavours to create points where stakeholders can anchor their activities to the city's operations, facilities, areas, and routes, and to gather information, test, co-create, and validate products, services, and systems. The city has specific city-wide targets, and it spells out how companies and other actors need to act with it, and what kinds of benefits they can receive. When the city exposes its processes to others, a network or an ecosystem forms around the city that organizes activities to streamline and develop the city's service provisioning.

An innovation platform produces ideas, solutions, and knowledge for making public services and their production more efficient, while the city acts as a utilizer of the results. The city scales processes by providing guidebooks while companies and research institutes gather information, test, develop, and co-create products, services, and systems. Companies may also be utilizers benefiting from the results of innovation activities in their product and service development processes. Rather than being active actors, users are essentially treated as "lab rats" for testing products, services, and systems. Therefore, this mode does not make use of the full expertise and potential of citizens. The innovation

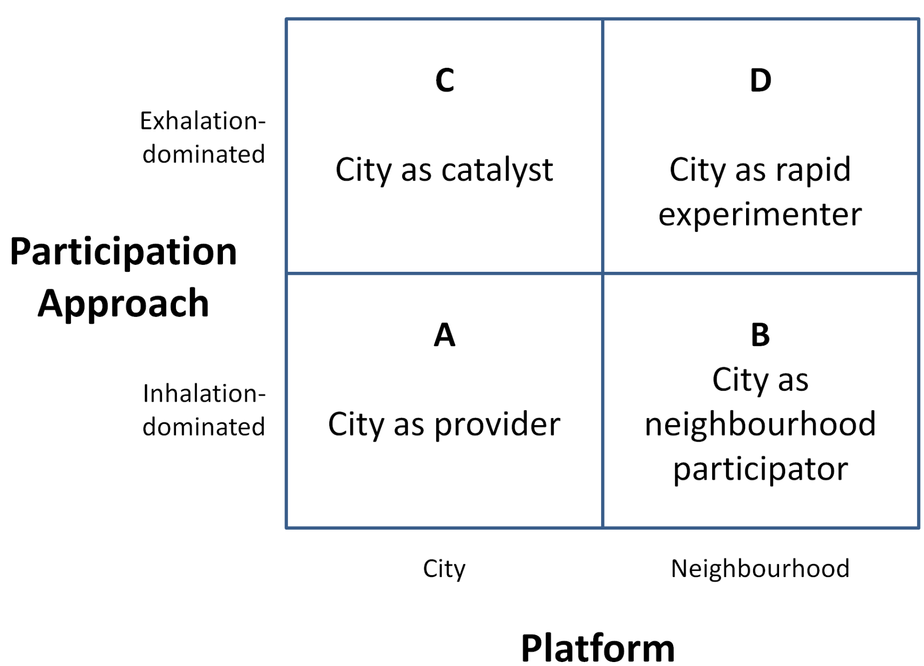

Figure 2. Collaborative innovation modes in cities

mechanism of this mode assumes a city exposes its activities to companies and research institutes that collect information from processes of the city and improve the city´s service provisioning.

B. The city as a neighbourhood participator
The mode of *city as a neighbourhood participator* (lower-right corner of Figure 2) represents an inhalation-dominated participation approach where the neighbourhood is seen as a platform. The mode refers to improving the neighbourhoods of citizens and their living conditions by local, grassroot activities initiated by the citizens. Similarly to the previous mode, innovation activities are initiated by and aimed at improving the conditions of the driving party. Specifically, citizens lead and benefit from innovation activities in this mode. In other words, a city engages itself in the collaborative innovation process, participates in activities, and supports citizen activities rather than attempting to steer the innovation activities.

A network or an ecosystem forms around a neighbourhood/community that organizes action to solve citizens' needs and aims to bring benefits for its citizens. Success is based on the activity and enthusiasm of citizens, and activities in this mode require patience from the city, not vast resources. The implemented operations are often small and quick, and easy to accomplish by the city. Examples of social innovations in our data included gardening activities initiated by the citizens in a neighbourhood, a village fête in the neighbourhood, and a digital bulletin board installed in stairwells – all of them jointly developed with the citizens. Another example: a residential area was isolated and there were hardly any services, but citizens, a local grocery store, and the developer of the residential area jointly ideated a drop-off location where the grocery store delivers online food purchases for pick-up by customers. Later, this resulted in the establishment of a specific e-grocery.

In this mode, the city is an enabler by participating in and supporting innovation activities in neighbourhoods. Scalability into citywide solutions is not as important as in the previous mode. However, the platform is the source of ideas and needs, which are the cultivated and developed into commercialized products, start-up companies, or social innovations. In contrast to the previous mode, where citizens act as lab rats, citizens here lead innovation activities or are participants in innovation activities with other stakeholders and can be perceived as co-creators or creative consumers (Leminen et al., 2014, 2015). The innovation mechanism of this mode assumes that the city not only initiates, participates in, and supports activities, but also collects the best ideas for further development.

C. The city as a catalyst
The mode of *city as a catalyst* (upper-left corner of Figure 2) represents an exhalation-dominated participation approach where the entire city is a platform. The city boosts the development of companies and increases value of their operations by combining other aims and connecting other actors to the service provisioning in a city region. The main objective of the city is not to develop more efficient services for itself but to enhance and nourish business ecosystem(s) through living labs, when no companies take a role in order to boost and cultivate new networks and ecosystems in the city.

A network or an ecosystem forms around the city`s own service provisioning, where living labs have a built-in role in the city's operations and service production. The city is a catalyst that opens up its service production and processes. The platform can be physical, virtual, or hybrid, and it consists of processes and procedures of the city, such as city planning and land use, wellbeing and healthcare, and the educational system. Although the city opens up the service production and data resources, it becomes a development platform for companies to develop, experiment, test, and validate products, services, and systems.

Because living labs and their activities are intertwined with the catalyst's service production and processes, they generate diverse value for the stakeholders. Put differently, by combining the conventional service provisioning of the city, as well as its processes, the city pursues benefits that are difficult to obtain otherwise. For example, residential area planning can be arranged with an innovative conveyancing competition, where construction companies and others compete on ideas that they implement, and they seek to identify potential companies interested in jointly building and experimenting with new types of houses and housing solutions such as zero-energy homes. Such operations catalyze development and stimulate adoption and creation of new solutions and services in the building industry.

In addition, co-operation between various sectors increases, and cross-pollination and learning take place between different sectors. The long-term benefits for the city are realized through activated business life in the city and through the success of companies developing their products and services, as the mode assumes prolonged development in the city region. Further, the scaling mechanism of the mode postulates learning and understanding of the principles of living labs by sharing and transferring knowledge regarding experiences of innovation activities between humans rather than formulating knowledge in manuals as the activities of living labs are at different maturity levels.

A city acts as an enabler by enhancing and nourishing a business ecosystem. That is, the innovation mechanism of this mode assumes opening the city's service provisioning and boosting business ecosystem(s) in the city. Companies and research institutes test, develop, and co-create their products, services, and systems. Although the roles of platforms are twofold, they enhance development, experimentation, testing, validation of companies' services, products, and systems, and act as showrooms for companies' activities and their outputs. Similar to the first mode, users act as mere "lab rats" for testing products, services, and systems; thus, the mode does not benefit from the full potential of citizens.

D. The city as a rapid experimenter
The mode of *city as a rapid experimenter* (upper-right corner of Figure 2) represents an exhalation-dominated participation approach, where the platform is a neighbourhood, unit, or a specific theme or activity rather than the entire city. This mode refers to accomplishing trials of new products, services, and systems by companies to gather experience and knowledge, to learn fast from such experiments, and to accelerate their product and service development processes and growth. The mode assumes development in predetermined thematic areas or neighbourhoods through rapid experiments that the city supports with a modest financial or non-financial stake in publicly funded projects. The city arranges competitions of rapid experimentation dedicated to certain predefined thematic fields, activities, or areas such as energy efficient solutions, smart mobility, health, and other solutions for smart cities. In other words, the city supports the growth of small companies and the business ecosystem by enabling rapid experiments.

The city has no specific short-term targets but can realize long-term benefits as it initiates a business network or an ecosystem around the needs that will be solved through rapid development. The development process will provide benefits to other stakeholders, bring new solutions for the city or citizens, and develop the platform or its processes. The benefits of rapid experimentation increase, at least indirectly, and include flexibility, learning, and knowledge transfer. The developed solutions can be scalable to other contexts, but the scaling is conducted by the involved companies.

The benefits of the participating companies are twofold. First, the companies can gather information, test, develop, and co-create their products, services, and systems. Second, they may look for references for their products and services in cities. Users' or citizens' specific roles may vary, and they may act as "lab rats" for testing products, services, and systems; yet, their full potential and expertise as a part of innovation activities may be involved. This mode assumes learning from trial and error; such flexibility can be achieved by bringing in new actors and developing limited and rapidly implementable solutions for topical problems in real environments. Table 2 presents characteristics of collaborative innovation in different types of third-generation living labs.

To summarize, our findings indicate that cities may simultaneously use several collaborative innovation modes and that innovation can adopt different modes at the same time. Furthermore, because the needs of cities are often versatile, various modes of platforms (virtual, physical, or hybrid) and operational models (ranging from everyday basics to complex collaborative innovation networks) are increasingly used. Consequently, a city must possess capabilities to simultaneously handle the variety of forms. A city has to be able to develop its basic services that it has legal obligations to provide to its citizens, and to activate companies, act efficiently and innovatively, and at the same time conduct small experiments benefiting its citizens and companies. In contrast to prior studies on living lab networks (e.g., Leminen et al., 2012; Leminen et al., 2014, 2015, 2016; Nyström et al., 2014; Steen & van Bueren, 2017), which documented innovation activities through the importance of users in various innovation networks characterized by openness in cities, we argue that cities play a pivotal role by enabling innovation activities using different mechanisms to boost innovation with different parties.

Conclusion

This study classified the variety of collaborative innovation activities in six cities in Finland. The study identified two essential dimensions in previous literatures on

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

living labs and cities, namely platforms and participation approaches, in order to propose a framework that demonstrates differences of current and potential collaborative innovation networks in cities. The study aimed to understand the plurality and variety of collaborative innovation networks in cities, referred to as third-generation living lab networks. Particularly, the study attempted to take a step towards research that would review implications of the third-generation of living labs in cities. Therefore, this study not only illuminates four collaborative innovation modes but also contributes to the growing literatures of open innovation networks and living labs by describing the ways living lab networks are exploited in the city context.

Table 2. Characteristics of collaborative innovation in different types of third-generation living labs

	Types of Third-Generation Living Labs			
Characteristic	**A. The city as a provider**	**B. The city as a neighbourhood participator**	**C. The city as a catalyst**	**D. The city as a rapid experimenter**
Definition	Expose service provisioning of a city to improve its services and processes for citizens with a broad variety of providers providing expertise for a city	Improve neighbourhood or living conditions of citizens by local, grassroot activities initiated by citizen(s)	Boost development of companies and increase value of operations by combining other aims and connecting other actors to service provisioning in a city region	Accomplish trials of new products, services, and systems by companies to gather experience and knowledge and learn fast, and to accelerate companies' development processes and growth
Strategy	Strategic R&D activity with preset objectives, where city utilizes the outcomes to streamline its service provisioning	Problem solving by collaborative accomplishments with neighbourhood	Enhancing or nourishing city's business ecosystem(s)	Learning and operations development through rapid experimentations
Organization	Network/ecosystem forms around a city that organizes actions to streamline its service provisioning	Network/ecosystem forms around a neighbourhood/ community, organizing action to solve citizens' needs and bring value for citizens	Network/ecosystem forms around a city`s own service provisioning or its data storages	Network/ecosystem initiated by needs to be solved by rapid development
Participation approach	Inhalation-dominated (city – city)	Inhalation-dominated (citizens – citizens)	Exhalation-dominated (city – companies)	Exhalation-dominated (city – companies)
Platform	Entire city and its spaces, places, areas, processes, and routes	Neighbourhood, suburb of a city, or theme	Entire city and its spaces, places, areas, processes, and routes	Neighbourhood, suburb of a city, or theme
Role of platform	Provide new ideas, solutions and knowledge Boost service provisioning and make production of public services more efficient	Ideas and needs are cultivated and developed towards commercialized products, startups, or social innovations	Enhance development, experimentation, testing, validation of companies' services, products, and systems A showroom for companies' products and services	Bring new solutions for the city or citizens, and develop the platform or its processes

Table 2. ***(continued)*** Characteristics of collaborative innovation in different types of third-generation living labs

	Types of Third-Generation Living Labs			
Characteristic	**A. The city as a provider**	**B. The city as a neighbourhood participator**	**C. The city as a catalyst**	**D. The city as a rapid experimenter**
Enabler (city)	*Expose, align, and improve* Initiate innovation activities and create anchorage points	*Initiate, participate, and support* Participate in and support innovation activities	*Open, activate, and boost* Enhance or nourish business ecosystem(s)	*Learn from trial and error* Promote rapid prototyping with small incentives
Utilizer (city)	Benefit directly and scale up results of streamlined service provisioning	Harvest ideas and needs from innovation activities and use them in development activities	Bring new solutions for citizens and develop the platform or its processes	Bring new solutions for citizens and develop the platform or its processes
Utilizer (companies)	Benefit from the results of innovation activities	Harvest ideas, needs, and results from innovation activities and use them in development activities	Benefit from results of innovation activities Platform as a showroom for products and services	Learn through rapid experimentations Look for references
Provider (companies and research institutes)	Gather information, test, develop, and co-create products, services, and systems	Gather information, test, develop, and co-create products, services, and systems	Gather information, test, develop, and co-create products, services, and systems Develop the platform	Gather information, test, develop, and co-create products, services, and systems Develop the platform
User/citizen	"Lab rats"	Leader or equal participants	"Lab rats"	"Lab rats" or equal participants
Innovation mechanism	Parallel skiing (alignment)	Participate, do not activate Collect the best ideas	Added value is produced for others by adding different processes and activities to city's own operations	Flexibility achieved by bringing in new actors and developing limited and rapidly implementable solutions
Outcome	New ideas, knowledge, and solutions for streamlined service provisioning	Social innovations and solutions offering pleasure and benefits for citizens Commercialized products or companies (e.g., digital notice boards, food halls)	New products and services Showroom for companies' activities Business ecosystem growth, new jobs	New solutions for a city and its citizens Showroom for companies' activities Business ecosystem growth, new jobs
Lifespan	Short, medium, or long	Long	Long	Short

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

Theoretical implications

There are three theoretical contributions that the study highlights in regard to the discussions on collaborative innovation and open innovation networks particularly in the area of living labs. First, the paper suggested a *new conceptual framework* for revealing collaborative innovation networks in the city context: the third-generation of living lab networks (Figure 1). Second, the framework distinguished *four archetypes of collaborative innovation* through third-generation living lab networks based on their participation approach and the platform: A. the city as a provider, B. the city as a neighbourhood participator, C. the city as a catalyst, and D. the city as a rapid experimenter. Third, the study proposed that *cities reinforce long-term participation and engagement of stakeholders,* suggesting various benefits to all stakeholders. Each of these contributions is described as follows:

1. *Conceptual framework:* Mulder (2012) argues that the existing living labs fail to benefit from their full potential, because they rely too much on traditional user-centric lab methodologies, forgetting the "living part" that makes a living lab an exceptional methodology. The framework suggested in the present study illuminates various types of collaborative innovation. The dimensions of the framework include the platform (in terms of "city" versus "neighbourhood") and the participation approach (in terms of "inhalation-dominated" versus "exhalation-dominated"). Whereas the former dimension is grounded on exploiting different platforms in cities, the latter is grounded on the assumption on the participation approach.

