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## *Insights*

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

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## Overview

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

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

We welcome input from readers into upcoming themes. Please visit [timreview.ca](http://timreview.ca) to suggest themes and nominate authors and guest editors.

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## 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](http://timprogram.ca)), an international graduate program at Carleton University in Ottawa, Canada.



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# Editorial: Insights

## Chris McPhee, Editor-in-Chief

Welcome to the October 2016 issue of the *Technology Innovation Management Review*. This issue was developed in collaboration with the International Society for Professional Innovation Management (ISPIM: [ispim.org](http://ispim.org)) – a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management. The articles in this issue were developed from papers presented at the 2016 ISPIM Innovation Conference, which was held in Porto, Portugal, from June 19–22, 2016 under the theme of "Blending Tomorrow's Innovation Vintage".

The authors in this issue share insights on the growth ambitions of entrepreneurs, strategy formation in innovation ecosystems, boundary objects for knowledge integration, entrepreneurial universities, and teaching methods for innovation and entrepreneurship.

In the first article, **Arto Wallin, Kaisa Still, and Katja Henttonen** from VTT, the Technical Research Centre of Finland, examine entrepreneurial growth ambitions among technology startups. Based on a case study of 21 growth-seeking technology startups operating in Finland, the authors found that an entrepreneur's growth ambitions may be influenced by their startup's institutional and market context, the scalability of their business model, their personal characteristics and experience, and their perceptions of the barriers and constraints of the field. The key implication for organizations aiming to foster technology entrepreneurship is that their support should be tailored to the entrepreneurs' specific growth ambitions and associated needs.

Next, **Jarkko Pellikka** and **Timo Ali-Vehmas** from Nokia Technologies in Espoo, Finland, propose a conceptual framework for senior leaders to form strategies to create and capture value in innovation ecosystems. In addition to their analysis of key concepts from the relevant literature, their practical contribution links and contrasts the practical questions arising during strategy development using traditional business-strategy literature with those arising when taking an ecosystem perspective.

Then, **Sari Mäenpää, Anu Helena Suominen, and Rainer Breite** from Tampere University of Technology, Finland, investigated the use of boundary objects for knowledge integration during a networked innovation process. The focal company in their case study participated in facilitated workshops with multiple stakeholders coming together to solve a major production-automation problem. As a test and refinement of an existing model for knowledge integration, the results show how managers can systematically approach problems requiring expert external knowledge and better integrate knowledge required for innovation within their project networks.

Next, **Martin Sperrer, Christiana Müller, and Julia Soos** from the Graz University of Technology in Austria assess the progression of Austrian universities of technology towards becoming "entrepreneurial universities". After reviewing the concept of the entrepreneurial university and the relevant stakeholders of today's higher-education institutions, they share the results of their assessment in the form of a scorecard that highlights where good progress had been made and where challenges remain.

Finally, **Anna Trifilova, John Bessant, and Allen Alexander** from the University of Exeter in the United Kingdom answer the question "How can you teach innovation and entrepreneurship?" by emphasizing the importance of gaining tacit knowledge in addition to explicit knowledge. They describe their current research into eight teaching approaches for innovation and entrepreneurship while emphasizing the need for novel project-based, practice-centred, and experiential learning approaches.

We are proud to be associated with ISPIM and are grateful for their assistance in putting together this issue. We hope you will enjoy and find value in the insights provided through these articles. Also, consider attending the upcoming ISPIM Innovation Forum in Toronto, Canada, from March 19–22, 2017. The deadline to submit outlines is November 25, 2016 ([forum.ispim.org](http://forum.ispim.org)).

## Editorial: Insights

Chris McPhee

In November, our editorial theme is **Innovation in Tourism** for which I am pleased to welcome guest editors **Dominic Lapointe** from Université du Québec à Montréal, Canada, and **David Guimont** from Cégep de Rivière-du-Loup and Living Lab en Innovation Ouverte (LLio) in Rivière-du-Loup, Canada, in collaboration with the International Association for Tourism Policy (iatour.net).

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](http://timreview.ca/contact)) with potential article topics and submissions.

### About the Editor

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

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# Entrepreneurial Growth Ambitions: The Case of Finnish Technology Startups

Arto Wallin, Kaisa Still, and Katja Henttonen

*“Growing up is losing some illusions,  
in order to acquire others.”*

Virginia Woolf (1882–1941)  
Author, publisher, and critic

Technology startups are expected to be a major driving force of economic growth in Europe. The search for new high-growth startups has been particularly topical in Finland, the country that is known for its high-tech products – and the fall of Nokia’s mobile phone business. Although a record number of startups has been established in recent years, the previously identified challenge is that only a small percentage of entrepreneurial businesses are responsible for the lion’s share of economic benefits typically associated with entrepreneurial activity. Hence, we need better understanding of what level of growth technology entrepreneurs aim to create and why there may be differences in growth ambitions among them. In this study, we undertook interpretivist case study research in pursuit of rich, empirically grounded understanding of entrepreneurial growth ambitions in the context of Finnish technology startups. We interviewed entrepreneurs at a Finnish startup event and supplemented this information with data available publicly on the Internet related to the growth ambitions of startups. Our study sought to increase understanding of the different aspects of entrepreneurial growth ambitions, and to explore the relationship between context and growth. Based on the findings, we suggest that growth ambitions should be seen as a complex, socially constructed concept. The growth ambitions of entrepreneurs in our study were influenced, at least in part, by their startups’ institutional and market contexts, the scalability of their business models, their personal characteristics and experience, and their perceptions of the barriers and constraints of the field. We conclude that startups have very different growth pathways: although the growth of one startup may depend on the talent of a few software developers, the growth of another startup may be based on its success in building international sales networks. As a result, to get most out of the support provided for a startup ecosystem, support activities should be tailored to different types of high-growth startups.

## Introduction

When Nokia’s dominance of the mobile phone market came crashing down, it was a disaster for the Finnish economy and left a huge gap to fill, especially for the employment of engineers (Lane, 2016). Since then, Finnish decision makers have been expecting new ventures – particularly technology startups – to fill the gap and lift the Finnish economy out from the recession. But this idea has a hidden assumption that might not hold: do all startups have growth ambitions? Do they

want to be global players like Nokia? And most importantly, do they build their growth by employing thousands of employees as Nokia did?

Finland is a contradictory context for technology-based growth entrepreneurship. Although the country is known for its high-tech contributions and has frequently ranked in the top category in innovativeness and competitiveness (e.g., Schwab & Sala-i-Martin, 2014), the Finnish society has traditionally been rather discouraging to high personal ambitions, as seen for ex-

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ample in the education system, which has been designed toward equality not excellence. Furthermore, the high-tech sector, dominated by Nokia, was not known for having an entrepreneurial mind-set. However, the fall of Nokia created the gap and incentives for entrepreneurship, which has made a major contribution toward the currently flourishing Finnish startup ecosystem. As an example, Nokia's Bridge funding program provided startup funding and support for past Nokia employees to encourage them to establish hundreds of startup companies (Bosworth, 2014). In addition, Finland is widely recognized as a leader in high-growth entrepreneurship policy (Autio & Rannikko, 2016; Mason & Brown, 2013) where many kinds of public funding and support services are offered for startups with the hope of benefits for the local, regional, and national economies.

Although there is extensive research related to entrepreneurial growth, we have identified some existing gaps between research and practice. First, much of the literature on entrepreneurial growth emphasizes the characteristics of the individual. Although some recent empirical studies highlight the importance of the context, for example Sipola (2015) found that entrepreneurial growth ambitions differ between countries, most of the studies are not fully taking into account how complex institutional forces and market environments may influence growth. In order to fully capture the importance of context for growth, we need to have very rich and diverse empirical coverage of this topic. Second, our literature review points out that the concept of growth is still largely translated into *employment*. However, in practice, we see the emergence of new kinds of startups that grow multibillion-dollar revenues with very few employees. The Finnish game company SuperCell (supercell.com) is a great example: established in 2010, five years later it achieved an annual revenue of \$2.3 billion with only 176 employees (Takahashi, 2016). It is clear that we need to rethink the concept of growth for today's technology startups.