2. *Four archetypes of third-generation living labs:* The conceptual framework distinguishes four archetypes of third-generation living labs based on the participation approach and the platform. The *city as a provider* assumes that an entire city is viewed as a platform, and its service provisioning is exposed to other stakeholders in order to improve and make services and their processes more efficient, as well as to provide expertise for the city. The mode of the *city as a neighbourhood participator* refers to improving neighbourhood of citizens or their living conditions by local, grassroot innovations by citizens, where the platform is a neighbourhood or a suburb of city, and such innovation activities are conducted for the benefits of citizens themselves. The *city as a catalyst* refers to a mode where the city boosts the development of companies and increases value of its own operations by combining other aims and connecting other actors to its service provisioning in the entire city region. Finally, the *city as a rapid experimenter* considers a part of city (e.g., a neighbourhood) as a platform, where it attempts to learn fast from the rapid experiments and to accelerate companies' service and product development processes.

3. *Cities reinforce long-term participation and engagement of stakeholders:* The extant literature proposes many benefits from engaging multiple stakeholders and particularly users in organization's innovation activities (e.g., Leminen & Westerlund, 2012; Leminen, 2015). Although the benefits are widely acknowledged, Hannukainen and colleagues (2017) note that user-oriented innovation activities may not be rooted in part of an organization's innovation and development activities even though the organizations are excited by such modes and find them useful. One explanation for this might be that many company-driven living lab targets are, by nature, short term; for instance, the goal may be to solve a company's instant needs in their innovation activities (Leminen et al., 2012). Our study proposes that cities increasingly reinforce the long-term participation and engagement of users, citizens, and other stakeholders particularly in the city as provider and city as catalyst modes because cities' innovation and development activities are increasingly coupled into their service-provisioning. Therefore, if a city succeeds in aligning its modes in collaborative innovation networks with its long-term mission and goal, and in building appropriate anchorage points for other stakeholders, the structure can become a long-lasting part of the city's innovation system.

Managerial implications

From the managerial perspective, the study contributes a framework, or tool, to identify and categorize collaborative innovation networks in cities. The framework and the identified characteristics of the modes with regards to collaborative innovation networks portray different stakeholders and their activities and benefits. We described four different types of third-generation living lab networks based on their participation approach and platform whose interests dominate the network's operation. By identifying each mode in collaborative innovation networks in cities, managers may link their own innovation and development processes as a part of the city's activities. In other words, cities may provide many benefits for managers when cities are seen as platforms, source(s) of data, and sources of needs by the citizens and the city. More specifically, managers may learn that cities have a key role in boosting companies' own innovation and development activities,

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

ranging from testing and validating their products to co-creating and developing new ones. Particularly companies should prepare for a revision of their roles and activities corresponding to identified collaborative innovation networks in cities.

Limitations and future research

All studies have their limitations. First, the present study put forward a matrix where we selected participation approach as one dimension while excluding the dimension of coordination approach presented by Leminen (2013). The coordination approach could be included in the matrix in future research. We were not able to include all the different stakeholders in the studied collaborative innovation networks, the third-generation networks, because of the limited resources. However, we believe that our data set is sufficiently rich and covers multiple types of informants and diverse collaborative innovation networks in six cities. Yet, the limitation may affect the results on modes in collaborative innovative networks in the city context. We share the view that living labs are coupled into the contexts (Leminen, 2015), and further research is needed for different modes of collaborative innovation networks. For example, new platforms enable citizens to participate and engage in development and innovation activities in cities, and it is crucial to understand the mutual interests and mechanisms of open and collaborative innovation activities. Therefore, we propose more research on how different stakeholders should be motivated in order to be engaged in the development and innovation processes in collaborative innovation networks, and on what actions are necessary to keep stakeholders engaged. Further, we propose the importance of studying the relations of different collaborative and open innovation networks. Also, we suggest a need for additional research on the characteristics in open and collaborative innovation networks. Therefore, we call for further analyses of specific cases, eventually including how different stakeholders employ collaborative and open innovation networks in cities. Are there relations (or correlations) between different types of cities, collaborative innovation networks, and the position of the informants? To conclude, we call for more research on collaborative innovation networks, the third-generation networks.

Acknowledgements

The authors gratefully appreciate the anonymous blind reviewer and the Editor-in-Chief, Chris McPhee for their valuable comments, suggestions, and guidelines to improve this article. Special thanks are also extended to Director for Services Development Päivi Sutinen and all of the interview subjects who kindly shared their knowledge and experience as stakeholders in living labs and other forms of collaborative innovations in cities. The authors express their gratitude to City of Espoo and the 6-aika program for funding the development of the article as a part of the Living Lab 3.0 project.

About the Authors

Seppo Leminen is a Principal Lecturer at the Laurea University of Applied Sciences in Espoo, Finland, and he serves as an Adjunct Professor of Business Development at Aalto University in Helsinki, Finland, and an Adjunct Research Professor at Carleton University in Ottawa, Canada. He holds a doctoral degree in Marketing from the Hanken School of Economics and a doctoral degree in Industrial Engineering and Management from the School of Science at Aalto University. His research and consulting interests include living labs, open innovation, innovation ecosystems, robotics, the Internet of Things (IoT), as well as management models in high-tech and service-intensive industries. Results from his research have been reported in *Industrial Marketing Management*, the *Journal of Engineering and Technology Management*, the *Journal of Business & Industrial Marketing*, *Management Decision*, the *International Journal of Technology Management*, the *International Journal of Technology Marketing*, the *International Journal of Product Development*, and the *Technology Innovation Management Review*, among many others.

Continued on next page...

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

About the Authors *(continued)*

Mika Westerlund, DSc (Econ), is an Associate Professor of Technology Innovation Management at Carleton University in Ottawa, Canada. He previously held positions as a Postdoctoral Scholar in the Haas School of Business at the University of California Berkeley and in the School of Economics at Aalto University in Helsinki, Finland. Mika earned his doctoral degree in Marketing from the Helsinki School of Economics in Finland. His current research interests include open and user innovation, the Internet of Things, business strategy, and management models in high-tech and service-intensive industries.

Mervi Rajahonka, DSc (Econ), works as an RDI Advisor at the Small Business Center (SBC), currently a part of the South-Eastern Finland University of Applied Sciences XAMK, Finland, and as an Adjunct Research Professor at Carleton University in Ottawa, Canada. She has been working at the SBC for about 10 years, participating in numerous EU-funded projects. She earned her doctoral degree in Logistics from the Department of Information and Service Economy at Aalto University School of Business in Helsinki, Finland. She also holds a Master's degree in Technology from the Helsinki University of Technology and a Master's degree in Law from the University of Helsinki. Her research interests include sustainable logistics and supply chain management, high-tech and service business models, service modularity, and service innovations. Her research has been published in a number of journals in the areas of logistics, services, and operations management.

References

Almirall, E., & Wareham, J. 2008. The Role of Living Labs in Open Innovation, In J. Schumacher & V.-P. Niitamo (Eds.), *European Living Labs – A New Approach for Human Centric Regional Innovation:* 48–165. Berlin: Wissenschaftlicher Verlag Berlin.

Almirall, E., & Wareham, J. 2011. Living Labs: Arbiters of Mid- and Ground-Level Innovation. *Technology Analysis & Strategic Management,* 23(1): 87–102.

Anttiroiko, A.–V. 2010. *Luova kaupunkikehittäminen. Kaupunkikonseptit innovatiivisen kaupunkikehittämisen apuna* (Creative Urban Development – City Concepts as Support Tools for Innovative Urban Development). Tampere, Finland: Research Unit for Urban and Regional Development Studies, Sente publications 32/2010, University of Tampere.

Anttiroiko, A.–V. 2016. City-as-a-Platform: The Rise of Participatory Innovation Platforms in Finnish Cities. *Sustainability,* 8(9): 2–31.

Ballon, P., Glidden, J., Kranas, P., Menychtas, A., Ruston, S., & Van der Graaf, S. 2011. Is there a Need for a Cloud Platform for European Smart Cities? In P. Cunningham & M. Cunningham (Eds.), *Proceedings of the eChallenges e-2011 Conference.* Dublin: International Information Management Corporation (IIMC).

Bergvall-Kåreborn, B., Ihlström Eriksson, C., & Ståhlbröst, A. 2015. Places and Spaces within Living Labs. *Technology Innovation Management Review,* 5(12): 37–47. http://timreview.ca/article/951

Bergvall-Kåreborn, B., & Ståhlbröst, A. 2009. Living Lab: An Open and Citizen-Centric Approach for Innovation. *International Journal of Innovation and Regional Development,* 1(4): 356–370. https://doi.org/10.1504/IJIRD.2009.022727

Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., Frederiksen, L., Gawer, A., Gruber, M., Haefliger, S., Hagedoorn, J., Hilgers, D., Laursen, K., Magnusson, M. G., Majchrzak, A., McCarthy, I. P., Moeslein, K. M., Nambisan, S., Piller, F. T., Radziwon, A., Rossi-Lamastra, C., Sims, J., & Ter Wal, A. L. J. 2017. The Open Innovation Research Landscape: Established Perspectives and Emerging Themes Across Different Levels of Analysis. *Industry and Innovation,* 24(1): 8–40. http://doi.org/10.1080/13662716.2016.1240068

Bollier, D. 2016. *The City as Platform: How Digital Networks Are Changing Urban Life and Governance.* Washington, DC: The Aspen Institute.

Brankaert, R., den Ouden, E., & Brombacher, A. 2015. Innovate Dementia: The Development of a Living Lab Protocol to Evaluate Interventions in Context. *Info,* 17(4): 40–52. http://dx.doi.org/10.1108/info-01-2015-0010

Dell´Era, C., & Landoni, P. 2014. Living Lab: A Methodology between User-Centred Design and Participatory Design. *Creativity and Innovation Management,* 23(2): 137–154. http://dx.doi.org/10.1111/caim.12061

Dutilleul, B., Birrer, F. A. J., & Mensink, W. 2010. Unpacking European Living Labs: Analysing Innovation's Social Dimensions. *Central European Journal of Public Policy,* 4(1): 60–85.

Guimont, D., & Lapointe, D. 2016. Empowering Local Tourism Providers to Innovate through a Living Lab Process: Does Scale Matter? *Technology Innovation Management Review,* 6(11): 18–25. http://timreview.ca/article/1031

Hakkarainen, L., & Hyysalo, S. 2016. The Evolution of Intermediary Activities: Broadening the Concept of Facilitation in Living Labs. *Technology Innovation Management Review,* 6(1): 45–58. http://timreview.ca/article/960

Hannukainen, P., Mäkinen, S., & Hyysalo, S. 2017. Organisational Adoption of the Lead User Method: A Follow-Up Study on Intentions Versus Actions. *International Journal of Business Excellence,* 12(4): 508–536. https://doi.org/10.1504/IJBEX.2017.085016

Habib, C., Westerlund, M., & Leminen, S. 2015. *Living Labs as Innovation Platforms.* Paper presented at the 6th ENoLL Living Labs Summer School, August 25–28, 2015, Istanbul, Turkey.

Hossain, M. 2016. Grassroots Innovation: A Systematic Review of Two Decades of Research. *Journal of Cleaner Production,* 137: 973–981. https://doi.org/10.1016/j.jclepro.2016.07.140

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

Hyysalo, S., Kohtala, C., Helminen, P., Mäkinen, S., Miettinen, V., & Muurinen, L. 2014. Collaborative Futuring with and by Makers. CoDesign: *International Journal of CoCreation in Design and the Arts,* 10(3-4): 209–228. https://doi.org/10.1080/15710882.2014.983937

Hyysalo, S., Repo, P., Timonen, P. Hakkarainen, L., & Heiskanen, E. 2016. Diversity and Change of User Driven Innovation Modes in Companies. *International Journal of Innovation Management,* 20(2): 1650023. https://doi.org/10.1142/S1363919616500237

Jarvenpaa, S. L., & Wernick, A. 2012. Open Innovation Networks: The Evolution of Bureaucratic Control. In A. Bøllingtoft, L. Donaldson, G. P. Huber, D. D. Håkonsson, & C. C. Snow (Eds.), *Collaborative Communities of Firms: Purpose, Process, and Design:* 9–33.

Juujärvi, S., & Lund, V. 2016. Enhancing Early Innovation in an Urban Living Lab: Lessons from Espoo, Finland. *Technology Innovation Management Review,* 6(1): 17–26. http://timreview.ca/article/957

Jensen, J. L., & Rodgers, R. 2001. Cumulating the Intellectual Gold of Case Study Research. *Public Administration Review,* 61(2): 235–260. http://dx.doi.org/10.1111/0033-3352.00025

Knight, T. 1749. *Reflections upon Catholicons, or Universal Medicines.* London: Printed for T. Osborne in Gray's-Inn.

Khomsi, M. R. 2016. The Smart City Ecosystem as an Innovation Model: Lessons from Montreal. *Technology Innovation Management Review,* 6(11): 26–31. http://timreview.ca/article/1032

Kohtala, C., & Hyysalo, S. 2015. Anticipated Environmental Sustainability of Personal Fabrication. *Journal of Cleaner Production,* (99): 333–344. https://doi.org/10.1016/j.jclepro.2015.02.093

Leminen, S. 2013. Coordination and Participation in Living Lab Networks. *Technology Innovation Management Review,* 3(11): 5–14. http://timreview.ca/article/740

Leminen. S. 2015. *Living Labs as Open Innovation Networks – Networks, Roles and Innovation Outcomes.* Doctoral dissertation. Helsinki, Finland: Aalto University.

Leminen, S., Nyström, A.-G., & Westerlund, M. 2015. A Typology of Creative Consumers in Living Labs. *Journal of Engineering and Technology Management,* 37: 6–20. http://dx.doi.org/10.1016/j.jengtecman.2015.08.008

Leminen, S., Turunen, T., & Westerlund, M. 2015. The Grey Areas Between Open and Closed in Innovation Networks. *Technology Innovation Management Review,* 5(12): 6–18. http://timreview.ca/article/948

Leminen, S., & Westerlund, M. 2012. Towards Innovation in Living Labs Network. *International Journal of Product Development,* 17(1/2): 43–59. http://dx.doi.org/10.1504/IJPD.2012.051161

Leminen, S., & Westerlund, M. 2013. Incremental and Radical Service Innovation in Living Labs. In B. Christiansen, S. Yildiz, & E. Yildiz, E (Eds.), *Transcultural Marketing for Incremental & Radical Innovation:* 281–295. Hershey, PA: Information Science Reference

Leminen, S., & Westerlund, M. 2015. Cities as Labs: Towards Collaborative Innovation in Cities. In P. Lappalainen, M. Markkula, & H. Kune, H. (Eds.), *Orchestrating Regional Innovation Ecosystems Espoo Innovation Garden:* 167–175. Espoo: Otavan Kirjapaino Oy.