The objective of this article is to provide rich, empirically grounded analysis of entrepreneurial growth ambitions in the context of Finnish technology startups. Our study aims to increase understanding of the different aspects of entrepreneurial growth ambitions and to explore the relationship between context and growth. In short, our research question is the following: what kind of growth do technology entrepreneurs aim to create and why there are differences in growth ambition levels? We believe that, with better understanding of

the growth ambitions of technology entrepreneurs, we may better help them achieve such growth, which is especially important now that digitalization and globalization have set the potential for unprecedented growth in technology-based startups.

### Related Research

In this article, we do not aim to provide a comprehensive review of extant literature of entrepreneurship, which is largely founded on the 1934 definition by Schumpeter of an entrepreneur as an individual whose function is to carry out new combinations of means of production. Entrepreneurship has been explored by multiple terms – for example, there is prominent research on technology startups and technology-based innovations in various research streams. Given that we want to explore the growth ambitions of entrepreneurs, we need to understand the phenomenon and the role of growth in entrepreneurship. In addition, we see growth ambitions going beyond the often-mentioned motivation of entrepreneurship as “the creation of wealth and commercialization of an idea” (Carbonell et al., 2009). The primary focus of the academic literature on entrepreneurship has been on the individual (Autio et al., 2014). However, going beyond the individual has been increasingly highlighted. For example, technology entrepreneurship is seen to eliminate the focus on individual entrepreneurs (Bailetti, 2012a) with increased emphasis on stakeholders and multiple actors (Autio et al., 2014), as well as with venture capitalists and customers being part of the ecosystem (Sipola, 2015). Similarly, within the stream of technology startups, there is much interest on how individual-level factors correlate with entrepreneurship and commercialization behaviours. For example, Nelson (2014) points out that the role of context in shaping entrepreneurial behaviour is less clear and suggests that the relationship between context and entrepreneurship should be studied in greater detail.

#### *Entrepreneurship, innovation, and growth*

As can be seen in Table 1, there are multiple approaches to entrepreneurship that all highlight different elements. We categorized these approaches based on their focus as it is explained in the definitions. Subsequently, we identified two main categories, which we acknowledge are inherently related.

First, we recognize that entrepreneurship is seen to be linked to technology and innovation with concepts such as technology entrepreneurship (Bailetti, 2012a).

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**Table 1.** Emphasis on entrepreneurship concepts in the literature

Area	Concept	Perspective
<b>Innovation, invention, and technology</b>	<i>Technical entrepreneurship</i> (Carbone, 2009)	Technical entrepreneurship is often associated with innovation, research, and invention.
	<i>Technology entrepreneurship</i> (Bailetti, 2012a)	An investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm
<b>Growth and disruption</b>	<i>High-growth entrepreneur</i> (Minniti et al., 2005)	High-expectation entrepreneurial activity is defined as early-stage businesses that expect to employ at least 20 employees within five years' time.
	<i>Born global</i> (Knight, 2015)	Highly international small and medium-sized enterprises that undertake international business at or near their founding
	<i>Entrepreneurial innovation</i> (Autio et al., 2014)	Entrepreneurial innovation involves the disruption of existing industries and creation of new ones through multi-level processes and stakeholders, multiple actors, and multiple contexts.
	<i>Startup ecosystem</i> (Sipola et al., 2016)	A startup ecosystem is a platform for high-growth entrepreneurship with constituencies that influence the emergence and non-emergence of high-growth firms.
	<i>Ambitious entrepreneur</i> (Hermans et al., 2015)	Someone who engages in the entrepreneurial process with the aim to create as much value as possible

Successful technology-based ventures are seen to heavily depend on the outcomes of actions by entrepreneurs and their ability to not only combine resources but also tolerate a higher degree of uncertainty (Giones et al., 2013). Much of the research has been concentrating on what type of resource configurations or combinations would explain the success or failure of the technology innovations of so many promising ventures (Giones & Miralles, 2015). Much of this research is dominated by studies of innovation in established companies; for example, Freeman and Engel (2007) explain that the corporate model of innovation differs significantly from the entrepreneurial model of innovation, which has been proven as “a robust vehicle for breakthrough innovations” and therefore deserves better attention.

Second, multiple concepts related to entrepreneurship emphasize growth. Concepts such as the high-growth entrepreneur and the ambitious entrepreneur are based on the understanding that an entrepreneurial venture has the principal goal of creating jobs or value. The born-global research stream (Bailetti, 2012b; Knight & Cavusgil, 1996; Tanev, 2012) provides more co-

herent concept defining a born-global firm as a highly international small and medium-sized enterprise that undertakes international business at or near its founding (Knight, 2015).

### *Growth ambitions*

The impact of goals and ambitions on entrepreneurial innovation activities has also been studied in innovation research and other related streams, but the research is scattered. One of the challenges related to this research is that the issue is discussed with many names. For example, growth ambitions (Gundry & Welsch, 2001), growth willingness (Davidsson, 1989), intended growth and growth intentions (Cassar, 2006), growth preferences (Cassar, 2007), attitude toward growth (Cliff, 1998; Wiklund, Davidsson, & Delmar, 2003), and growth aspirations (Kolvereid, 1992; Tominc & Rebernik, 2007) are all terms that are used in studies that generally aim to understand why and how entrepreneurs seek (or do not seek) high growth. Although these concepts have varying meanings for growth, many of those regard growth as increase in employment.

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A growing body of knowledge emphasizes that some entrepreneurs have higher ambitions than others, and that these entrepreneurial ambitions are an important antecedent of actual firm outcomes (Hermans et al., 2015). Again, as in the entrepreneurship literature in general, one of the explaining factors for growth ambitions of entrepreneurs is related to the types of people that become startup entrepreneurs in the first place. Lee and Venkataraman (2006) theorize about this process and claim that each individual has a combination of economic, social, and psychological benefits, collectively called the aspiration vector, that defines the set of entrepreneurial opportunities open to that individual. In a combination of available non-entrepreneurial options, the aspiration vector explains why individuals with certain type of human, intellectual, and social capital become entrepreneurs. Verheul and van Mil (2011) support this theoretical frame and link it to growth ambitions. In their study, they found out that Dutch early-stage entrepreneurs who are exploiting a perceived business opportunity (“opportunity entrepreneurs”), as opposed to those who became entrepreneurs due to lack of alternative employment options (“necessity entrepreneurs”), are more likely to have high growth ambitions. The context of entrepreneurship has also been addressed by Sipola and colleagues (2016), who compared high-growth-ambition startups in three different countries and found clear differences in internationalization activities, which were related to attributes such as ambition levels, a sense of urgency, and the accountability of the entrepreneur. These attributes were strongly linked to the cultural-cognitive and regulative level of the society.

A recent attempt to bring structure to addressing growth ambitions is the framework of ambitious entrepreneurship, with its three major concepts: i) growth aspiration (what the entrepreneur ideally wants to achieve), ii) growth intention (what the entrepreneur intends to achieve, combined with the effort they intend to make), and iii) growth expectation (what the entrepreneur wants to achieve, combined with the opportunities and constraints they perceive) (Hermans et al., 2015). It should be noted that all sample questions used to obtain answers for each of these concepts included the number of jobs as a measure of growth. For example, growth intention is typically addressed with the following question: within 5 years, how many employees do you intend to employ in this firm? Consequently, methods for measuring growth ambition need to be updated if we want to capture all aspects of the growth of modern technology startups.

### Methodology

This study utilizes case studies as a research strategy because the aim is to analyze the contemporary phenomenon of entrepreneurial growth ambitions within a real-life context (Chetty, 1996; Ghauri, 2004). We decided to conduct a multiple comparative case study (Mills et al., 2006) in order to better understand the contrasts, similarities, and patterns in entrepreneurial innovation, especially from the viewpoint of growth ambitions. The context of the research is growth-seeking technology startups established in Finland. The selected approach to case study research could also be described as interpretivist because the goal is to accumulate understanding on the topic rather than to make measurements or predictions (Andrade, 2009; Walsham, 1995).

For data collection, the researchers went to the major technology startup event in Finland, where growth-seeking Finnish startups are expected to be present to investors, although it is also one of the biggest startup events in whole Europe. The event was called Slush (slush.org) and it was held in Helsinki from November 12–13, 2015. The primary data was collected with short (10–20 minute) semi-structured interviews conducted by three researchers during the two-day event. In the interview, the ambition level was approached with the question “where will your company be in 5 years”.

In total, 27 interviews were conducted from which 21 Finnish companies were selected for further data collection and analysis. Relevant contextual information about the selected companies is presented in Table 2, showing that most of the companies were younger than 3 years and are mostly in the product-market fit and in scaling phases (see the categorization by Wallin et al., 2015) with turn-overs ranging between zero and 4M€. With few exceptions, most interviewed entrepreneurs were men over 30 years-old with relatively long prior careers in technology, innovation, or entrepreneurship.

The second round of data collection was conducted by accessing publicly available documents and social media data to study what the startups had written about their growth ambitions. The aim of the document analysis was to obtain more detailed data and to triangulate interview data. Finally, the combined interview and document data were analyzed by researchers using content-coding and theme-based categorization.

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**Table 2.** Contextual information about the 21 Finnish startups in this study

Dimensions	Categories	Number of Companies
<b>Year Founded</b>	2010 or before	5
	2011	1
	2012	4
	2013	5
	2014	4
	2015	2
<b>Phase</b>	Ideation	2
	Problem-solution fit	2
	Product-market fit	10
	Scaling	7
<b>Turnover (2015)</b>	none	6
	<100k€	4
	100–500k€	4
	500k€–1M€	1
	>1M€	3
<b>Startup Origin</b>	Industrial spin-off	2
	University spin-off	3
	From-scratch, serial entrepreneurs	5
	From-scratch, experienced professionals	9
	From-scratch, fresh graduates	2
<b>Entrepreneur Gender</b>	Male	19
	Female	2
<b>Entrepreneur Age</b>	<30	2
	30–49	15
	50+	4

## Findings and Discussion

Our analysis of the data shows that, although all studied companies were present at the same startup investor event, there are clear differences between entrepreneurs' ambition levels regarding growth. Intuitively, all companies should be aiming for high growth if they are about to attract private investments. However, surprisingly few companies use language that implies extremely high growth ambitions, and on the other hand, quite a few companies expressed only low or moderate growth expectations (see Table 3 for examples).

### *How do Finnish startup entrepreneurs express their growth ambitions?*

Table 3 also indicates substantial variation among startup entrepreneurs in their interpretations of growth for their ventures. Expanding international scale (7 companies), referring to geographical coverage of sales, was interpreted by seven startups to be a key indicator for the growth of their company. Increase in market share (6) and turnover (6) were both indicated to be main growth targets for several startups. Growth measured by number of users (4) or customers (1) represented successful growth for five interviewed startups. In addition to these, increase in sales revenue (2) and increased brand recognition (2) were identified as key growth targets. Contradictory to previous research, the number of employees was considered to be a key measure for growth for only two startups. Instead, many startups emphasize that they want to keep their organization small and lean in terms of employees. Finally, one company (the only startup that focused purely on games) regarded the number of downloads as the key measure of growth.

### *Why do ambition levels differ?*

Mostly from the document analysis, we identified numerous potential reasons for the variance in growth ambition levels, from which we will highlight four main categories:

1. Institutional and market environment
2. Scalability of business model
3. Founder background and personal characteristics
4. Perception of expectations

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**Table 3.** Growth ambition levels of the 21 companies in this study

Growth Ambition	Description	Interpretation of Growth	Examples
<b>Low/no</b> (N=1)	No or very low growth expectations, pessimistic view on the success of product/company at large scale	* International scale	“We start in Finland and later on we might expand to international markets.”
<b>Moderate</b> (N=7)	Clear international growth target, but the ambition level is not particularly high	*** International scale *** Turnover ** Sales/revenue ** Brand recognition * Number of users * Number of employees	“International breakthrough and increasing turnover to millions” “maybe double the turnover” “create internationally well-recognized brand that generates license fees to the company”
<b>High</b> (N=10)	High long-term growth expectations, or rapid short-term growth with an aim of buyout	**** Market share **** Number of users/customers *** International scale *** Turnover ** Number of employees * Number of downloads	“leading supplier in Europe” “from 200,000 users to 1.4 million” “operations on three continents” “10X our turnover...” “we will employ hundreds of people [currently 12]” “more than 100 million downloads”
<b>Very high</b> (N=2)	Seeking rapid exponential growth, or global market leadership in the long term	** Market share	“we already have customers in 87 countries and our aim is to become the global leader in [chosen market segment]...”

First, the *institutional and market contexts* that are identified as important in recognition of entrepreneurial opportunity (e.g., Wood & McKinley 2010) are also important factors in entrepreneurial growth ambitions. The target markets differ among the studied startups, for example, in terms of size, geographical focus, phase, and network effects. Moreover, some markets are highly institutionalized, which constrains the growth of new ventures (e.g., due to laws and regulations). On the one extreme, there are markets of online networking platforms, mobile applications, and games, which have strong network effects. For example, in the mobile game markets, the potential growth can be exponential and extremely rapid: through established channels startups can reach millions of customers on the very same day that a product is launched. Moreover, there are

widely known entrepreneurial success stories from Finland in game markets (e.g., Rovio and Supercell), which increases the legitimacy of the game industry and clearly shows the potential for exponential growth and businesses worth of billions of euros. An entrepreneur's perception of the market potential and barriers are therefore partly defined by success stories from the specific market, but also by the success of other players in a comparative market (e.g., aiming to become the Uber of market X).

Second, some companies made *business model design choices* (Osterwalder & Pigneur, 2010; Teece, 2010) that notably influenced the scalability of their business. For example, the business was either highly labour intensive (e.g., consulting) or the distribution, sales, or mar-

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keting were very labour intensive (e.g., selling to local governments). As a result, entrepreneurs described their business as regionally focused and targeted for city-by-city or country-by-country growth (e.g., “next we will focus on establishing footholds in Sweden and China”). In these cases, entrepreneurs had often realized the limitations of their business model. Accordingly, their growth expectations were mostly moderate and, although they aimed to be international players, the ideal scale of the business was somewhat limited. Given that the impression given by these startups was that they were satisfied with creating profitable businesses in smaller geographical areas, the question remains whether the lack of growth ambition drives a certain type of entrepreneurs to build their business on non-scalable business model?

Third, our data confirm previous research (e.g., Mitchell et al., 2008) showing that growth ambitions strongly depend on the entrepreneurs' *personal characteristics and previous experiences*. Our data provides three initial insights in this area. For one thing, those entrepreneurs who have previous international experience or a strong entrepreneurial mind-set seem to be inclined to seek faster international growth. For another, those startup founders that are “forced” to become entrepreneurs due to (threat of) unemployment, also referred as necessity entrepreneurship (Block & Koellinger, 2009) seem to have more modest growth expectations as compared to “opportunity entrepreneurs” that have started businesses not because of fear of unemployment, but because of a tempting business opportunity that they have identified. Lastly, startup founders' understanding of the institutional constraints in the targeted organizational field may explain their growth ambitions, especially in the early stages of entrepreneurship. Initially, it seems that those early-stage entrepreneurs who do not deeply understand institutional arrangements in the field may have more positive growth expectations than those who are more familiar with the specific barriers and constraints related to creating business in that particular field.