Leminen, S., & Westerlund, M. 2016. A Framework for Understanding the Different Research Avenues of Living Labs. *International Journal of Technology Marketing,* 11(4): 399–420. https://doi.org/10.1504/IJTMKT.2016.079731

Leminen, S., & Westerlund, M. 2017. Categorization of Innovation Tools in Living Labs. *Technology Innovation Management Review,* 7(1): 15–25. http://timreview.ca/article/1046

Leminen, S., Westerlund, M., & Nyström, A.-G. 2012. Living Labs as Open-Innovation Networks. *Technology Innovation Management Review,* 2(9): 6–11. http://timreview.ca/article/602

Leminen, S., Westerlund, M., & Nyström, A.-G. 2014. On Becoming Creative Consumers – User Roles in Living Labs Networks. *International Journal of Technology Marketing,* 9(1): 33–52. http://dx.doi.org/10.1504/IJTMKT.2014.058082

Leminen, S., Westerlund, M., Nyström, A.-G., & Kortelainen, M. 2016. The Effect of Network Structure on Radical Innovation in Living Labs. *Journal of Business & Industrial Marketing,* 31(6): 743–757. http://dx.doi.org/10.1108/JBIM-10-2012-0179

Leminen, S., Westerlund, M., Sánchez, L., & Serra, A. 2014b. Users as Content Creator, Aggregator, and Distributor at Citilab Living Lab. In R. DeFillippi & P. Wikstrom (Eds.), *Business Innovation and Disruption in Film, Video and Photography:* 247–266. Cheltenham, UK: Edward Elgar.

Markkula, M., & Kune, H. 2015. Making Smart Regions Smarter: Smart Specialization and the Role of Universities in Regional Innovation Ecosystems. *Technology Innovation Management Review,* 5(10): 7–15. http://timreview.ca/article/932

Mulder, I. 2012. Living Labbing the Rotterdam Way: Co-Creation as an Enabler for Urban Innovation. *Technology Innovation Management Review,* 2(9): 39–43. https://timreview.ca/article/607

Neuendorf, K. A. 2002. *The Content Analysis Guidebook.* Thousand Oaks, CA: Sage.

Nyström, A.-G., Leminen, S., Westerlund, M., & Kortelainen, M. 2014. Actor Roles and Role Patterns Influencing Innovation in Living Labs. *Industrial Marketing Management,* 43(3): 483–495. http://dx.doi.org/10.1016/j.indmarman.2013.12.016

Ojasalo, J., & Kauppinen, H. 2016. Collaborative Innovation with External Actors: An Empirical Study on Open Innovation Platforms in Smart Cities. *Technology Innovation Management Review,* 6(12): 49–60. https://timreview.ca/article/1041

Ojasalo, J., & Tähtinen, L. 2016. Integrating Open Innovation Platforms in Public Sector Decision Making: Empirical Results from Smart City Research. *Technology Innovation Management Review,* 6(12): 38–48. https://timreview.ca/article/1040

Patton, M. 1990. *Qualitative Evaluation and Research Methods* (2nd ed.). Newbury Park, CA: Sage.

Raunio, M., Nordling, N., Ketola, T., Saarinen, J. P., & Heinikangas, A. 2016. *Open Innovation Platforms: Handbook for Developers.* Tampere, Finland: 6Aika.

Towards Third-Generation Living Lab Networks in Cities

Seppo Leminen, Mervi Rajahonka, and Mika Westerlund

Rits, O., Schuurman, D., & Ballon, P. 2015. Exploring the Benefits of Integrating Business Model Research within Living Lab Projects. *Technology Innovation Management Review,* 5(12): 19–27. http://timreview.ca/article/949

Roberts, C.W. (Ed.). 1997. *Text Analysis for the Social Sciences: Methods for Drawing Statistical Inferences from Texts and Transcripts.* Mahwah, NJ: Lawrence Erlbaum.

Savelkoul, L., & Peutz, M. 2016. Needsfinding in Living Labs: A Structured Research Approach. *Technology Innovation Management Review,* 7(2): 42–51. http://timreview.ca/article/1057

Schuurman, D., De Marez, L., & Ballon, P. 2016. The Impact of Living Lab Methodology on Open Innovation Contributions and Outcomes. *Technology Innovation Management Review,* 6(1): 7–16. http://timreview.ca/article/956

Schuurman, D., & Tõnurist, P. 2016. Innovation in the Public Sector: Exploring the Characteristics and Potential of Living Labs and Innovation Labs. *Technology Innovation Management Review,* 7(1): 7–14. http://timreview.ca/article/1045

Steen, K., & van Bueren, E. 2017. The Defining Characteristics of Urban Living Labs. *Technology Innovation Management Review,* 7(7): 21–33. http://timreview.ca/article/1088

Ståhlbröst, A., & Lassinantti, J. 2015. Leveraging Living Lab Innovation Processes through Crowdsourcing. *Technology Innovation Management Review,* 5(12): 28–36. http://timreview.ca/article/950

Sutinen P., Erkkilä K., Wollstén P., Hagman K., Hirvikoski T., & Äyväri A. 2016. *KYKY Living Lab Handbook for Co-Creation by Schools and Companies.* Espoo, Finland: City of Espoo.

Tukiainen, T., Leminen, S., & Westerlund, M. 2015. Cities as Collaborative Innovation Platforms. *Technology Innovation Management Review,* 5(10): 16–23. http://timreview.ca/article/933

Tukiainen, T., & Sutinen, P. 2015. Cities as Open Innovation Platforms for Business Ecosystems. In P. Lappalainen, M. Markkula, & H. Kune (Eds), *Orchestrating Regional Innovation Ecosystems: Espoo Innovation Garden:* 313–322. Espoo: Aalto University in cooperation with Laurea University of Applied Sciences and Built Environment Innovations RYM Ltd.

Veeckman, C., Schuurman, D., Leminen, S., & Westerlund, M. 2013. Linking Living Lab Characteristics and Their Outcomes: Towards a Conceptual Framework. *Technology Innovation Management Review,* 3(12): 6–15. http://timreview.ca/article/748

Walravens, N., & Ballon, P. 2013. Platform Business Models for Smart Cities: From Control and Value to Governance and Public Value. *IEEE Communications Magazine,* 51(6): 72–79. https://doi.org/10.1109/MCOM.2013.6525598

Westerlund, M., & Leminen, S. 2011. Managing the Challenges of Becoming an Open Innovation Company: Experiences from Living Labs. *Technology Innovation Management Review,* 1(1): 9–25. http://timreview.ca/article/489

Citation: Leminen, S., Rajahonka, M., & Westerlund, M. 2017. Towards Third-Generation Living Lab Networks in Cities. *Technology Innovation Management Review,* 7(11): 21–35. http://doi.org/10.22215/timreview/1118

Keywords: living lab, third-generation, open innovation, networks, innovation, co-creation, city, smart city, collaborative innovation

Designing a Business Model for Environmental Monitoring Services Using Fast MCDS Innovation Support Tools

Tuomo Eskelinen, Teemu Räsänen, Ulla Santti,

Ari Happonen, and Miika Kajanus

> *"Small-scale community sustainability transitions are recognized as an important strategy toward a sustainable society in general. It is now suggested, that with environment monitoring and open data plus information as a service, sustainable transitions can be achieved with more actual details and the effects of change process would be then evident."*
>
> Nigel Forrest and Arnim Wiek (2014)

The free availability of open data provides opportunities to start new businesses and gain business intelligence. However, although data is often used to support decisions and actions, the possibilities offered by modern sensor technologies with connections to cloud-based data collection services are not being effectively capitalized. Data collection systems are also not generally open source solutions, even though open and flexibly adjustable systems would broaden the opportunities for solutions and larger revenue streams. In this article, we used action research methods to discover new business opportunities in a semi-open information system that utilizes environmental monitoring data. We applied a four-stage innovation process for industry, which included context definition, idea generation, and selection, and produced multi-criteria decision support (MCDS) data to help the design of business model. This was done to reveal business opportunities for an environmental monitoring service. Among these opportunities, one service-style business model canvas was identified as feasible and selected for further development. We identified items that are needed in the commercialization process of environmental monitoring services. Our process combines open environmental monitoring data, participative innovation process, and MCDS support, and it supports and accelerates a co-creative business model creation process that is cost-beneficial in terms of saving time. The results are applicable to the creation of an open data information system that supports data-driven innovation.

Introduction

Open data is a major driver for innovation. It can be used by anyone as a free public resource to start new businesses, improving existing ones, or gain business intelligence. Although the potential for innovation is large, we do not know exactly which kinds of applications will turn out to be the most promising, the most robust, and the most replicable. Therefore, we need to learn about the mechanisms of value creation and the ways in which open data fits into different companies' strategic and operating models (Gurin, 2014). The business of open data is a young field, but it holds promise for service innovation in a variety of domains (Lindman & Nyman, 2014).

Consider the domain of environmental monitoring. Understanding the quality of available water is critical because, for example, climate change projections indicate that cities all around the world will face threats to water supply security, heightened flood risks, and severe heatwaves (Bates, 2008). Some of these impacts are already being felt, and as such are no longer just a collection of projections (de Haan, 2015). To start to tackle to these challenges and to answer the questions arising with them, environmental data produced by environmental monitoring should form a basis for added knowledge, and it should give a starting point to address actual problems, not just causes (Niemi, 2009). Thus, the domain of environmental monitoring represents a rich domain for the study of open data and for the development of novel business models.

From 2016 through to 2020, the cumulative market size for open data is estimated at €325 billion (Wüstenhagen, 2006), and the availability of publicly available open environmental data is increasing rapidly. In Finland, the market for businesses related to environmental monitoring data is estimated to reach €6 billion by 2020 (Hietaniemi, 2009). Already now, legal documents, statistics, geographical data, traffic data, and environmental data are freely available for public use in Finland (Kinnari, 2013). In this context and in this study, we describe a participative business model creation process that is built on an actual Finnish case of available open data from environmental monitoring.

Environmental monitoring means measuring physical, chemical, and biological variables over time (usually over long time periods) to provide data about any possible changes and the speed of such changes on the monitored environment and its ecosystem with an aim to understand the present state of the environment and any subtle changes (Artiola, 2004). With historical data, even small indications of possible future environmental dangers can be identified with event monitoring of any current abnormal situations. Good open data about the environment also enhances decision making and supports open politics models.

From a business perspective, the demands for more green solutions and more nature-friendly ways of working have been increasing in many different industries, for example, in the area of basic infrastructures such as power generation (Niemi, 2009). Environmentally friendly companies can differentiate themselves from their competition and enhance their market share. However, companies need to understand what aspects of eco-friendliness will appear to their customers: earlier studies have shown that, for example, eco-friendly products that save energy are of interest and concern to many groups (de Haan, 2015) but products that reduce carbon dioxide emissions are less so. For example, Hornibrooks and colleagues (2015) found that putting "…carbon labels on supermarket own brand products has had no discernible impact on shifting demand to lower carbon products".

In this study, our goal was to find connections between the environmental monitoring open data and business models. Open data was seen as business value accelerator that creates new business innovation possibilities. Unlike private big data, open data is for everyone as a free public resource and can be seen as a resource to start new businesses, gain business intelligence, and improve business processes (USCCF, 2014). To enhance the usability of open data, the solutions considered in this study were limited to the application of open software solutions. Morgan and Finnegan (2014) studied the benefits of open source software, stating that the most important benefits are: high reliability and stability, lower costs, user support from the experts in the online community, flexibility in terms of customization, and avoidance of vendor lock-in.

Through customization, the use of open source software facilitates value creation and accelerates innovation and exchange of ideas, gives access to superior knowledge outside the firm, and adds flexibility of use. Innovation and idea exchange happen by opening the source code to everyone, which in turn opens the door for follow-up innovations and improvements. Superior knowledge can be obtained when the engineers of a firm work as part of a development team of a community that gives the firm access to knowledge outside their own areas of expertise. This access also provides the flexibility of using new technologies and selecting the most suitable open software components to fulfill any development needs (Morgan & Finnegan, 2014).

Without measurements and data, it would be impossible to identify the gains of any change process. For example, in the mining sector, measurements are needed to identify environmental impacts. Also, municipal water distribution systems needs hydrological measurements to improve water safety. More data also typically generates new findings and inspires innovation, which builds possibilities for new business opportunities. New business opportunities will emerge and some old models will be revised; as van den Bergh, Truffer, and Kallis (2011) argue, "transitions research assumes that transitions are rather smooth, well-governed processes. But like all social and technological changes, transitions involve creative destruction with winners and losers."

Environmental monitoring typically combines many data sampling sources (e.g., from water, air, or soil) with multiple methods of measurement and analysis, including traditional laboratory analyses, to understand the extent of chemical contamination in a certain area. Unfortunately, traditional field measurements and sampling only provide information about one given area, space, and time, and do not provide any information between samples. Furthermore, time delays with manual sampling can be days, weeks, months, or even years. The development of continuous monitoring technology has made it possible to collect data almost constantly in real time, with multiple variables being measured simultaneously. Together with sampling, laboratory analyses, and continuous field measurements, it now is possible to generate more comprehensive ways to better understand the state of environment, thereby improving overall situational awareness (Laniak et al., 2013). With publicly available data, people can understand better the state of local environment and contribute to political efforts or environmental and infrastructure construction projects. The core of the information services based on open data are data availability and usability.

By creating a new business model, a business can create new markets (Nenonen & Storbacka, 2010). But a business model is also integral to the functioning of the business. Indeed, Magretta (2012) describes a business model as, "the story that explains how an enterprise works". It is important to ask how a business model creates value for customers through its "architecture of value creation" (Teece, 2010). Many companies fail to do this because they do not focus on market re-shaping. The challenge is to produce radical new innovations to products, services, or business models and to challenge the de-facto ideas in current markets (Nenonen & Storbacka, 2011). Without a market re-shaping focus, the business cannot achieve high-level understanding of the actual needs of the customer and efforts for customer collaborative value creation will fail (Furr & Dyer, 2014).

A typical business model formulation process is also an iterative learning process – it proceeds by trial and error – and studies show that this process is more effective in teams (Sosna, 2010). According to Aljena (2014), business model research is far from practical usability and the actual practices of building a business model vary greatly from detailed planning to un-planning. The big challenge is balancing the needs of different stakeholders and customer demands, and deciding how to select items correctly when creating a business model to suit these various and sometimes contradictory cases. Indeed, more research is needed to simplify the business model formation process. In this context, supportive tools, such as multi-criteria decision support (MCDS) methods, provide help with the design challenges, including the prioritization of business model items. Especially in complex interconnected cases, experimental small change based on rapid development models are needed to obtain new knowledge (Parker, 2016). For example, with environmental monitoring, where private, public, and third sector entities collaborate, a shared fairness in the solution increases the likelihood of success (Hague, 2011; Parker, 2016; Tikka & Gävert, 2014). Business model creation in the open data business context requires applied science models on how to build new business models, which also includes the prioritization, selection, and analysis of the building blocks of the business model. To address this gap, we have identified the following research questions for this study:

1. *How can a participative business model technique be used in the identification and prioritizing of business model items relating to open data from environmental monitoring?*

2. *Can we accelerate business model creation in an open data ecosystem with a participative business model process and multi-criteria decision support?*

The remainder of this article presents environmental information services and models, and a four-phase business model creation process with multi-criteria decision support, which was done in order to build a core of a business model on environmental monitoring service.