Resulting from varying personal characteristics and experiences, our data shows goal incongruence (Vancouver & Schmitt, 2006) between founders, implying that, in a new venture, some of the co-founders may have significantly different growth expectations than other co-founders, which may also differ from the startups' “official” goals. Our study hints that differing opinions between entrepreneurial founders within a single company seem to be largely based on the personal characteristics, risk-averse behaviour, and perception of

barriers to growth. For example, in one of our cases, one founder said “[in five years] our goal is to have product in the market, but this is my personal perspective, and our CEO has a more optimistic view”.

Finally, growth ambitions seem to be refined by the *entrepreneurs' perception of the expectations and actions of external stakeholders* who either directly or indirectly provide support in commercialization and scale-up of the business. In some cases, a prerequisite for external funding was to steer business to new high-growth markets, thereby external stakeholders were aiming to increase the growth ambition level. However, if the external steering was done forcefully, our impression was that it did not have significant impact on the real growth ambitions of the entrepreneurs. In some other cases, external stakeholders did not directly force the entrepreneur, but the entrepreneurs nonetheless experienced normative pressure that impacted their expression of growth ambition. For example, from the funding perspective, entrepreneurs even joked that you need to have at least three slide decks with different growth projections: (pessimistic/realistic) steady growth projections for banks, middle-of-the-road estimations for the public funding authorities, and overly positive for business angels and venture capital organizations.

Our data implies that the observed behaviour is related to variance in institutional logic and expectations of different types of investors. On the one hand, regulative and normative institutional forces limit risk taking of traditional banks in favour of steady growth instead of gambling for big returns. On the other hand, private investors' portfolio investment strategies are based on high risk and high returns, and therefore they are not usually interested in investment opportunities with low or moderate long-term growth estimates (Feeny et al., 1999). Our findings suggest that entrepreneurs who participate in the activities of a startup ecosystem learn about these institutionalized rules and templates that constrain investment decision making, which leads them to emphasize different aspects of their growth estimates when meeting different investors and funding organizations. Thereby, *public funding and private external funding* can have substantial impact on the growth strategy of startups.

Startup *incubators and accelerator programs* are another potential source that may increase an entrepreneur's growth ambitions. First, they usually need to show some level of growth orientation to be accepted into these programs. Second, discussions and potential

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co-residence with other growth-oriented startup entrepreneurs, and guidance and inspirational talks from successful entrepreneurs may be an inspiration for higher-growth ambitions. Our interviews and document analysis also provide hints that *press and media attention* may increase the expressed growth ambitions of startups. In general, extreme cases receive the most media attention, and thereby it may be good strategy for an entrepreneur to emphasize ambitious goals when looking for optimal media visibility.

### *Theoretical implications*

The numerous studies on entrepreneurial growth ambition form an extensive body of knowledge. This stream of research has been mainly focusing on the objective measurement of the level of growth ambition, where the measure has usually been the number of people employed by the company (e.g., Hermans et al., 2015). Our research departs from the mainstream on two points. First, we view the phenomenon from the constructivist perspective (see e.g., Bouchikhi, 1993) and claim that growth ambition should not be seen as single number; rather, it is a more *complex socially constructed phenomenon* that emerges from complex interactions between entrepreneurs, their previous experiences and expectations, and other actors and institutional contexts (formal rules, norms, and cultural-cognitive beliefs). Entrepreneurs continually construct their entrepreneurial goals and visions through interactions within their social groups, and when they are exposed to new people, their ambitions may change. They also continuously learn about appropriate and acceptable ways of expressing growth ambitions in different contexts, regardless of their true intentions. Thereby, an entrepreneur may present to potential investors that they want to build a hyperscalable business that will become “the next Google”, but at the same time they may be secretly applying for a more secure job at a large corporation. The level of growth ambition also depends on the perspective of observers as two different people evaluating growth may have different normative views and cultural-cognitive scripts that guide their evaluation. All this leads to the conclusion that there can be several co-existing views on the level of growth ambition, and one view does not need to be judged as true or false.

Second, our study highlights that the concept of *growth* is interpreted differently among entrepreneurs. For many Finnish startup entrepreneurs, growth is still about expanding the business to international markets, which can be considered as a quite conservative view on growth in a small nation that has always relied heavily on foreign trade. Even though all startups are focus-

ing on digital product and services, in a business-to-business or business-to-government context, there is in many cases a lot of work that requires physical presence and therefore the perspective is: “how do we expand to the next geographical area”. For entrepreneurs whose business relies on global digital delivery channels, the growth ambition can be very different. For them, country-by-country growth is not necessarily relevant, although country-specific customization might still be an issue (e.g., due to different languages). However, they are more focused on how many users or customers they have, and how they can grow the user/customer base while keeping their operational efficiency at a high level. In contrast to previous research, our findings clearly indicate that growth in terms of number of employees is not necessarily the main target for technology startups. Instead, many of the startups we studied aim to build their businesses such that the scalability of their businesses are not strongly linked to the number of employees, and the possibility of becoming a large hierarchical organization is seen as a threat to long-term success.

### *Practical and policy implications*

This work supports the national and local policy makers responsible for new venture funding and decision makers of startup ecosystems (e.g., managers of accelerator programs) who design and offer supportive actions for startup entrepreneurs. Our study helps these actors to better understand the differences between startups that operate in different institutional contexts, that perceive different pressure and constraints, and that have different levels of ambition and goals for their business. Based on our study, it is neither realistic nor beneficial to expect the same level of growth ambition from startups that aim for different types of markets by executing business models that are very different from the scalability perspective. Moreover, the entrepreneurs’ previous and current social contexts can be seen as social constructs that define informal rules on how growth ambitions are expected to be expressed. Thereby, understanding the diversity of startups helps to tailor specific support to the different types of startups or helps to recognize which startups would benefit most from the provided support.

The study also has practical implications for entrepreneurs. First, individuals considering jumping onto the path of entrepreneurial innovation can gain a better understanding of the varying perspectives and expectations within a startup ecosystem regarding growth. Second, startup entrepreneurs who already are on the entrepreneurial innovation path can learn from the ex-

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pressed growth ambitions of other entrepreneurs and benchmark their growth ambitions relative to other entrepreneurs.

## Limitations

One of the main challenges in conducting research that aims to reveal the delicate issue of ambition level, which might for example impact greatly on a startup's funding, is how to ensure that the data will be reliable. We acknowledge that entrepreneurs learn how they are expected to express their growth ambitions in different social contexts and in some cases it may be difficult for a researcher to create sufficient trust within a short timeframe to overcome this learned behaviour. Even though a startup investment event is assumed to be a context where entrepreneurs are expected to overemphasize their growth ambitions, only very few startups showed very high growth ambitions. This finding may indicate that a researcher is seen as a more impartial actor even though the setting for the interview is an investor event. Regardless of the truthfulness of their answers, due to the socio-constructivist stance, our aim is not to find a single objective truth about the level of growth ambition, but to create better understanding about the phenomenon by exploring different views and explanations that are embedded in the different social contexts experienced by entrepreneurs.

## Conclusion

During the last few decades, there has been significant interest in entrepreneurship research that examines how individual-level factors correlate with entrepreneurship and commercialization behaviours (e.g., Nelson, 2014). This article focuses on entrepreneurial growth ambitions and takes a socio-constructivist view on answering the question: what kind of growth do technology entrepreneurs aim for and why there are differences in growth ambition levels? Our data from the context of the Finnish startup ecosystem provide empirical findings that the concept of growth differs between startups. For some companies, growth is geographical expansion, for others it is more about num-

ber of users or customers, regardless of their origin. For most of the startup companies we studied, growth in terms of the number of employees is not the goal, which may be somewhat contradictory to the goals of the policy makers that aim to increase employment in general.

We contribute to the theoretical discussion by suggesting that growth ambitions should be seen as a more complex socially constructed concept than just an easily observable value defining the level of ambition. In our cases, growth ambitions were influenced at least by the perception of market potential and the social context they are embedded in, the scalability of the business model, personal characteristics and background of entrepreneurs, and their perceptions of the barriers and constraints of the field. We claim that different types of startup companies have different needs and therefore the support provided to those startups should be different. It is also worth considering whether all kinds of startups need equal support.

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**Keywords:** startups, growth ambitions, entrepreneurial innovation

# Managing Innovation Ecosystems to Create and Capture Value in ICT Industries

Jarkko Pellikka and Timo Ali-Vehmas

*“Great discoveries and improvements invariably”  
involve the cooperation of many minds.*

Alexander Graham Bell (1847–1922)  
Scientist, inventor, and a founder of Nokia Bell Labs

In a new knowledge-intensive economic landscape, firms need to access external knowledge sources due to their inability to generate all necessary knowledge on their own. The interaction with and learning from external knowledge sources implies that firms depend upon decisions and actions made by business partners and external support organizations. This network of linkages can be considered as an ecosystem in which commercial enterprises and non-firm organizations interact with one another and work together to create and capture value. Previous studies have shown that a firm's ability to successfully commercialize a new product depends not only on its own technology strategy but also its capabilities to manage an innovation ecosystem strategy. Dynamic markets, intense competition, and shorter product lifecycles force companies across different industries to create and capture value more rapidly by launching new innovations. Well-defined and executed innovation ecosystem strategies can help companies to develop new markets and business opportunities for the different types of innovations and enable their businesses to grow. This study provides new insight into how an ecosystem strategy can be formed based on the traditional strategy literature and proposes a conceptual framework for senior leaders to form an ecosystem strategy.

## Introduction

Capability to create new innovations is important for both large and small companies to enhance growth. In order to achieve this, an organization must have: i) in-depth understanding of innovation dynamics, ii) a well-crafted innovation strategy, and iii) well-designed processes for innovation, with iv) the innovation ecosystem and external collaborators that will enable it to bring in complementary assets to the innovation process (see e.g., Adner, 2006; Teece, 2007; Pellikka, 2014). In order to co-evolve capabilities, to incorporate a new round of innovations, and to satisfy changing customer needs, many companies have started to seek new business opportunities with the other key players. This article focuses on the "innovation ecosystems" that can be defined as a network of interconnected organizations that is organized around a focal firm or a platform, and incorporates both production- and use-side participants, and focuses on the development of new value through innovation (see Autio & Thomas, 2014). This

definition goes beyond the current thinking by addressing the challenges and opportunities emerging via digitalization, new developments in information and communications technologies (ICT) and new resources such as big and small data.

Working cooperatively with other players such as private and public organizations and consumers as a quadruple helix (Arnkil et al., 2010) provides companies new ways to take advantage of other organizations' technologies, processes, and brands. Adding consumers as the fourth type of actor in the helix also introduces a new type of system dynamics to the existing ecosystem models. Research on ecosystems applied to human multi-actor assemblages is only emerging based on, for instance, the observed nature of the different types of ecosystems (Valkokari, 2015) or their different dynamics and network structures (Ali-Vehmas & Casey, 2012). Along with new opportunities, however, the emerging network of dependencies between the different parties of the innovation ecosystems also presents a

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new set of risks and uncertainties that need to be taken into account when managing and developing the desired innovation ecosystems. Systems thinking, ecosystems, and digitalization have become a core element in several industry sectors where firms seek new ways to accelerate growth (Adner, 2006). The capability of a group of companies to adapt to the changes in the market and at the same time maintain a high degree of productivity requires collaborative structures and styles between the organizations that would ultimately determine whether the group is only a group of independent self-driven but cooperating companies or a resilient business ecosystem (Crespo et al., 2014).

In today's dynamic business environment, an organization's capability to catalyze the emergence and guide the development of a business ecosystem offers increasing potential as a powerful source of competitive advantage that underlines the importance of ecosystem strategies and their execution (e.g., Rohrbeck et al., 2009; Williamson & De Meyer, 2012). For example, Adner (2006) highlighted that depending on others in the innovation ecosystem has two important strategic implications: timing of market entry (i.e., getting to market ahead of your rivals is of value only if your partners are ready when you arrive) and resource allocation (i.e., allocating resources externally to the relevant partners can be more effective than allocating resources internally). In addition, Williamson and De Meyer (2012) listed six ways organizations can realize the benefits of the ecosystem: i) pinpointing the added value, ii) structuring differentiated partner roles, iii) stimulating complementary partner investments, iv) reducing transaction costs, v) enabling flexibility and co-learning, and vi) engineering value-capture mechanisms. However, it is not clear how organizations should use these approaches in different types of ecosystems. Moreover, companies must understand the potential impact of digitalization and digital technologies on their strategy to create and capture value both at the organizational and ecosystem levels (Bharadwaj et al., 2013). Therefore, organizations must be able to identify in greater detail the key value-creation elements, drivers, and constraints (Ali-Vehmas & Casey, 2015; Davidson et al., 2015).

Taken together, the perspectives described above led us to formulate the main research question of this study:

*What are the key differences between business strategy formulations based on a single company and innovation ecosystem perspective?*

This article provides a conceptual setting of a new research project that is designed to answer this research question by identifying an extended set of strategies for innovation ecosystems and their stakeholders, including multiple dependencies. The aim is to complement the large body of research on value creation and capture a single-company perspective. The article is organized as follows. First, we present the key concepts of the study and the relevance of the ecosystem and collaboration strategies. Then, we describe our conceptual analysis and the project's preliminary findings. Finally, we describe key managerial implications and avenues for future research.

## Key Concepts

Collaborative models depend on multiple different factors such as the logic of action (Valkokari, 2015). However, if and when ecosystems follow different logic, the collaboration between the ecosystems becomes a new, higher-level challenge of a system of systems, including the fact that companies may be members of different ecosystems at the same time. Therefore, we must first summarize the three key concepts – namely knowledge, benefits, and innovation – that will form the basis of our conceptual analysis of innovation ecosystems.

### *Knowledge*

Knowledge and information have become primary wealth-creating assets of firms; they are essential for innovation management and for developing and maintaining competitiveness. According to the systemic view of innovation, the search for and acquisition of technological knowledge and information should be regarded as a process in which a number of agents interact with each other and their external socio-economic environments (e.g., Lundvall, 1992). In the knowledge-based economy, companies are particularly dependent on the knowledge resources of other firms and organizations. The competitiveness of a firm in a dynamic business environment depends on the competitive quality of its knowledge-based assets and the successful application of these assets in operational activities in order to fulfil its strategic objectives (Teece et al., 1997). Efforts to acquire (and apply) knowledge can be implemented via contributions by universities, research institutes, government agencies, suppliers, clients, and other companies. The success of a company in turbulent markets depends on its ability to further develop, implement, and maintain – as well as exploit – the combination of the internal and external sources of knowledge and data (e.g., Pellikka, 2014).

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## Benefits

The potential business benefits for a private company engaging in inter-organizational collaboration can be summarized as follows:

1. *Increased profitability.* Collaboration can enable a firm to obtain necessary skills or resources more quickly than developing them in-house (Harper & Georghiou, 2005). When a dynamic technology market is changing rapidly, firms may want to avoid committing themselves to fixed assets that may rapidly become obsolete, which is a common challenge for instance in the modern pulp and paper industry.
2. *Shortened time to market.* Obtaining some of the required capabilities (e.g., for research and development activities) from the business partners rather than building them in-house can help a firm, for example, to reduce its financial asset commitment and therefore enhance its flexibility. This might be especially important in small technology firms, where financial resources may be limited (Lawton-Smith, 2004; von Hippel & von Krogh, 2006).
3. *Enhanced innovation capability and learning.* Collaboration with partners can be an important source of learning for the firm (Lawton-Smith, 2004). By transferring and pooling their technological know-how and resources, firms may be able to expand their knowledge bases and competences (e.g., Allocca & Kessler, 2006).
4. *Expanded market access.* Firms may also collaborate to facilitate the creation of a new standard (Schilling, 2008) when there is a need for regulation or to address a larger base of customers. Collaboration in the development phase can be a crucial way of ensuring partnering in the commercialization phase of a technology, and such cooperation (e.g., via standardization) may play a highly important role in securing compatibility and reducing market uncertainties.