Environmental Information Services and Models

Indeed, the availability of the data itself is only part of the story. Implementation requires the information service provider to consider technical properties and functions such as measuring devices (sensors), data transfer, data collection, data processing, methods of analysis, and modelling procedures. The information service provided has to consider means to share only the information needed by the end users. One possible model for this sort of integrated environmental modelling, monitoring, and decision process was presented by Laniak and colleagues (2013). Their model not only focuses on getting the data, it also considers a wide view of the subject by beginning from the clarification of environmental issues through to the analysis and results up until to the end, where decisions are made. At the core of the model is the integrated environmental modelling stage, which includes the data collection and measurement observations, which are also the core parts of this study. In Figure 1, the main components of the integrated environmental modelling and decision process (Laniak et al., 2013) are presented, including a boundary that delineates the elements included in our proposed business model development process, as will be described in this article.

In information services, the most scalable solution is to use a cloud service for data sharing. Cloud services have rapidly developed into an important ICT technology tool that responds to the fast-growing needs of data storage and other IT resource needs. For example, cloud services are well suited to a complex platform business field, where one change affects multiple players and experimental development is needed. These rapid changes build the knowledge about the usability of the solutions (Parker, 2016). As platform business models make it possible for private, public, and third sector entities to collaborate towards a shared business goal, fairness is one of the core elements supporting the possibility for great success (Hague, 2011; Parker, 2016; Tikka & Gävert, 2014).

Cloud-based information technology has significantly lowered entry costs of IT deployment, it connects users to a shared pool of IT resources, and it allows a higher level of elasticity, which makes IT deployment more scalable. Moreover, cloud computing lowers the innovation barriers and opens up opportunities because it is easier to involve many people to use and develop services (Testa, 2015). So, services should focus on providing ease of use for information required by the end user while ensuring that other functionalities of the system and the technologies behind the delivery process of the information fade to background. An example of an environmental information service is shown in Figure 2, including its various components (Räsänen, 2011).

Furthermore, given that the data is the base ingredient of the information services, a large effort should be directed towards availability and overall accessibility of observation data and the information that is constructed from this data. Also, different data (and information) providers should enter into deep cooperation and collaboration in order to reveal new (business) possibilities lurking inside in their costly collected data. Finally, to be truly able to provide the information as a service, open and standardized software approaches are needed for the technological solutions used as service platforms. For example, open application programming interfaces (APIs) and wide-timeframe data access are needed. These steps can improve the transparency of computational and data-processing methods (Räsänen, 2011).

In Finland, the Centre for Economic Development, Transport and the Environment (ELY Centre; ely-keskus.fi/web/ely-en) monitors environmental conditions and changes together with Finnish Environment Institute (SYKE; syke.fi). Priority is given to water systems monitoring, to the regular controlling of climate (in most areas), and to the observation of endangered

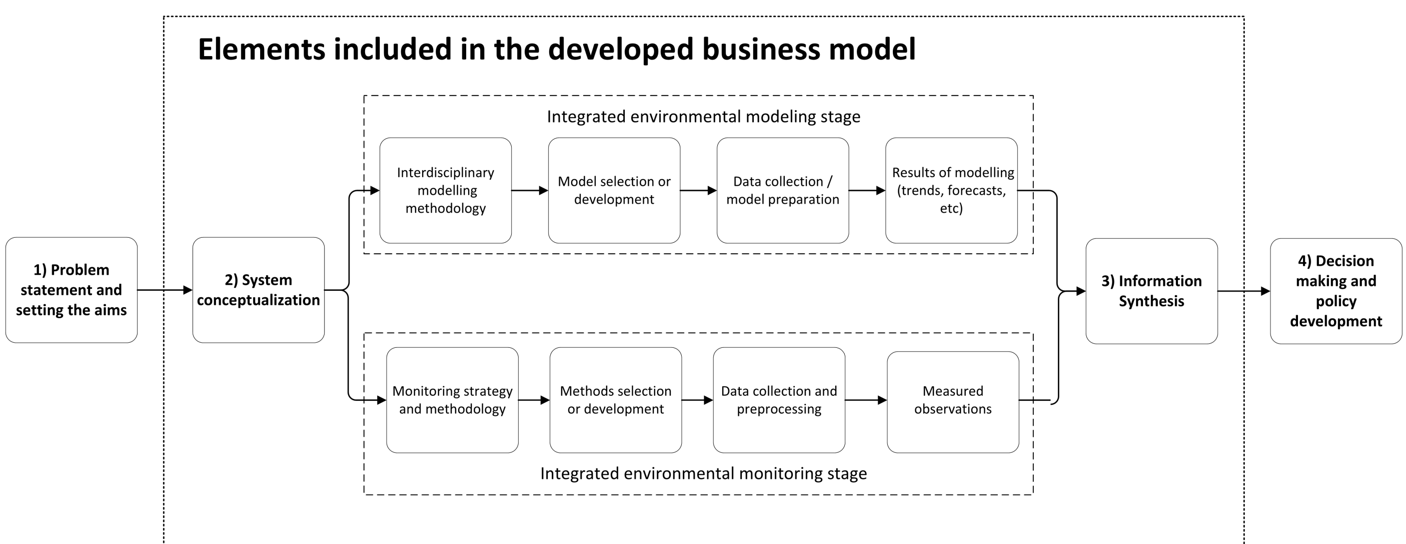

Figure 1. The main components of the integrated environment modelling and decision process (adapted from Laniak, 2013), including the proposed business model development process

Designing a Business Model for Environmental Monitoring Services Using Fast MCDS

Tuomo Eskelinen, Teemu Räsänen, Ulla Santti, Ari Happonen, and Miika Kajanus

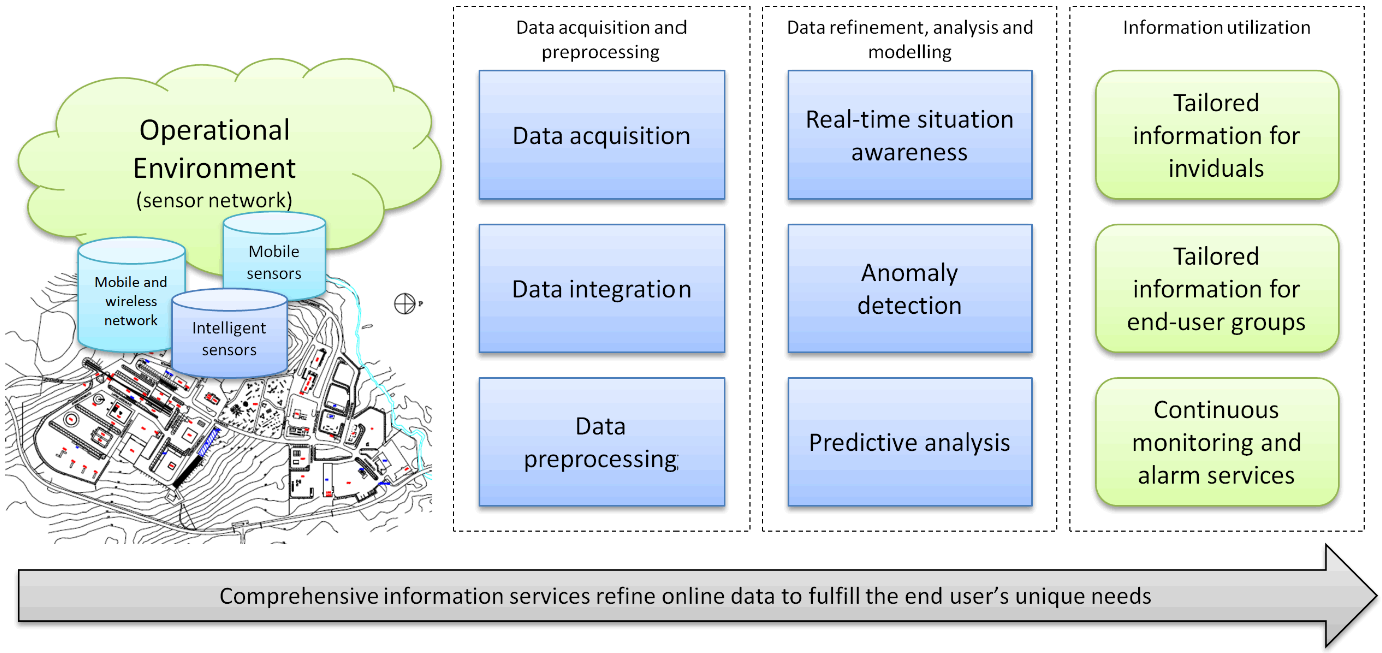

Figure 2. An example of an environmental information service and its components (Räsänen, 2011)

animals. Companies and institutions follow and report pollutants and effects caused by their actions. The data is saved in national databases, which are open for all users, but for some of them user identification is needed. The ELY Centre uses this data for decision making, forming statements, and as a basis for planning. It also analyzes and publishes information about environmental conditions in different areas of Finland.

Business Model Creation and Multi-Criteria Decision Support

Considering the possible challenges of developing new business models, practitioners would welcome a set of tools to help make the process easier. For this need, multi-criteria decision support (MCDS) methods provide transparent and coherent decision support and facilitate communication in complex situations. These methods are especially well suited to cases with conflicting objectives, multiple alternatives, and actors with uncertain or incomplete information. As they are used in the current study, MCDS methods are sometimes used with other planning tools. As an example, connecting MCDS methods with SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis can yield analytical priorities for the SWOT factors and makes them commensurable (Kajanus, 2012).

The idea of using MCDS methods within a business model canvas (Osterwalder, 2004) as a design framework is to systematically evaluate the components of a business model. This is done to identify the components with the greatest potential or importance. First, through a creative process, a set of potential items for a business model is identified and documented. After this, identified components are analyzed and prioritized. The business model canvas provides the basic framework within which an analysis of the decision situation can be performed. The MCDS method enables the creation of business models that are based on an analytical selection process. Any MCDS method, and its prioritization principles, can be applied; the existence of different techniques allows the adaptation of use of the MCDS method according to the needs of the decision maker and the specific planning situation.

The business model design process, with prioritization, starts with the identification of needs. From there, a starting point for a new business model is a description based on the business model canvas. First, the process starts with a few items and then more are added to cover all canvas blocks needed in a given context. The connections and interrelations among the items are important in this part because they help to compose a well-balanced business model. Good connections generate a believable business structure with an appealing value proposition. The business model itself is built upon a collection of ideas; it can be said that a business model, as expressed in a business model canvas, is a portfolio of relevant items belonging to their relevant building blocks. So, the business model design closely parallels project portfolio selection (Archer & Ghasemzadeh, 1999; Stummer & Heidenberger, 2003; Thore, 2002), where the organization seeks to choose projects to meet the given goals and constraints. Thanks to extensive methodological research, a broad variety of approaches exists for project portfolio selection. For more information about project portfolio selection methods, see Gustafsson and Salo (2015) and Martino (1995).

To create a core business model, robust portfolio modelling can be used to find "the best" from all the rest. Robust portfolio modelling (Liesiö, 2007; Salo, 2006) is an MCDS method designed to select ideal sets of projects (or items) to constitute a portfolio, which is a collection of items (or projects) selected from a large group of different possibilities. In its basic variant, robust portfolio modelling is a scoring model (Casadesus-Masanell, 2007), which is widely employed in the evaluation and generation of a portfolio of projects, in settings where multiple objectives are required to be considered (Sosna et al., 2010). A central concept and key outcome of robust portfolio modelling is the so-called "core index", which is used to map and build an ideal portfolio from the evaluated items. The core index values indicate the most important and best-fitting items for a possibly successful business model, and is especially important when the evaluation has contrasting needs. With the help of robust portfolio modelling and core index calculations, key ideas for the different canvas blocks will be defined.

As a pragmatic solution, a four-phase approach is presented by Kajanus and co-authors (2014). In Phase 1, the context for the business model is described and an effective process is designed. It includes decisions on the objectives, selection of participants (e.g., customers and experts), the evaluation criteria, and needs for innovation workshops or information collection (e.g., interviews). In Phase 2, a number of business model ideas are collected with multiple methods (e.g., interviews, workshops, questionnaires). In this phase, the quantity is of ideas is important. With a larger idea base, there are more seeds to help others to generate more (and better) ideas. Typical ideation is implemented as group work session with relevant stakeholders (e.g., firm CEO, decision makers, key customers, service providers). Then follows Phase 4, the analysis phase, during which a final list of the most promising items for the business model will be defined.

Methods for Business Model Development

Business model development process of environmental monitoring systems

In this section, we describe the business model generation process in the context of an environmental monitoring system, which consisted of four primary phases:

1. Defining the decision context (environmental monitoring) and preparing for a planning process involving selecting and briefing the participants and defining evaluation criteria.

2. Identifying and innovating the relevant items and new ideas for the business model to be generated, and including them in the business model analysis.

3. Determining the relative importance of the business model items (core indexing).

4. Defining the business model and then re-designing it (new items were added in four steps) with the aid of the evaluation information.

In Phase 1, the context of a business model for industrial environmental monitoring services was decided. Evaluation criteria were discussed and determined. Also, it was decided to hold a workshop for idea generation and evaluation. Because this research was done by applying action research methods, with real specialists, a workshop was organized for the experts with the researchers also participating in the event. Action research was used because the method is well suited to finding solutions to practical problems where researchers are active participants (Eriksson & Kovalainen, 2008).

The workshop covered phase 2 and 3 of the innovation process. The purpose of the workshop was to clarify the most important business factors in (industrial) environmental monitoring services. The business model generation process in a workshop was started with an idea of open environmental monitoring platform with possible use cases. Attendees of the workshop primarily came from the mining industry and the water management sector; environmental authorities were also represented. As a starting point, it was proposed that a continuous environmental monitoring system would gather the sensory data, that it would also process the data and share refined information with end users. Some of the discussed examples of possible use cases for such system were:

- observation of the infrastructure of the water distribution network and any potential leaks
- detection of changes in quality of the water in the distribution supply network
- instant messaging services to customers and citizens when problems arise
- monitoring the functioning of the water storage structures
- management of water balance in a mine production area
- detection of contamination in the water
- automated collection of information to be reported to the environmental authorities

The goal of the workshop was to develop business models for an environmental monitoring service that is based on an open information system. Ideas for the model were collected by using an extended business model canvas (described above). The ideas were fed to an online evaluation environment, and the results were analyzed with a portfolio analysis tool. The portfolio analysis gave the core indices for inputs, which were used to select the best input ideas for the business model. For this business model generation process, the Phase 1 activities and the preparation of the workshop were started about six months before in a preparation group managed by the project leader. The 19 workshop participants were from private companies and associations (4), public environmental administration organizations (3), universities (11), and regional development companies (1).