## Innovation

Innovations result from a complex, interactive, and interdependent process involving multiple actors and influences within dynamic systems, rather than arising exclusively from the internal research and development activities of commercial enterprises. Inter-organizational collaboration can provide a strong basis for the generation of innovation, and provide other potential benefits, such as facilitating access to new technology and entry to new markets through licensing

(Chiaroni et al., 2008). Carayannis and Campbell (2009) evaluated the key concepts that have played a role in the formation of the knowledge-based economy and in knowledge creation. They highlight that the conceptual settings have changed in many ways and therefore there is a need to understand the new ways in which knowledge production, utilization, and renewal take place in the knowledge economy. They define a 21st Century innovation ecosystem as "a multi-level, multi-modal, multi-nodal and multi-agent system of systems" and state that "the constituent systems consist of innovation meta-networks (networks of innovation networks and knowledge clusters) and knowledge meta-clusters (clusters of innovation networks and knowledge clusters) as building blocks" (Carayannis & Campbell, 2009). Continuous forming, re-forming, and dissolving are characteristic of the innovation ecosystems due to the fractal interplay of the diverse institutional, political, technological, and socio-economic domains including government, universities, industry, non-governmental organizations, as well as the consumers who are applying the new digital information and communication technologies.

## Conceptual Analysis

In order to analyze the linkage between traditional business strategy and the innovation ecosystem perspective specifically, we started our analysis by summarizing the traditional strategy-related literature (see Table 1). Traditionally a corporate strategy can be defined as "a pattern of decisions that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals, and defines the range of business the company is to pursue, the kind of economic and human organization it is or intends to be, and the nature of the economic and noneconomic contribution it intends to make to its shareholders, employees, customers and communities" (Andrews, 1980). A successful business strategy requires a fit between all the elements discussed in the literature. The same is valid for innovation ecosystems but in a different way. As a practical contribution for senior leaders, Table 1 also lists key questions that complement the traditional strategy literature by highlighting the role of ecosystems, inter-organizational collaboration, and open innovation approaches that have been especially enabled by technological developments and digitalization. Analyses of the collaborative networks based on systems thinking and system dynamics can provide additional projections to the strategic problems related to ecosystems and also to system-level collaboration between the ecosystems.

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**Table 1.** Questions arising when an innovation-ecosystem strategy perspective is applied to the traditional business-strategy literature

Dimension	Traditional Business Strategy	Innovation Ecosystem Strategy
<b>Vision</b>	<ul style="list-style-type: none"> <li>Does our organization have a vision that is clear, consistent, and understandable?</li> </ul> <p>(Davidson, 2005; Mintzberg &amp; Quinn, 1996)</p>	<ul style="list-style-type: none"> <li>Has our organization developed a vision of how an innovation, product, technology, or service could become an essential part of a business ecosystem?</li> <li>What different roles does digitalization play in our business strategy?</li> </ul> <p>(Bharadwaj et al., 2013; Gawer &amp; Cusumano, 2014)</p>
<b>Industry &amp; Business Environment</b>	<ul style="list-style-type: none"> <li>What are the key characteristics of our industry and the current business environment including inter-organizational structures?</li> <li>How can we win given the competitors in the potential field available to us?</li> </ul> <p>(Christensen, 2002; Mintzberg &amp; Waters, 1985; Porter, 1980)</p>	<ul style="list-style-type: none"> <li>What are the impacts of our actions on our strategic partners in terms of their performance in the ecosystem?</li> <li>What collaboration models exist in the target industries and which one is best aligned with our corporate innovation model?</li> <li>How do the current value systems work and how they may change in the future?</li> </ul> <p>(Ali-Vehmas &amp; Casey, 2012; Easley &amp; Kleinberg, 2010; Iansiti &amp; Levien, 2004)</p>
<b>Goal Setting</b>	<ul style="list-style-type: none"> <li>Are all our efforts directed toward clearly understood, decisive, and attainable goals against which we can measure our progress?</li> </ul> <p>(Martin, 2010; Mintzberg &amp; Quinn, 1996)</p>	<ul style="list-style-type: none"> <li>What are our key business objectives and key performance indicators that we are trying to achieve via partnerships in our ecosystem?</li> <li>How can we measure value creation and capture in our ecosystem?</li> </ul> <p>(Adner, 2006; Teece, 2009)</p>
<b>Resources &amp; Capabilities</b>	<ul style="list-style-type: none"> <li>How should our firm's resources be allocated to create an exploitable advantage?</li> <li>What capabilities are necessary for our firm to build, maintain, and continuously improve competitiveness?</li> </ul> <p>(Helfat &amp; Peteraf, 2003; Peteraf, 1993; Teece et al., 1997)</p>	<ul style="list-style-type: none"> <li>Have we identified the key organizations in our ecosystem that can provide us with, for example, technology-related assets, funding, or other complementary assets for our business?</li> <li>Have we agreed upon a configuration and valuation of contributions (i.e., knowledge, products, channel)?</li> <li>What open innovation approaches can we use to combine internal and external assets into effective architectures and systems that will generate innovations?</li> </ul> <p>(Dittrich &amp; Duysters, 2007; Doz &amp; Hamel, 1998; Enkel et al., 2009; Laursen &amp; Salter, 2006; Nambisan &amp; Baron, 2012; Williamson &amp; De Meyer, 2012)</p>
<b>Organizations &amp; Systems</b>	<ul style="list-style-type: none"> <li>What kind of organizational structure, management systems, and mechanisms do we need to operate, build, and maintain the key capabilities and create value for our shareholders and customers?</li> </ul> <p>(Caves, 1980; Miles et al., 1978; Payne &amp; Frow, 2005)</p>	<ul style="list-style-type: none"> <li>What is the operational scope of inter-organizational collaboration that defines the activities and tasks jointly performed by our partners?</li> <li>How will the ecosystem activities and regular interactions between the organizations be governed?</li> </ul> <p>(Doz &amp; Hamel, 1998; Gilsing et al., 2008; Perrons, 2009; Schilling, 2008)</p>

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## Conclusions and Managerial Implications

A traditional view of a strategy stresses the external dimension from the point of competition instead of inter-organizational collaboration to seek growth and commercialize innovations. In contrast, the ecosystem view has been relatively neglected in the traditional strategy literature. We suggest that an individual company's business performance and capabilities to capture the value of innovation are increasingly dependent on its capabilities to manage assets and resources outside its direct control and therefore innovation-ecosystem strategy perspectives such as co-creation, networking, and interaction with innovation-ecosystem partners plays a crucial role (see also Iansiti & Levien, 2004; Wu, 2012). We also recommend that increasing collaboration in an ecosystem can provide the early signals of significant technological and industrial reconfiguration or a "technology shock" (i.e., technological and business model changes that affect production outcomes through either different types of new innovations or major improvements of the existing ones) (see also Iansiti & Levien, 2004; Schilling, 2015). Thus, executives should systematically identify the organizations with which the future is most closely intertwined and determine the network of dependencies that will contribute to business growth and renewal.

Our study also highlights the importance of a common vision among the innovation ecosystem participants, which leads to alignments with goal settings and a preferable industry and business environment for the overall innovation. In addition, the decisions related to resource allocations and using shared capabilities via collaboration are also crucial to meet the actual expectations of all the ecosystem participants. For the leading company in an innovation ecosystem to tap into the innovative capabilities of an ecosystem of external firms, it needs to: i) develop a vision for the innovation ecosystem and promote it among potentially key players, ii) build a sufficiently open or modular architecture to facilitate ecosystem-wide innovation, iii) carefully manage innovation ecosystem relationships that are mutually beneficial for participants, and iv) continue evolving the ecosystem to remain competitive as challengers emerge (see also Autio & Thomas, 2014; Gawer & Cusumano, 2014; Iansiti & Levien, 2004). However, it is important to note that the different roles of different types of organizations in the innovation ecosystem – where ambitions of knowledge ecosystems and business ecosystems may conflict – are crucial ecosystem-specific concerns. Strong reactive competition inside an ecosystem represents positive feedback and makes

the ecosystem oscillate whereas internal consensus-seeking coordination is a negative feedback process (i.e., a stabilizing element). The ecosystem leader may, however, want to increase competition among other parties in order to maintain its leading position and further enhance structures to be mutually beneficial for the ecosystem participants (see also Perrons, 2009). Strong control mechanisms are not needed in fully voluntary collaborative ecosystems where all the participants share the common evolutionary views related to all the factors of Table 1, but in disruptive innovation ecosystems, the alignment may not be achieved automatically.