In Phase 2, as a kick-start for idea generation, a possible scenario of a monitoring service based on open data sources was presented to the participants. This was followed by an idea generation session. To support the idea generation and to give a clear framework for where to position new ideas, items for the business model were allocated into an expanded business model canvas (Kajanus et al., 2014), where the structure of the business model is divided into 12 business model blocks. To support Phase 3, the ideas were imported into an online evaluation environment: the InTo tool (Kajanus et al., 2014) where the participants evaluated the ideas with a visual evaluation tool. In this particular evaluation, two evaluation criteria were used, which were earlier agreed in Phase 1: i) business potential and ii) customer need/benefit. The evaluator gave each idea values from 1 (low perceived value) to 7 (high perceived value) against the evaluation criteria using the online evaluation tool. After Phase 3 was completed, calculated results values from the evaluation were used in the decision-making analysis. Finally, in Phase 4, the best ideas were chosen to form the core business model.

Results

The workshop participants generated new ideas and subsequent idea evaluation by the participants resulted in 11 to 15 evaluations of each idea. The best ideas were selected to be applied to the canvas in four steps according to core index, which resulted in a prioritized list of ideas starting from best core index. First, the best 4 ideas were applied to the canvas, which were: a full solution for industrial use (company solution), a start-to-end full monitoring chain solution with sensor (key function), an information-based data and end-user service (customer relations item), and process industry companies (customer segment).

Second, the following items were added to the canvas: ease of use and time saving (value proposition), collaboration model (customer relationships), and service providers, for example, in areas of ICT and data analysis (key resources).

Third, the following items/ideas were added to the model: easily modified turnkey solution (customer need), experts (resources), continuity and support (key activity), and Internet and direct contacts (channels). Adding these items resulted in the core business model canvas, which is presented in Figure 3.

Discussion

In this business model, the customer segment should be in an industrial context (e.g., water production facilities or industrial operators). In evaluator comments, it was suggested that industry would want to buy comprehensive services, not just measurement devices. Even when the companies would have different needs, from a system and service point of view, many base components of the service could be the same for all. In this context, only the outcome of the service should be tailored

Designing a Business Model for Environmental Monitoring Services Using Fast MCDS
Tuomo Eskelinen, Teemu Räsänen, Ulla Santti, Ari Happonen, and Miika Kajanus

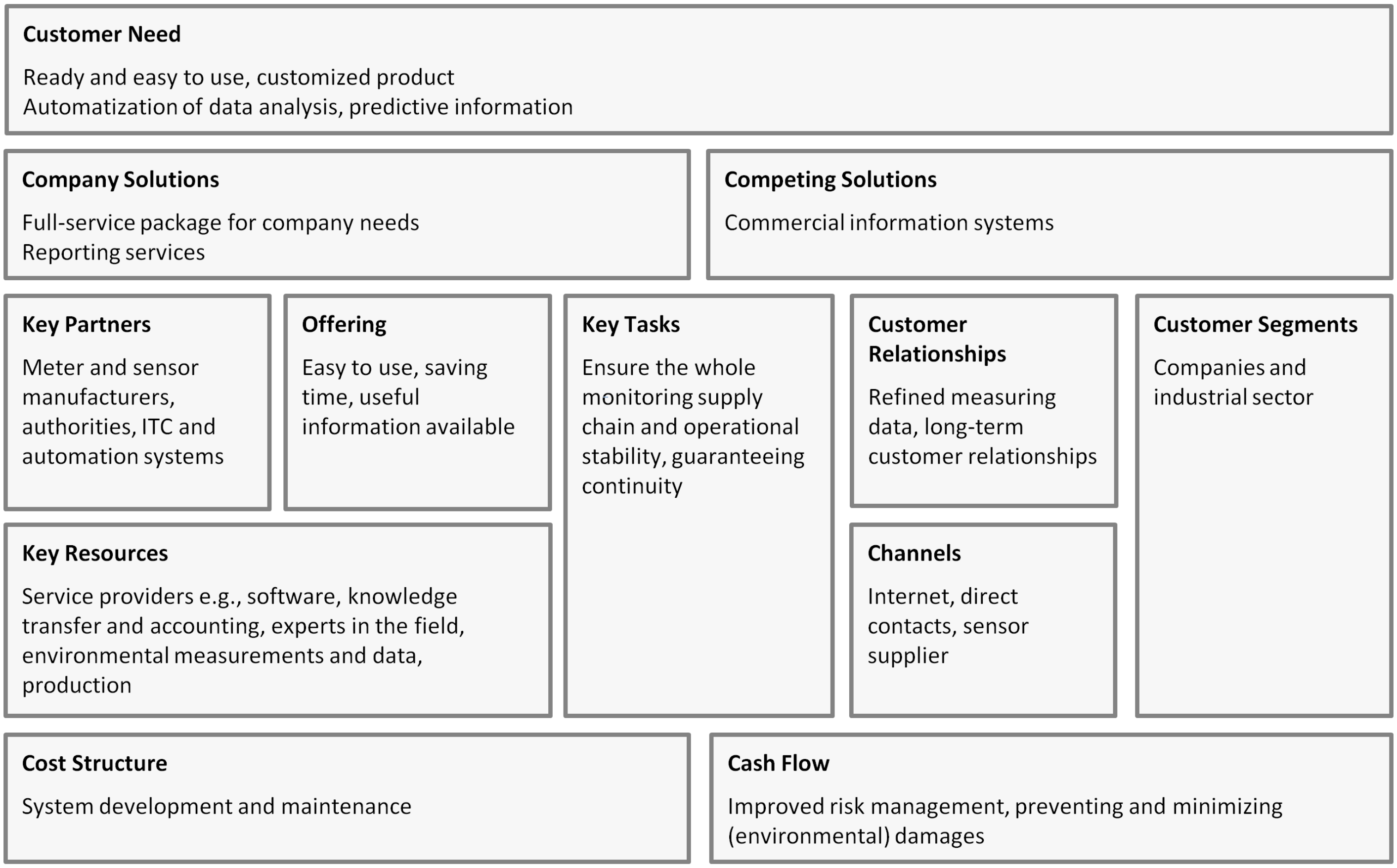

Figure 3. Extended business model canvas (adapted from Kajanus et al., 2014) for the core environmental monitoring solution

to fulfill customer needs, meaning the ways the data is analyzed and presented. Moreover, related to service usability, the information service offered has to be able to guarantee continuity. It might possibly be an open architecture system, which can be maintained and developed by several actors without sharing data, and that approach would also make the system itself more adjustable and continuous. Monitoring on its own is not that interesting to customers; they are interested in easy ways of reading and interpreting the results. Big actors, such as those from the mining industry, seek reporting that would be directly available for the authorities: a system generating environmental reports would support faster and easier operations. One identified problem in the Finnish system was that both the private and public organizations and environmental authorities have several information systems, which together generate huge amounts of data and measurement services. To increase cost-efficiency, human labour should be focused in the last steps of the monitoring chain (e.g., conclusions based on data analysis and automated reports).

The workshop created wide discussion and resulted in insights on essential business items. The feedback was that the working method is efficient and that the InTo tool accelerated idea evaluation and prioritization in a systematic way. The presentation of business model in a canvas made the model visible in a compact and easily understandable way.

After the workshop, the Savonia University of Applied Sciences (portal.savonia.fi/amk/en) launched a European Union funded project (Water-M project in ITEA-3 program; itea3.org/project/water-m.html), which has built an information service in accordance with the proposed business model. In this project, a demonstration of an online water distribution network monitoring service was built in close co-operation with Kuopio Vesi water works (kuopionvesi.fi). The monitoring service was created using an open source software platform which has been published already in the GitHub software development platform. This information service is now under the evaluation of end-users and business actions are currently in progress.

Designing a Business Model for Environmental Monitoring Services Using Fast MCDS
Tuomo Eskelinen, Teemu Räsänen, Ulla Santti, Ari Happonen, and Miika Kajanus

Conclusions

We were able to integrate open data from environmental monitoring and a participative business model creation process. This is an empirical approach to help find new ideas and produce business models in an open data context by relying on open source application ideologies. The novel contribution is the process and how it starts from typical idea generation, but then enhances the business model quality by workshopping with area experts that both evaluate and prioritize the ideas. The MCDS decision support tools are then applied to the evaluations for sensitivity analysis, which results in a core indexed business model framework including only the most promising idea seeds.

The innovation process proved to be a useful method and tool that supports open innovation in idea generation, fast evaluation and development of ideas, and finally, identification of the core business model. Core items of a business model were identified and prioritized in one-day in a workshop, which is a relatively short time, and added value. Decision supportive data was available at the end of the workshop day, which helped to prioritize business model items, and also facilitated discussion on the core business model. Core items of a service-for-industry business model on environmental monitoring were identified, and this structure will be used when further developing the business model.

Acknowledgements

The project was partly funded by the European Social Fund.

About the Authors

Tuomo Eskelinen, PhD, works as an RDI Advisor at the Savonia University of Applied Sciences in Finland. His background is in Environmental Sciences, and his expertise and research interests include sustainable value networks, development of business partnerships, and sustainable business models. He organizes research, development, and innovation processes with enterprises and other organizations, with scientists, end users, and customers, from idea generation to business models development and commercialization. He has participated in more than 20 EU-funded projects in the fields of forestry, energy, food, water safety, and processing. He is experienced in performing and coordinating interdisciplinary, international, large-scale research projects, workshops and training.

Teemu Räsänen, D.Sc. (Tech), works as a Senior Lecturer at the Savonia University of Applied Sciences (UAS) in Finland. His background is in Environmental Technology, and his expertise and research interests include environmental informatics, environmental monitoring, data analysis, data mining and developing online monitoring systems. Within this context, his main focus is in the fields of water management, monitoring the impacts of industrial emissions, and waste management. He is also the head of Savonia UAS environmental technology degree program, which includes about 170 students annually.

Ulla Santti, MSc (Econ), has experience as a teacher of Business Administration and Marketing, and she is an expert on research, development, and innovation projects at the Savonia University of Applied Sciences in Finland. She has also undertaken SME business development through practical fieldwork in healthcare, industrial factories, advertising, and the tourism industries. Currently, she is preparing her doctoral thesis at the Lappeenranta University of Technology, Finland. Her research interest includes business models and organizational culture development of SMEs with an interest in what kind of common ground, effects, and connections these concepts have on each other.

Continued on next page...

Designing a Business Model for Environmental Monitoring Services Using Fast MCDS
Tuomo Eskelinen, Teemu Räsänen, Ulla Santti, Ari Happonen, and Miika Kajanus

About the Authors *(continued)*

Ari Happonen, DSc (Tech), is the Head of Computer Science Bachelor programme in the Lappeenranta University of Technology's (LUT) School of Business and Management, Finland. Ari has been working at LUT for more than 15 years, participating in numerous RDI projects with Finnish and international companies in the contexts of international logistics services, consumer products industries, service development, innovation facilitations and mentoring, consultation, business development, mobile service development, construction industries, digitalization, public–private collaboration R&D efforts, and so on. Ari has a long history working as an intermediate and collaboration facilitator in interdisciplinary projects, workshops, innovation facilitation, development mentoring, teaching, and training and has also acted as the LUT Project Manager for the Akseli project, providing the base knowledge for this publication.

Miika Kajanus works as an RDI-liaison in Savonia University of Applied Sciences in Finland. The role is in international RDI funding in Savonia's focus areas related to food, water, health, industry, and bio products. The main tasks are to organize research, development, and innovation processes with enterprises and other organizations. The work involves collaboration with scientists, SMEs, inventors, end users, and experts aiming in a straightforward way to implement innovations including all the phases starting from idea generation, conceptualization, business models development, and commercialization. Since 2004, he has been involved in more than 100 innovation commercialization projects, and he has more than twenty international research publications. He is one of the creators of the InTo innovation tool.

References

Aljena, A. 2014. *Business Model Designing Tool – Filling the Gap between Philosophy and Reality.* Paper presented at the Innovate Teaching in Business & Management Conference, April 2014, Gdansk, Poland.

Archer, N., & Ghasemzadeh, F. 1999. An Integrated Framework for Project Portfolio Selection. *International Journal of Project Management,* 17(4): 207–216.
http://10.1016/S0263-7863(98)00032-5

Artiola, J., Pepper, I. L., & Brusseau, M. L. 2004. *Environmental Monitoring and Characterization.* San Diego, CA: Elsevier Academic Press.

Bates, B., Kundzewicz, Z., Wu, S., & Palutikof, J. (Eds.). 2008. *Climate Change and Water.* Geneva: Intergovernmental Panel on Climate Change (IPCC) Secretariat.

Biber, E. 2011. The Problem of Environmental Monitoring. *University of Colorado Law Review,* 83(1): 1–82.

Casadesus-Masanell, R., & Ricart, J. E. 2007. *Competing through Business Models.* IESE Business School Working Paper No. 713. Pamplona, Spain: University of Navarra.

de Haan, F. J., Rogers, B. C., Frantzeskaki, N., & Brown, R. R. 2015. Transitions through a Lens of Urban Water. *Environmental Innovation and Societal Transitions,* 15: 1–10.
https://doi.org/10.1016/j.eist.2014.11.005

Eriksson, P., & Kovalainen, A. 2008. *Qualitative Methods in Business Research.* London: SAGE Publications.

Forrest, N., & Wiek, A. 2014. Learning from Success—Toward Evidence-Informed Sustainability Transitions in Communities. *Environmental Innovation and Societal Transitions,* 12: 66–88.
http://doi.org/10.1016/j.eist.2014.01.003

Furr, N., & Dyer, J. 2014. *The Innovator's Method: Bringing the Lean Startup into Your Organization.* Boston, MA: Harvard Business Review Press.

Gurin, J. 2014. *Driving Innovation with Open Data.* Washington, DC: U.S. Chamber of Commerce Foundation.

Gustafsson, J., & Salo, A. 2005. Contingent Portfolio Programming for the Management of Risky Projects. *Operations Research,* 53(6): 946–956.
http://doi.org/10.1287/opre.1050.0225

Haque, U. 2011. *The New Capitalist Manifesto: Building a Disruptively Better Business.* Boston, MA: Harvard Business Press.

Hietaniemi, L. 2009. *Visio suomalaisen laboratoriotoiminnan mahdollisuuksista.* Kemian päivät. Vantaa, Finland: Green Net Finland.

Hornibrook, S., May, C., & Fearne, A. 2015. Sustainable Development and the Consumer: Exploring the Role of Carbon Labelling in Retail Supply Chains. *Business Strategy and the Environment,* 24(4): 266–276.
http://doi.org/10.1002/bse.1823

Kajanus, M., Iire, A., Eskelinen, T., Heinonen, M., & Hansen, E. 2014. Business Model Design: New Tools for Business Systems Innovation. *Scandinavian Journal of Forest Research,* 29(6): 603–614.
http://dx.doi.org/10.1080/02827581.2014.949301

Kajanus, M., Leskinen, P., Kurttila, M., & Kangas, J. 2012. Making Use of MCDA Methods in SWOT Analysis - Lessons Learnt in Strategic Natural Resources Management. *Forest Policy and Economics,* 20: 1–9.

Kinnari. T. 2013. *Open Data Business Models for Media Industry - Finnish Case Study.* Master's Thesis. Helsinki: Aalto University School of Business.

Laniak, G. F, Olchin, G., Goodall, J., Voinov, A., Hill, M., Glynn, P., Whelan, G., Geller, G., Quinn, N., Blind, M., Peckham, S., Reaney, S., Gaber, N., Kennedy, R., & Hughes, A. 2013. Integrated Environmental Modeling: A Vision and Roadmap for Future. *Environmental Modelling & Software,* 39: 3–23. http://dx.doi.org/10.1016/j.envsoft.2012.09.006

Liesiö, J., Mild, P., & Salo, A. 2007. Preference programming for robust portfolio modeling and project selection. *European Journal of Operational Research,* 181(3): 1488–1505. http://dx.doi.org/10.1016/j.ejor.2005.12.041

Lindman, J., & Nyman, L. 2014. The Businesses of Open Data and Open Source: Some Key Similarities and Differences. *Technology Innovation Management Review,* 4(1): 12–17. http://timreview.ca/article/757

Lintukangas, K., Kähkönen, A.-K., & Ritala P. 2014. Supply Risks as Drivers of Green Supply Management Adoption. *Journal of Cleaner Production,* 112(30): 1901–1909. http://dx.doi.org/10.1016/j.jclepro.2014.10.089.

Magretta. J. 2002. Why a Business Model Matters? *Harvard Business Review,* 80(5): 86–92.

Martino, J. P. 1995. *Research and Development Project Selection.* New York: John Wiley and Sons.

Morgan, L., & Finnegan, P. 2014. Beyond Free Software: An Exploration of the Business Value of Strategic Open Source. *Journal of Strategic Information Systems,* 23(3): 226–238. http://dx.doi.org/10.1016/j.sis.2014.07.001

Nenonen, S., & Storbacka, K. 2010. *Markkinamuotoilu. Johdatko markkinoita vai johtavatko markkinat sinua?* Hämeenlinna, Finland: WSOYpro.

Niemi, J. (Ed). 2009. Environmental Monitoring in Finland 2009–2012. *The Finnish Environment,* 12. Helsinki: Finnish Environment Institute.

Osterwalder, A. 2004. *The Business Model Ontology – A Proposition in a Design Science Approach.* PhD Thesis. Lausanne, Switzerland: University of Lausanne.

Parker, G. G., van Alstyne, M. W., & Choudary, S. P. 2016. *Platform Revolution.* New York: W.W. Norton & Company Ltd.

Räsänen, T. 2011. *Intelligent Information Services in Environmental Applications.* Doctoral Thesis C 403. Oulu, Finland: University of Oulu.

Salo, A., Mild, P., & Pentikäinen T. 2006. Exploring Causal Relationships in an Innovation Program with Robust Portfolio Modeling. *Technological Forecasting & Social Change,* 73(8): 1028–1044. https://doi.org/10.1016/j.techfore.2006.03.005

Sosna, M., Trevinyo-Rodríguez, R. N., & Velamuri, S. R. 2010. Business Model Innovation through Trial-and-Error Learning: The Naturhouse Case. *Long Range Planning,* 43(2-3): 383–407. https://doi.org/10.1016/j.lrp.2010.02.003

Stummer, C., & Heidenberger, K. 2003. Interactive R&D Portfolio Analysis with Project Interdependencies and Time Profiles of Multiple Objectives. *IEEE Transactions on Engineering Management,* 50(2): 175–183. https://doi.org/10.1109/TEM.2003.810819

Teece, D. J. 2010. Business Models, Business Strategy and Innovation. *Long Range Planning,* 43(2-3): 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

Testa, F., Iraldo, F., Vaccari, A., & Ferrari, E. 2015. Why Eco-labels Can Be Effective Marketing Tools: Evidence from a Study on Italian Consumers. *Business Strategy and the Environment,* 24(4): 252–265. https://doi.org/10.1002/bse.1821

Thore, S. A. (Ed). 2002. *Technology Commercialization: DEA and Related Analytical Methods for Evaluating the Use and Implementation of Technical Innovation.* Boston: Kluwer Academic Publishers.

Tikka, V., & Gävert, N. 2014. *Arvonluonnin uusi aalto. Näin rakennetaan tämän vuosisadan arvokkaimmat yritykset.* Tekes-katsaus 309/2014. Helsinki: Tekes.

USCCF. 2014. *The Future of Data-Driven Innovation.* Washington, DC: U.S. Chamber of Commerce Foundation (USCCF). https://www.uschamberfoundation.org/sites/default/files/Data%20Report%20Final%2010.23.pdf

van den Bergh, J. C. J. M., Truffer, B., & Kallis, G. 2011. Environmental Innovation and Societal Transitions: Introduction and Overview. *Environmental Innovation and Societal Transitions,* 183(3): 1488–1505. https://doi.org/10.1016/j.eist.2011.04.010

Wüstenhagen, R., & Bilharz, M. 2006. Green Energy Market Development in Germany: Effective Public Policy and Emerging Customer Demand. *Energy Policy,* 34(13): 1681–1696. https://doi.org/10.1016/j.enpol.2004.07.013

Citation: Eskelinen, T., Räsänen, T., Santti, U., Happonen, A., & Kajanus, M. 2017. Designing a Business Model for Environmental Monitoring Services Using Fast MCDS Innovation Support Tools. *Technology Innovation Management Review,* 7(11): 36–46. http://doi.org/10.22215/timreview/1119

Keywords: open data, environmental monitoring, data collection, service innovation, MCDS, business model

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

> *Many well established publishers are struggling to come up with new, sustainable business models that work in the digital environment.*
>
> Abby Clobridge (2013)
> Managing Director, Clobridge Consulting

After 350 years of operation, the academic journal publishing industry is imbalanced and in flux as a result of the impacts of Internet technology, which has led, over the past 20 years, to the rise of open access publishing. The introduction of open access journals, in the opinion of many researchers, is considered to be a case of disruptive innovation that is revolutionizing the industry. This article analyzes the traditional journal publishing system, the recent open access models of journal publishing as an evolving phenomenon, the nature and extent of open access as a disruptive innovation, and the implications for key stakeholders. The major finding is that open access publishing has gained traction because technology has contributed to lower publication costs, easier access to research articles, and speedier publishing processes. However, the threat posed by open access has not significantly impacted traditional publishers because of strategies employed by the major publishers and slow adoption of open access by some researchers.

Introduction

Academic journals date back more than 350 years, and the dominant publishing model over much of this period has focused on subscription journals circulated among academics in print form with the content mainly focused on the sciences, technology, and medical disciplines (Larivière et al., 2015). These academics were largely members of "learned" societies that sponsored the costs of publication (Correia & Teixeira, 2005; Solomon, 2012). The early history of scholarly journal publishing was traced to an initiative of the Royal Society of London, whose objective was to promote knowledge dissemination among research colleagues (Larivière et al., 2015; Peters et al., 2016). An industry developed based on literature published by these "learned societies" or that was supplied to commercial publishers, who thrived for many years through the production and dissemination of subscription journals (Correia & Teixeira, 2005; Solomon, 2012). The growth of subscription journals was fueled by the expansion of commercial publishers who acquired society journals and eventually became an oligopoly of five big companies that command more than 50% of journal output, mainly in the science-related disciplines (Larivière et al., 2015; Peters et al., 2017; Solomon, 2012, 2013). The dominance of the subscription model continues to the present in terms of market share and profitability (Forgues & Liarte, 2013). The subscription model was sustained by payments from universities and libraries, but more recently, this model has come to be viewed as a restraint on access to research, of questionable viability, and even deemed to be unsustainable because of increasing costs (Chang, 2006; Wellen, 2013).

The subscription publishing model still dominates the journal publishing industry, but the development and increased application of Internet technology made the distribution of research much easier and also opened up new opportunities. In the 1990s, with the spread of the Internet, a new competitor entered the publishing business based on a philosophy that knowledge should be open to all, leading to the publishing of open access journals (Solomon, 2013). An open access journal is considered one "in which all content is available freely on the web from day one, either exclusively online or

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

parallel with a subscription print version, and which can be accessed by anyone with Internet access" (Laasko et al., 2011).

The rise of open access journals benefitted from the "serials crisis", which described the dilemma faced by libraries of declining budgets alongside rising subscription costs charged by publishers (Miguel et al., 2016). The entry and rapid production of open access journals is considered by several reputable researchers as constituting a disruptive innovation that challenges the dominance of large commercial publishers and their subscription journals, thereby radically changing the industry (Clobridge, 2014b; Lafferty & Edwards, 2004; Peters et al., 2016; Wellen, 2013). The question of whether open access publishing amounts to a disruptive innovation in the journal publishing industry will be explored later in the article.

Nonetheless, the growing acceptance of open access publishing of science-related research was also spurred by supporting actions taken by governments, universities, and societies, which were formalized in declarations endorsing open access publishing as recorded in the Budapest Open Access Initiative (2002), the Bethesda Statement (2003), and the Berlin Declaration (2003), to which many countries were signatories. Subsequently, open access policies were adopted by many governments, research and educational institutions, and universities across the globe. Significant cases and the relevant years were Copenhagen Business School (2009) in Denmark; Harvard (2008) and California (2013) in the United States; Cambridge (2013), Oxford (2016), and Nottingham (2016) in the United Kingdom. Canada was also a relatively early adopter of open access policies with the examples of the Social Sciences and Humanities Research Council in 2006, the Canadian Institutes of Health Research in 2008, and the Natural Sciences and Engineering Research Council in 2013 (Hewitt, 2014). Similar policies were adopted in the Latin American and the Caribbean region led by the Scientific Electronic Library Online (SciELO; scielo.org), which started in 1978, and the Network of Scientific Journals from the Latin American and Caribbean region, Spain, and Portugal (Redalyc; www.redalyc.org), which started in 2002. Both of these organizations serve most Latin American and Caribbean countries and host a range of publications in the sciences, humanities, and social sciences with free access to over 1,000 journals as at 2017. However, a gap remains in the publishing of social science and business journals, which disadvantages small developing countries such as those in the Caribbean, where science research is at a low level.

As open access publishing developed, the year 2012 was described as a watershed because it witnessed: a researcher-led boycott of the largest traditional publisher, Elsevier; the introduction of new enabling policies by major research funders; increased interest generated in the media and by the public as a result of growing awareness of open access; the publication of the Finch report in the United Kingdom; the launch of an open knowledge repository by the World Bank; and the launch of open data platforms and portals by United Nations agencies that linked open data and open access (Clobridge, 2013). This embrace of open access publishing by governments and key stakeholders, such as libraries, academic researchers, and journal authors, was described as "a solution to a dysfunctional journals market and as a way of realizing the potential of the Internet to enhance impact and productivity of research" (Wellen, 2013). However, open access has not received universal acceptance, especially from researchers in the social sciences and business fields, who have not followed the path of science researchers. Indeed, there is still resistance to open access publishing by some academics who consider that the newer open access journals lack legitimacy and credibility. Nonetheless, this position is changing, as evidenced by the indexing of open access journals in the Web of Science and Scopus (Björk, 2017)

This article aims to create awareness of the emergence of open access publishing and stimulate an increase in publication of research articles, particularly in the Caribbean where a deficiency exists (Iton & Iton, 2015). The rest of this article discusses the methodology employed, an overview of the publishing landscape, the emergence of open access models of publishing, the argument that open access constitutes disruptive innovation, the impacts, and trends in open access publishing, and context-related conclusions.

Methodology and Theoretical Background

A qualitative research approach was adopted involving a bibliographic, descriptive, and analytical approach to the collection and distillation of relevant literature on the study area sourced from: the leading digital full-text aggregator databases ABI/Inform (search.proquest.com/abicomplete) and EBSCOhost (search.ebscohost.com); Google Scholar (scholar.google.ca), recognized as the most comprehensive source for retrieving open access articles; the Directory of Open Access Journals (doaj.org), considered the best source for accessing open access business journals; and Internet searches of websites of the main publishers of relevant content such as the *Online*

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

Information Review (emeraldinsight.com/loi/oir), *Publications* (www.mdpi.com/journal/publications), *Online Searcher* (infotoday.com/OnlineSearcher/), and *The Scholarly Kitchen* (scholarlykitchen.sspnet.org), which is the official blog of the Society for Scholarly Publishing. These data sources were searched using the keywords "academic publishing", "Internet technology and publishing", "open access publishing models", "disruptive innovation", and "journal publishing". Consistent with acknowledged qualitative procedures, the process involved: the researcher as the key instrument for conducting the research; multiple sources of data obtained from peer-reviewed journals and specialist reports; and a theoretical lens that seeks to identify the social and political context of the issues studied and that represents a holistic account to better reflect the complex picture of the study elements (Cresswell, 2009). A thematic analysis of the literature was undertaken to identify patterns across the research data and identify the critical issues through a process of data familiarization, coding, and theme development (Braun & Clarke, 2006; Rodrigues et al., 2016). The results provided a deeper understanding of the dynamics of the publishing industry, its challenges, and the impacts, implications, and trends likely to be experienced by multiple stakeholders such as authors and academic researchers – including those based in developing countries, readers, university librarians, traditional publishers, scholarly societies, open access journals, academic social networks, and mobile technology users.

The theoretical underpinning of this article is the theory of disruptive innovation the origins of which can be traced to Schumpeter (1950), who introduced the concept of "creative destruction" in the context of the opening of new markets that radically change the economic structure from within, while destroying the old and creating a new structure. The modern development of the concept of disruptive innovation was attributed to Christensen (1997), who studied the impact of destructive technologies on earlier business innovations. Christensen distinguished between sustaining technologies that improve existing products and destructive technologies that result in poor performance in the short term. Such technologies were viewed by Christensen (1997) as "typically cheaper, simpler, smaller, and, frequently more convenient to use" and were thus appealing to new customers. Lewis (2012) emphasized that disruptive innovation usually starts off as an inferior product but provides value through the application of new technologies and business models that enhance access to a new service or product while disrupting the market. These characteristics of cheaper, simpler, and enhanced access to a new product (as a result of new technology) are directly applicable to the case of open access journals.

Overview of the Publishing Landscape

The subscription journal model evolved slowly until expansion of research resulted in an increase in the creation of journals by commercial publishers who grew through acquisition of society journals (Solomon, 2012). Currently, the commercial production of subscription journals is controlled by five major, for-profit publishers labelled as "The Big Five": Elsevier (elsevier.com), Springer-Verlag (springer.com), Taylor & Francis (taylorandfrancis.com), John Wiley & Sons (www.wiley.com), and Sage (sagepublications.com). Four are headquartered in Europe, and the fifth (Sage) is based in the United States. Described as an oligopoly in the digital era (Larivière et al., 2015), "The Big Five" were responsible for over half of all papers published in peer-reviewed journals in 2013, but they concentrated on the science-related disciplines (Krisch, 2015; Solomon, 2012, 2013). Together, they published more than 8,000 journals in 2014: 2,571 by Elsevier, 2,209 by Springer-Verlag, 1,803 by Taylor & Francis, 1,604 by John Wiley, and 742 by Sage (International Scientific Institute, 2014).