As for further avenues for ecosystem research, there is an obvious need to understand the role of the collaboration networks in more detail where the structure, characteristics, and dynamic changes in the collaboration may happen without any conscious action of any innovation ecosystem participant. The role of the weakest link as a hindering point for growth may be more important than the strength of the leading company. Furthermore, digitalization has shortened the delays in information and knowledge networks and the same is now taking place in business delivery networks. The stability – or deliberate instability – of the ecosystems may also cause concerns. Although single-company strategies can assume the internal networks in a company to be well understood based on the organizational hierarchies, the situation in innovation networks is fundamentally different. In addition, when externally observed, ecosystems need positive network effects, which will increase the dynamic output of the ecosystem. External competition can make the ecosystem internally more coherent and it can motivate large investments and therefore more capabilities for the ecosystem to compete and improve. In addition, since the 1990s, the emergence of open innovation approaches due to, for example, digitalization, market dynamics, and dispersed value chains has also challenged the traditional view of business strategy.

Across many firms spanning different industries and sectors, digital technologies (viewed as combinations of information, computing, communication, and connectivity technologies) are fundamentally transforming business strategies, business processes, firm capabilities, products and services, and the ways in which companies are forming and implementing their ecosystem strategies (see e.g., Easley & Kleinberg, 2010). Therefore, the impact of digitalization on business strategy and further developments is essential to take into account in forthcoming studies (both qualitative and

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quantitative). In addition, the observations of this study can be used to selected use cases, for instance in the area of digitalized healthcare. The analysis uses the digitalized data as the value-creating asset rather than traditional assets of a physical nature such as equipment and labour. The data consists of any data, information, knowledge, and even wisdom collected, developed, and utilized in the use cases by the ecosystem participants. The simple network model based on the data is used to understand the dependencies between the ecosystem stakeholders and to identify the borders of the ecosystems. If there is an actor who traditionally has been part of the value chain but actually neither contributes nor utilizes any digital data, the actor may not be relevant in the digitized projection of the ecosystem.

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**Keywords:** innovation ecosystem, management, strategy, network, value capture

# Boundary Objects as Part of Knowledge Integration for Networked Innovation

Sari Mäenpää, Anu Helena Suominen, and Rainer Breite

*“All knowledge is connected to all other knowledge. The fun is in making the connections.”*

Arthur Aufderheide (1922–2013)  
Paleopathologist

Networked innovation in co-creation networks is not possible without collaborative practices. Especially in complex projects, contextual knowledge is often spread among different stakeholders. To harness this dispersed knowledge for networked innovation, working knowledge management and collaborative practices are needed. This article addresses this need for better understanding and approaches to facilitate knowledge integration for networked innovation. We consider knowledge integration as the ability to put knowledge into action, and networked innovation as the co-created goal-driven output of selected partners. Our study focuses on describing and reporting a cross-learning type of expert knowledge-integration process with boundary objects, concrete or abstract “bridges” for overcoming possible knowledge boundaries, in a co-creation network. This article adds knowledge on networked innovation through knowledge integration with boundary objects. The reported process will help managers to systematically approach problems requiring expert knowledge that does not exist within their own organization and to better integrate knowledge required for innovation within their project networks.

## Introduction

When problems arise in a project, particularly in an industrial R&D project, they can quickly become quite complex due to the number of participating actors, changing situations and demands, insufficient know-how, and a requirement for prompt knowledge sharing in the face of global competition. Solving complex problems often demands new solutions through innovation. The expert knowledge of individuals is an essential component of organizational innovation (Amabile, 1998); yet, expert knowledge can be dispersed within an organization, and sometimes lies beyond the organization's boundaries. In complex cases, the needed knowledge can be a combination of tacit, personalized expert knowledge that is spread across multiple stakeholders. Tacit knowledge, which is personal, context-specific, and hard to formalize, cannot be transferred but must be shared in social interaction (Nonaka, 1995). Therefore, to yield networked innovations that are goal oriented, brought

about in a process open to selected participants in co-creation from tacit knowledge, knowledge management processes must be in place to support knowledge sharing (Valkokari et al., 2012). Such knowledge management processes encompass, for example, knowledge integration (Lee & Yang, 2000). In practice, knowledge integration (Grant, 1996) is an ability to put knowledge into action; therefore, active doing is an imperative part of the process (Tiwari, 2015). In the literature, knowledge integration is approached by either relying on structural mechanisms or enabling cross-learning that emphasizes frequent communication and extensive mechanisms based on knowledge sharing (Enberg, 2012). Our view is based on the latter, because knowledge integration through cross-learning aims at integrating knowledge that resides in individuals (Enberg, 2012) by bringing people together to share knowledge in co-creation. In other words, the cross-learning type of knowledge integration as a knowledge management process constitutes a platform for learning and knowledge sharing.

## Boundary Objects as Part of Knowledge Integration for Networked Innovation

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We found innovation process studies showing that a diverse set of stakeholders are scarcely collaborating simultaneously (Kazadi et al., 2015). Yet, according to West and Bogers (2014), co-creation has been studied in an open innovation context to some extent. However, Valkokari and colleagues (2012) state that knowledge co-creation between firms and the knowledge owner's motivation to share knowledge are more narrowly studied subjects. In their model of networked innovation, which includes transaction networks and co-creation networks, they point out that knowledge management and collaboration practices should be different in those two network types. Particularly in co-creation networks, the collaboration is more exploratory and is aimed at creating new knowledge. However, they stress that the concept of networked innovation is not yet complete, having identified a research gap in terms of how networked innovation relates to the knowledge management and collaborative practices.

There is literature regarding knowledge integration (e.g., Baxter et al., 2013; Enberg, 2006, 2012; Mitchell, 2006; Tsai et al., 2015) and its three stages: knowledge identification, knowledge acquisition, and knowledge utilization. Tiwari's (2015) study revealed that knowledge coordination is also an important intermediate process of knowledge integration, especially in a multi-stakeholder environment, which presupposes collaboration. Furthermore, in an inter-organizational setting, besides common knowledge and understanding (Grant, 1986), knowledge integration requires overcoming organizational boundaries (Carlile, 2004). This boundary spanning can be done with the help of concrete (Star & Griesemer, 1989; Star, 2010) boundary objects, such as maps, repositories, and standardized forms, and metaphorical (Koskinen, 2005) boundary objects, such as figures of speech. Tiwari's (2015) model of knowledge integration, including the three stages of knowledge integration together with coordination and collaboration as intermediate processes, was empirically studied in one transaction type of network. Therefore, the model's applicability to co-creation networks should also be studied, including the role of boundary objects as potential boundary-spanning elements.

Our study examines the knowledge management process of networked innovation in a co-creation network in an R&D-project context. The focus is on the cross-learning type of knowledge integration process and the role of boundary objects in spanning the boundaries between organizations. This article describes the know-

ledge integration process, its outcomes, and feedback from the case process. Tiwari's (2015) knowledge integration process model is used as a theoretical basis for the case of networked innovation efforts. The process aims to enhance communication, knowledge sharing of versatile expertise, and collaboration demanding endeavours by identifying and utilizing various boundary spanning objects and activities. Therefore, the article also presents the various boundary objects applied in the knowledge integration process, and discusses their usability from the viewpoints of different stakeholders, such as internal and external experts, suppliers, and customers.