The dominance of the major publishers of subscription journals was sustained through a strategy of "bundling", which involves selling a mixture of high- and low-impact journals through "Big Deals", mainly to university libraries, at high subscription rates (Wellen, 2013). Through this strategy, libraries, which contributed between 68% and 75% of journal revenue, had no option but to buy an entire bundle in order to access particular journals of interest (i.e., there was no cost-effective way to subscribe to only a subset of journals), and they faced complex negotiations if they decided to cancel subscriptions (Solomon, 2013).

On this basis, journal publishing continues to be a very profitable business when judged on the financial results of the leading European publishers, Elsevier and Springer, who recorded revenue growth in excess of 30% per annum from 2008 to 2012 (Forgues & Liarte, 2013). The profitability of journal publishing as a business enterprise was also demonstrated by the 2015 industry earnings of $9 billion USD, which produced a return of 20% to 30% (Fecher & Wagner, 2016). However, a trend was observed toward the cancellation of "Big Deals", which was attributed to declining library budgets and the demonstration effect of libraries that had cancelled subscriptions without adverse reactions from users (Anderson, R., 2017).

Academics have pointed to two significant concerns with subscription journals: the business model utilized and the dissemination of research output. The business model does not provide for any form of revenue to authors, whether royalties or payment for peer-review or editorial services (Lambert, 2015). Further, researchers prefer to have their work disseminated in the most prestigious journals, as well as reach a wide audience, which are conflicting objectives because greater resources may be required to publish the prestigious journals. Also, there is little incentive to publish in low-cost, open access journals because of the prestige factor (Lambert, 2015), which is associated with a journal being ranked by reputable organizations such as the Financial Times (www.ft.com) and the Australian Business Deans Council (www.abdc.edu.au/master-journal-list.php). This situation led to the view of the leading academic journals and universities as "dispensers of status" rather than "purveyors of information and knowledge" (Fox, 2016).

While the development of the Internet ushered in the digital era of publishing, the movement for greater access to published research was driven by librarians (especially through the Scholarly Publishing and Academic Resources Coalition, or SPARC; sparcopen.org), researchers, socioeconomic forces, and the evolution of academic publishing (Fogues & Liarte, 2013). Thus, these forces led to the emergence of open access publishing in the 1990s as an alternative model to subscription journals (Correia & Teixeira, 2005; Solomon, 2012). According to Kember (2016), open access "challenges the spiralling costs and price barriers put up by commercial journal publishers [that are] draining library budgets while profiting from academic free labour".

Emergence of Open Access Models

The recent development of open access within the journal publishing industry witnessed the adoption of different models that vary according to the type of access to articles permitted by publishers. The system of open access publishing is somewhat confusing because open access, in its pure sense, implies that journal articles are freely available on the Internet. However, the introduction of article processing charges led to the creation of several variations of open access journals defined by their degree of openness and classification. Open access options offered by different publishers have been elaborated and debated in the literature (e.g., Burchardt, 2014; Clobridge, 2014a; Eger et al., 2015; Fecher & Wagner, 2016; Harington, 2017; Jubb et al., 2015; Rodrigues et al., 2016; Solomon, 2013; Wellen, 2013) and can be classified as follows:

- *Gold open access:* the full content of the article is immediately available to any reader with Internet access regardless of the journal's business model. However, many of the journals published by the top-ranked publishers provide an abstract but charge a fee to read or download an article.

- *Diamond open access:* open access journals that are totally free of charges because costs are met by societies, sponsors, and universities.

- *Green or delayed open access:* publishing an article in a subscription journal that is subsequently deposited in a repository becoming accessible after a publisher-imposed embargo period of usually six to twelve months. Authors also can deposit in a library repository or upload to a personal website or a social academic network such as Academia.edu (academia.edu) or ResearchGate (researchgate.net).

- *Hybrid open access:* a journal operates as a subscription journal but offers the authors an open access option for a processing fee of hundreds or thousands of dollars. This model has been criticized as "double-dipping" because the publishers collect payment from both university libraries and authors, and it has been described as a failed model because this option has not gained the expected popularity, being used by a mere 1 to 2 percent of authors (Bjork, 2012).

The evolution of open access publishing from the mid-1990s was traced as passing through three waves: the first wave was the non-acceptance of open access by academics due to doubts about sustainability, quality of peer review, lack of indexing in the Web of Science, and lack of prestige; in the second wave, the subscription journals adopted a strategy of making an electronic version of articles freely available through online portals; and the third wave was the introduction of article processing charges by new publishers BioMed Central and PLOS ONE, both of whom have become major open access publishers (Björk & Solomon, 2012).

Despite slow but steady growth, concerns remain about publishing in open access journals, including: perceptions questioning the academic calibre of open access journals and possible impacts on career progression

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

and tenure if authors publish in such journals; publisher-imposed embargo periods; high costs of article processing charges; sustainability of journal business models; unfamiliarity with the self-archiving option; and visibility and discoverability of materials archived in repositories (Hewitt, 2014). These issues are discussed in the next section, however, a key point is that the "subscription versus open access" journals debate is ongoing in the literature. But, according to Osborne (2015), this debate amounted to a distraction because the issue should not be the cost of access to publications, but ensuring good writing and increased accessibility. Any argument against publishing in an open access journal should not influence an author's decision of where to publish, provided that the quality of the journal's standards is assessed (Björk & Solomon, 2012). In the view of Ren (2015), openness is about more than accessibility; it facilitates "universal participation in the co-development and co-creation of knowledge".

But, how successful has the open access model been so far, in terms of uptake? At least in the United Kingdom, some evidence suggests that the subscription model is retaining its dominance despite growth in the open access model. Gold open access was adopted by several subscriptions journals, which was reflected in growth of 15% between 2012 and 2014, however, the hybrid model was the most utilized at 62% (Jubb et al., 2015). The subscriptions model, although still dominant at 87%, declined by only 1% over the two-year period. Data from Outsell (2015) showed that open access journals published in 2014 totalled 11,740, which included journals from the Big Five publishers and the second largest open access publisher, Hindawi (hindawi.com). The total number of open access journals that did not charge an author fee amounted to 1,505 (13%) with growth of 35% over 2013; 8,044 were hybrid (69%) with growth of 9% and 2,191 (6.2%) were subscription, which declined by 14% and was the only model that experienced a decline.

Open Access Publishing and Disruptive Innovation

The concept of disruptive innovation was applied in its early formulation by Christensen (1997), mainly to firms in the hard-disk drive business during the 1970s and 1980s. However, Christensen also pointed to ongoing disruptive innovation in telecommunications, personal computing, utilities, construction, medical-related industries, and offset printing. The concept has now been widely applied to many of the modern industries such as airlines, transportation, consumer buying, and more recently, 3D printing (Hahn et al., 2014). As summarized by King and Baatarogtokh (2015), the key arguments of the theory of disruptive innovation are that: firms in a market who are on an improvement trajectory follow a path of sustaining innovation; customers' needs are overshot; capability to address disruptive threats exists; firms fail because of the disruption; and it was argued that managers tended to disregard low-level disruptive actions such as digital printing. King and Baatarogtokh (2015) go on to challenge these assumptions while accepting that the theory is valuable provided it serves as a warning, not a prediction nor a substitute for critical thinking. Here, the insights from the theory of disruptive innovation will be used to illustrate the case of publishing of open access journals, which some researchers view as disrupting the traditional publishing industry (Lafferty & Edwards, 2004; Peters et al., 2016; Russell et al., 2015; Weeks, 2015; Wellen, 2013).

Lafferty and Edwards (2004) argued that disruptive technologies "disrupt the market, change the industry paradigm and create a whole new market for a new product often driving out the incumbent organisations". The authors applied the theory to universities and the publishing industry, concluding that universities were disrupted by simulation and games technology, telepresence, and online teaching. In turn, the publishing industry was disrupted by electronic versions of scholarly journals supported by online submission of articles, electronic indexing, abstracting and searching, translation services, and the incorporation of multimedia components. This position was challenged by Peters and colleagues (2016), who argued that technological disruption has little connection to innovation if it concentrates on competition among publishing companies while downplaying the role of researchers in publishers' innovations. The authors argued that the theory has too narrow a focus to be valuable to the objectives of publishing because "a scholarship of publishing should provide a critique of the theory…. through alternative theorisations of technology and innovation in publishing" (Peters et al., 2016).

Weeks (2015) criticized the notion of disruptive innovation by highlighting specific anomalies including: the definition of disruptive innovation is too broad and loose and does not clearly distinguish between the meanings of disruption and sustaining behaviour; the unit of analysis is not specific whether the reference point is the industry, the technology, the firm, or the firm leaders; and managerial behaviour in dealing with disruption assumes rational action in avoiding the threat of disruption. Weeks (2015) concluded that the theory of disruptive innovation does not fit all situations, so its application should be limited to "instances where the innovation is lower cost, lower performing (on at least one performance dimension), and appeals to a subset of the existing market or a new market". However, the disruptive innovation framework was considered by Weeks as relevant to an understanding of the dynamics of innovation and the actions by firms in introducing lower-performing, lower-cost products that can gain market share. From this perspective, the framework may be applied to the open access journal publishing model.

Wellen (2013) viewed the theory of disruptive innovation as relevant to open access publishing, as evidenced by the creation of megajournals by commercial publishers and massive online open courses, where the discovery, management, utilization, and aggregation of academic and educational material were already disrupting the market. It was further argued that gold open access has all the features of disruptive innovation because it combines new technology (digital distribution of content using the Internet) with a new business model (free distribution to the reader with costs met by the author or an institution) (Lewis, 2012). Gold open access started off at a low tier and in niche fields such as the underserved humanities and social sciences and the business and management disciplines, which explains why open access has been embraced in developing countries, as suggested by the global ranking on adoption with: Brazil (3rd), Chile (7th), India (9th), Venezuela (11th), Turkey (13th), and Mexico (15th) (Lewis, 2012). Further, significant growth in open access publishing was observed in India, Brazil, Nigeria, and Iran, with many new journals being established in these countries (Miguel et al., 2016).

Impacts of Gold Open Access Publishing

The literature on open access publishing pointed to the critical impacts and implications of the gold open access model of publishing and the trends in the business, the key aspects of which were explored by authors who have published several articles on the subject (Laasko et al., 2017; Lewis, 2012; Ren, 2015; Ware & Mabe, 2015). Indeed, there are impacts on all major stakeholders, as discussed below.

Impact on authors and individual academics
Gold open access suits most authors because of wide distribution and use of post-publication review. The concerns of academics about prestige and quality will be diminished with the growing acceptance of open access journals. It was suggested that academics should develop publishing strategies balanced among "metrics, visibility and impact", which facilitate "collaborative mechanisms within institutional academic systems" to achieve sustainable openness (Ren, 2015). Authors based in developing countries, with limited funds and access to foreign exchange, should select diamond open access journals as a first option for publishing because publishing costs are (typically) met by host universities and sponsors (i.e., authors are not charged fees to publish in such journals).

Impact on readers
Researchers worldwide, and particularly in developing countries, benefit from increased access to the literature and learning, particularly those based in Latin America and the Caribbean who have free access to SciELO, which is indexed in the Web of Science (Packer, 2014), and Redalyc – both of which house over 1,000 journals each covering a range of natural science and social science disciplines – and Sci-Hub (described below) for science topics.

Impact on university libraries
Libraries are confronting the "serials crisis" caused by increasing subscription costs from journal publishers by themselves working as publishers in an arrangement with university presses and also expanding institutional and subject repositories, thereby disrupting the established publishing ecosystem.

Impact on traditional publishers
Faculty and students are increasingly gaining access to literature freely through online sources such as Sci-Hub (en.wikipedia.org/wiki/Sci-Hub), which provides free access to millions of journal articles by bypassing paywalls and other restrictions, which has attracted legal challenges by publishers. Traditional journals are also formulating strategies to counter the issue of cancellations of subscriptions by libraries. However, it is expected that traditional journals will continue to survive as long as the prestige label persists. Journal prestige has been maintained through the peer-review system and the indexing of journals, but the development of innovative approaches to peer review such as post-publication review and the creation of alternative metrics have the potential to disrupt the established processes with greater application by open access publishers

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

Impact on scholarly societies
Scholarly and professional societies are traditionally responsible for providing journal content and covering the publishing costs of many journals in science disciplines, with funds typically derived from membership fees, grants, and endowments. With articles increasingly becoming available from open access journals, society members must weigh the cost of membership against the value of journal access, and societies must decide whether to form alliances with major publishers to retain a role in journal production.

Impact on open access journal models
Gold open access is considered the major disruptive innovation in the publishing industry, and its impact will be felt by the hybrid and delayed open access variations, which do not modify the cost structure nor substantially change the view of libraries with regards to paying subscriptions. Green open access, which is a supplement to gold open access, is expected to continue in existence through registering with repositories, but it is still not what "a stable financially sustainable arrangement will look like in detail" (Ware & Mabe, 2015).

Current Trends in Open Access

Academic social networks
Platforms such as Academia.edu and ResearchGate can be viewed as disrupting academic publishing by providing new ways for disseminating, searching, and retrieving research content, and are becoming a major way of providing access to individual author's articles (Laasko et al., 2017), particularly for authors in small developing countries. However, Laasko and colleagues (2017) foresee that publishers will exert influence to restrict distribution if the impact reduces income as happened in the case of Elsevier, which was awarded damages from Sci-Hub for copyright infringement (Schiermeier, 2017).

Mobile technology
Mobile devices are now in common use: the sales of smartphones and tablets now exceed the sales of PCs, and time spent on digital media takes up an increasing proportion of our daily life – now up to 5.6 hours per day – largely because of mobile devices (Anderson, K., 2017). These devices can be used to research and read open access literature directly from journal websites and the Internet, further disrupting journals that provide immediate access but require online payment to read.

Conclusions

This article identified the impacts on the key participants in the field of academic publishing and highlighted four significant features of the publishing industry that are immediately relevant to the participants: the creation of subscription journals by large publishing companies as the dominant players in the industry; the emergence of open access journals as an alternative business model; the configuration of the open access model into variations on the theme; and the notion of open access as a form of disruptive innovation. The critical impacts of these features on the publishing industry were presented as an update on recent developments within the industry. The conclusions derived from the discussion are as follows.

First, the position of subscription journals remains intact as a publishing vehicle, and the conclusion is that this status will continue for the medium term because of the policy of acquiring small and medium-size journals, efforts to embrace variations of the open access model and even adopt the payment of article processing charges, and the entrenchment of the image of prestige journal brands that appeal to universities and academics seeking tenure.

Second, open access publishing is gaining in prominence, accounting for a 15% share in the Web of Science index (Björk, 2017), which provides some legitimacy to open access journals. This trend is beneficial to authors in developing countries, where access to subscription journals for research is typically limited by financial resources, especially outside of academia.

The conclusion is that the process is slow, but this is expected to change in the future as some researchers view open access as the future of journal publishing and the growth experienced in developing countries, such as India, Brazil, Nigeria, and Iran (Miguel et al., 2016). Open access journals are building credibility in the eyes of researchers as with the case of the large open access journals, PLOS ONE and PubMed Central. A gap remains, however, in the publishing of social science and business-related journals, which are areas of particular interest to developing countries such as those of Latin America and the Caribbean, where science research is not well developed (Iton & Iton, 2015; Troncoso, 2012).

Third, the emergence of alternative models of open access has created confusion in the minds of many re-

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

searchers by providing options such as the hybrid open access, which is essentially a subscription journal that includes an option to authors to publish as open access for a fee (Bjork, 2012). The state of confusion is compounded by the continuing change in "processes and policies, practices, and opportunities" (Broome, 2014). The conclusion is that open access publishing was utilized more by the science-related disciplines than the social science and business disciplines, with the latter requiring time to establish its validity in the industry and enter the mainstream (Ponte et al., 2017).

Fourth, the debate about the disruptive impact of open access journals on established journals continues in the literature, however, a clear conclusion can be drawn that the impacts of open access as disruptive innovation are beginning to be experienced. These are manifested in the impacts on university libraries, publishers of subscription journals, scholarly societies, and particularly the publishing processes such as peer review, indexing, and impact measurement as the established quality indicators. But, such impacts do not happen overnight. As Peters and colleagues (2016) put it: "If open access is to be viewed as a publishing innovation it will need more time to develop its scope in consideration of the complex systems, practices, and ideologies in which it prospers".

The publishing business is complex and the emergence of a menu of open access options presents challenges to new researchers seeking to publish research articles and who must come to terms with the requirements. This article contributes to the quest of new researchers to arrive at a greater understanding of the publishing industry, and it aims to increase awareness of the dynamics of open access with the aim of increasing publication of research.

About the Authors

Haven Allahar is an Adjunct Lecturer in Entrepreneurship and Innovation in the Graduate School of Business of the University of the West Indies in Trinidad and Tobago. Haven has over 40 years of management experience in the public and private sectors of Trinidad and Tobago, having held corporate management positions as COO at an industrial development company and CEO at both small business development and urban development companies. Over the past 15 years, he was a co-owner and Managing Director of a development planning consulting firm. Haven holds a BSc in Economics from the University of the West Indies in Mona, Jamaica, a Diploma in Hotel Administration from Ryerson University in Toronto, Canada, an MA in Management from American Public University in West Virginia, United States, and a DBA in Entrepreneurship from California Intercontinental University, United States. Specialized training was undertaken in Industrial Project Planning, Financing, and Management at Bradford University, England and the Central School of Planning and Statistics, Warsaw, Poland. Haven's publications are available at Academia. Edu and ResearchGate.

References

Anderson, K. 2017. Trouble at Hand – How Mobile Devices Perpetuate Weak Business Models. *The Scholarly Kitchen,* July 24, 2017. Accessed November 1, 2017:
https://scholarlykitchen.sspnet.org/2017/07/24/trouble-hand-mobile-devices-perpetuate-weak-business-models/

Anderson, R. 2017. When the Wolf Finally Arrives: Big Deal Cancelations in North American Libraries. *The Scholarly Kitchen,* May 1, 2017. Accessed November 1, 2017:
https://scholarlykitchen.sspnet.org/2017/05/01/wolf-finally-arrives-big-deal-cancelations-north-american-libraries/

Björk, B.-C. 2012. The Hybrid Model for Open Access Publication of Scholarly Articles – A Failed Experiment? *Journal of the American Society for Information Science and Technology,* 63(8): 1496–1504.
https://helda.helsinki.fi/handle/10138/2317

Björk, B.-C. 2017. Scholarly Publishing in Transition – From Restricted to Open Access. *Electronic Markets,* 27(2): 101–109.
http://dx.doi.org/10.1007/s12525-017-0249-2

Björk, B-C., & Solomon, D. J. 2012. Open Access versus Subscription Journals: A Comparison of Scientific Impact. *BMC Medicine,* 10(73): 1–10.
https://doi.org/10.1186/1741-7015-10-73

Braun, B. V., & Clarke, V. 2006. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology,* 3(2): 77–101.
http://dx.doi.org/10.1191/1478088706qp063oa

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

Broome, M. E. 2014. Open Access Publishing: A Disruptive Innovation. *Nursing Outlook,* 62(2): 69–71. http://dx.doi.org/10.1016/j.outlook.2014.02.004

Burchardt, J. 2014. Researchers Outside APC-Financed Open Access: Implications for Scholars Without a Paying Institution. *Sage Open,* 4(4). http://dx.doi.org/10.1177/2158244014551714

Chang, C. C. 2006. Business Models for Open Access Journals Publishing. *Online Information Review,* 30(6): 699–713. http://dx.doi.org/10.1108/14684520610716171

Christensen, C. M. 1997. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail.* Boston, MA: Harvard Business School Press.

Clobridge, A. 2013. You Say You Want a Revolution? Open Access on the March. *Online Searcher,* 37(2): 39–43.

Clobridge, A. 2014a. Open Access: Progress, Possibilities, and the Changing Scholarly Communications Ecosystem. *Online Searcher,* 38(2): 42–52.

Clobridge, A. 2014b. All Things Open: Open Access as the Entry Point to Open Knowledge. *Online Searcher,* 39(1): 38–41.

Correia, A. M. R., & Teixeira, J. C. 2005. Reforming Scholarly Publishing and Knowledge Communication: From the Advent of the Scholarly Journal to the Challenges of Open Access. *Online Information Review,* 29(4): 349–364. https://doi.org/10.1108/14684520510617802

Creswell, J. W. 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (3rd ed.). Thousand Oaks, CA: SAGE Publications.

Eger, T., Scheufen, M., & Meierrieks, D. 2015. The Determinants of Open Access Publishing: Survey Evidence from Germany. *European Journal of Law and Economics,* 39(3): 475–503. http://dx.doi.org/10.1007/s10657-015-9488-x

Fecher, B., & Wagner, G. G. 2016. Open Access, Innovation, and Research Infrastructure. *Publications,* 4(2): 1–8. http://dx.doi.org/10.3390/publications4020017

Forgues, B., & Liarte, S. 2013. Academic Publishing: Past and Future. *M@n@gement,* 16(5): 739–756. http://doi.org/10.3917/mana.165.0739

Fox, J. 2016. Academic Publishing Is All About Status. *Bloomberg View,* January 5, 2016. Accessed November 1, 2017: https://www.bloomberg.com/view/articles/2016-01-05/academic-publishing-is-all-about-status

Harington, R. 2017. Diamond Open Access, Societies and Mission. *The Scholarly Kitchen,* June 1, 2017. Accessed November 1, 2017: https://scholarlykitchen.sspnet.org/2017/06/01/diamond-open-access-societies-mission/

Hahn, F., Jensen, S., & Tanev, S. 2014. Disruptive Innovation vs Disruptive Technology: The Disruptive Potential of the Value Propositions of 3D Printing Technology Startups. *Technology Innovation Management Review,* 4(12): 27–36. http://timreview.ca/article/855

Hewitt, T. 2014. *Open Access in Canada: Towards a Common Policy for Federal Funding Agencies.* Paper presented at the RUCK International Open Access Meeting, March 20, 2014, London, UK.

Iton, I. & Iton, A. 2015. Open Access and the Caribbean Academic: An Exploratory Investigation of the Adoption of this Medium for Publishing among Science Faculty of the University of the West Indies. *IFLA Journal,* 42(1): 25–35. http:/dx.doi.org/10.1177/0340035215616977

Jubb, M., Goldstein, S., Amin, M., Plume, A., Aisati, M., Oeben, S., Pinfield, S., Bath, P., Salter, J., Johnson, R., Fosci, M. 2015. *Monitoring the Transition to Open Access: A Report for Universities UK.* Research Information Network (RIN), Elsevier, University of Sheffield, and Research Consulting.

Kember, S. 2016. Why Publish? *Learned Publishing,* 29(S1): 348–353. http://dx.doi.org/10.1002/leap.1042

King, A. A., & Baatarogtokh, B. 2015. How Useful Is the Theory of Disruptive Innovation? *MIT Sloan Management Review,* 57(1): 77–90.

Krisch, J. 2015. These Five Corporations Control Academic Publishing. *Vocativ,* June 10, 2015. Accessed November 1, 2017: http://www.vocativ.com/culture/science/five-corporations-control-academic-publishing/

Lafferty, S., & Edwards, J. 2004. Disruptive Technologies: What Future Universities and Their Libraries? *Library Management,* 25(6/7): 252–258. https://doi.org/10.1108/01435120410699636

Lambert, C. 2015. The "Wild West" of Academic Publishing: The Troubled Present and Promising Future of Scholarly Communication. *Harvard Magazine,* January–February: 56–83. https://harvardmagazine.com/2015/01/the-wild-west-of-academic-publishing

Larivière, V., Haustein, S., & Mongeon, P. 2015. The Oligopoly of Academic Publishers in The Digital Era. *PLOS ONE,* 10(6): e0127502. https://doi.org/10.1371/journal.pone.0127502

Laasko, M., Lindman, J., Shen, C., Nyman, L., & Björk, B. 2017. Research Output Availability On Academic Social Networks: Implications for Stakeholders in Academic Publishing. *Electronic Markets,* 27(2): 125–133. http://dx.doi.org/10.1007/s12525-016-0242-1

Lewis, D. W. 2012. The Inevitability of Open Access. *College & Research Libraries,* 73(5): 493–506.

Miguel, S., de Oliveira, E. F. T., & Grácio, M. C. C. 2016. Scientific Production on Open Access: A Worldwide Bibliometric Analysis in the Academic and Scientific Context. *Publications,* 4(1): 1. http://dx.doi.org/10.3390/publications4010001

Osborne, R. 2015. Open Access Publishing, Academic Research and Scholarly Communication. *Online Information Review,* 39(5): 637–648. http://dx.doi.org/10.1108/OIR-03-2015-0083

Osborne, R. 2013. Why Open Access Makes No Sense. In N. Vincent & C. Wickham (Eds.), *Debating Open Access:* 96–105. London: The British Academy.

Outsell. 2015. *Open Access 2015: Market Size, Share, Forecast, and Trends.* Burlingame, CA: Outsell, Inc.

Packer, A. L. 2014. SciELO Citation Index in the Web of Science. *SciELO in Perspective,* February 28, 2014. Accessed November 1, 2017: http://blog.scielo.org/en/2014/02/28/scielo-citation-index-in-the-web-of-science/

Academic Publishing, Internet Technology, and Disruptive Innovation

Haven Allahar

Peters, M. A., Jandrić, P., Irwin, R., Locke, K., Devine, N., Heraud, R., Gibbons, A., Besley, T., White, J., Forster, D., Jackson, L., Grierson, E., Mika, C., Stewart, G., Tesar, M., Brighouse, S., Arndt, S., Lazaroiu, G., Mihaila, R., Legg, R., & Benade, L. 2016. Towards a Philosophy of Academic Publishing. *Educational Philosophy and Theory,* 48(14): 1401–1425. http://dx.doi.org/10.1080/00131857.2016.1240987

Ponte, D., Mierzejewska, B. I., & Klein, S. 2017. The Transformation of the Academic Publishing Market: Multiple Perspectives on Innovation. *Electronic Markets,* 27(2): 97–100. http://dx.doi.org/10.1007/s12525-017-0250-9

Ren, X. 2015. The Quandary between Communication and Certification the Individual Academics' Views on Open Access and Open Scholarship. *Online Information Review,* 39(5): 682–697. https://doi.org/10.1108/OIR-04-2015-0129

Rodrigues, R. S., Taga, V. & dos Passos, M. F. 2016. Research Articles about Open Access Indexed by Scopus: A Content Analysis. *Publications,* 4(4): 31. http://dx.doi.org/10.3390/publications4040031

Russell, B., Bessant, J., & Brown, S. 2015. Dealing with Disruption: A Sector Study of Exploitation and Exploration in Academic Publishing. In *Proceedings of the XXVI International Society of Professional Innovation Management (ISPIM) Conference – Shaping the Frontiers of Innovation Management,* June 14–17 June, Budapest, Hungary.

Schiermeier, Q. 2017. US Court Grants Elsevier Millions in Damages from Sci-Hub. *Nature News,* June 22, 2017. Accessed November 1, 2017: https://www.nature.com/news/us-court-grants-elsevier-millions-in-damages-from-sci-hub-1.22196

Schumpeter, J. A. 1950. *Capitalism, Socialism, and Democracy* (3rd ed.). New York: Harper & Row.

Solomon, D. J. 2012. Digital Distribution of Academic Journals and Its Impact on Scholarly Communications: Looking Back After 20 Years. *The Journal of Academic Librarianship,* 39(1): 23–28. http://dx.doi.org/10.1016/j.acalib.2012.10.001

Solomon, D. J. 2013. Types of Open Access Publishers in Scopus. *Publications,* 1(1): 16–26. http://dx.doi.org/10.3390/publications1010016

Troncoso, J. D. 2011. Role of Open Access in the Emergence and Consolidation of Refereed Journals in Latin America and the Caribbean. *Higher Education and Society Magazine,* 16(2): 1–21.

Ware, M., & Mabe, M. 2015. *The STM Report an Overview of Scientific and Scholarly Journal Publishing* (4th ed.). The Hague, Netherlands: International Association of Scientific, Technical and Medical Publishers.

Weeks, M. R. 2015. Is Disruption Theory Wearing New Clothes or Just Naked? Analyzing Recent Critiques of Disruptive Innovation Theory. *Innovation: Management, Policy & Practice,* 7(4): 417–428. http://dx.doi.org/10.1080/14479338.2015.1061896

Wellen, R. 2013. Open Access, Megajournals, and MOOCs: On the Political Economy of Academic Unbundling. *Sage Open,* 3(4). http://dx.doi.org/10.1177/2158244013507271

Citation: Allahar, H. 2017. Academic Publishing, Internet Technology, and Distruptive Innovation. *Technology Innovation Management Review,* 7(11): 47–56. http://doi.org/10.22215/timreview/1120

Keywords: academic publishing, internet technology and publishing, open access publishing models, disruptive innovation, journal publishing

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 2000 words or longer than 5000 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

Technology Innovation Management Review

timreview.ca

Academic Affiliations and Funding Acknowledgements

The Federal Economic Development Agency for Southern Ontario (FedDev Ontario; feddevontario.gc.ca) is part of the Innovation, Science and Economic Development portfolio and one of six regional development agencies, each of which helps to address key economic challenges by providing regionally-tailored programs, services, knowledge and expertise.

- *The TIM Review receives partial funding from FedDev Ontario's Investing in Regional Diversification initiative.*

Technology Innovation Management (TIM; timprogram.ca) is an international master's level program at Carleton University in Ottawa, Canada. It leads to a Master of Applied Science (M.A.Sc.) degree, a Master of Engineering (M.Eng.) degree, or a Master of Entrepreneurship (M.Ent.) degree. The objective of this program is to train aspiring entrepreneurs on creating wealth at the early stages of company or opportunity lifecycles.

- *The TIM Review is published in association with and receives partial funding from the TIM program.*