Our study features two research questions:

1. *Given that collaboration and knowledge management practices in co-creation networks yielding networked innovation should be different from transaction networks, is the Tiwari's knowledge integration model applicable also for co-creation networks?*
2. *What kind of boundary objects can enhance communication and knowledge sharing in a knowledge integration process in co-creation networks yielding networked innovation?*

Our case of the knowledge integration process was carried out in the context of a temporary R&D and innovation project in an industrial organization's network. A co-creative process was put into practice with multiple inter-organizational stakeholders and facilitated by external facilitators (university researchers).

The article is structured as follows. In this introduction, we have justified the need to further test Tiwari's knowledge integration process as a knowledge management process for networked innovation in co-creation networks. Next, we discuss the literature regarding knowledge, knowledge integration based on communication, and knowledge sharing together with networked innovation and boundary objects. The method and case description follow the use of single empirical case study (Dyer et al., 1991; Siggelkow, 2007; Weick, 2007) applied in a networked innovation context. Next, we describe the results by portraying the knowledge integration process with boundary objects together with the stakeholder feedback and the networked innovation outcomes. Finally, we contemplate the usability of the further developed knowledge integration process and conclude with some practical and managerial implications.

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### Knowledge, Innovation, and Knowledge Integration

#### *Knowledge*

Polanyi (1966) identified two distinct types of knowledge – explicit and tacit – which interact in individuals (Nonaka, 1995). Explicit knowledge can be codified, and is thus transmittable in formal, systematic language, whereas tacit knowledge is personal and context-specific, and is thus hard to formalize and communicate (Nonaka, 1995). Therefore, there are also different knowledge management strategies for organizations: i) codification for explicit knowledge, which links people to documents and ii) personalization for tacit knowledge, which links people to people (Hansen et al., 1999).

Another relevant characteristic of knowledge is its mobility. Knowledge mobility is the “ease with which knowledge is shared, acquired, and deployed within the network” (Dhanaraj & Parkhe, 2006). In other words, knowledge moves whether being transferred (Szulanski, 1996) or shared (Nonaka, 1995).

#### *Networked innovation*

Innovation is a process that encompasses the transformation of valuable ideas “into new forms of added value for the organization, customers, employees and stakeholders” (Merx-Chermin & Nijhof, 2005), or invention into action within the organization (Martins & Terblanche, 2003). Our view on innovation is based on its process-type characteristic of transformation. Organizational innovation is intertwined with the creativity of individuals in organizations (Amabile, 1997). Besides motivation and creative thinking skills, one of the three components of human creativity is expertise, which includes technical, procedural, and intellectual knowledge. Here, we concentrate on the form of expertise that manifests as expert knowledge.

Organizational innovation requires combining different types expertise (Amabile, 1998), but innovation sometimes requires organizations to cross organizational borders to gain access to ideas (Amabile et al., 1996) and knowledge (Enberg, 2012). Depending on the willingness and opportunities for spanning organizational boundaries, innovations can be either closed, open (Chesbrough, 2004), or networked (Valkokari et al., 2012). In networked innovation, interdependent but independent network actors co-produce the innovation outcome (Valkokari et al., 2012). “Networked innovation occurs through relationships that are negotiated in an ongoing communicative process, and which relies

on neither market nor hierarchical mechanisms of control” (Swan & Scarbrough, 2005). According to Valkokari and colleagues (2012), networked innovation has three collaboration characteristics: i) it includes multiple actors and is seldom open to everyone, ii) it happens always for a specific purpose, and iii) the models deal with both the knowledge transfer and co-creation functions between actors. Depending on their knowledge management needs, there are two types of networks focusing on transaction of explicit knowledge (i.e., transaction networks) or co-creation of new knowledge (i.e., co-creation networks). Our view concentrates on networked innovation in co-creation networks, which means that the network process is open to selected participants, has a specific aim (for new knowledge), and is focused on co-creation between actors. Even though a lot of research on co-creation exists, few studies cover the diverse set of stakeholders collaborating simultaneously in the innovation process (Kazadi et al., 2015).

#### *Knowledge management processes for innovation: knowledge integration*

Innovation networks are described as loosely coupled systems of autonomous firms (Dhanaraj & Parkhe, 2006) with properties of sparseness, asymmetry, and locally clustered with low diameter (Cowan & Jonard, 2009). However, “project business is the part of business that relates directly or indirectly to projects, with a purpose to achieve objectives of a firm or several firms.” (Artto & Wikström, 2005) Those firms form a project network, which is a network “including several firms and other organizations from different businesses and from different institutional environments that are participating in a project” (Artto & Kujala, 2008). Project networks have a temporary nature: “they exist in that specific form only during the time-line of a single project” (Artto et al., 2008). Thereby, similarly to networked innovation, project networks have various organizations cooperating, none of which have a completely dominating role and an aspiration toward precise and specified objectives; however, project networks are distinctively temporal in nature (Tiwari, 2015). Therefore, rather than using the term “innovation network”, we use the term “project network” because we want to emphasize the task-specific combination of organizations, the goal orientation, and the temporal nature.

When project networks produce innovations, they need various knowledge management processes, such as knowledge integration, as introduced by Grant (1996). Enberg (2012) defines knowledge integration as a “goal-oriented process with the purpose of taking advantage

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of knowledge complementarities which exist between individuals with differentiated knowledge bases” (Enberg, 2012). Knowledge integration is needed when knowledge is specialized and dispersed among individuals. Knowledge integration can be enabled by the use of different integration mechanisms. In the knowledge integration literature, there are two main approaches. One relies on structural mechanisms and downplays the need for communication and knowledge sharing. The other, the cross-learning approach, emphasizes the need for knowledge integration mechanisms that are based on frequent communication and extensive knowledge sharing (Enberg, 2012). Our view is based on the latter approach: cross-learning.

According to Tiwari (2015), past studies have revealed that knowledge integration in project networks basically includes a three-stage process of knowledge identification, knowledge acquisition, and knowledge utilization, which all should be seamlessly and efficiently integrated in order for a project network to successfully achieve its goals in a dynamic environment. Tiwari (2015) has based her framework on those three stages (Figure 1). The emphasis on knowledge integration in a project network is in the ongoing collective process facilitated by social engagements. That is, knowledge integration is the ability to “transform know-

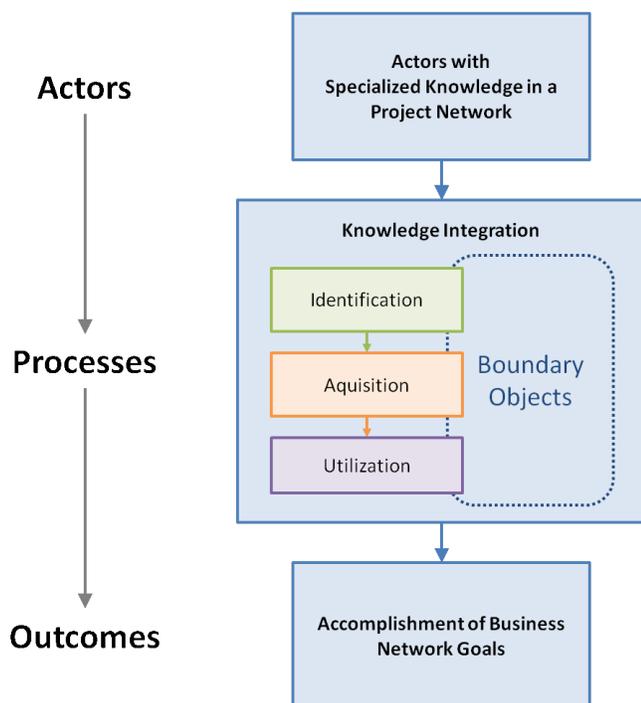
ledge into action” (Tiwari, 2015). Thus, Tiwari also emphasizes the significance of coordination and collaboration, because in some cases, for example where the required expert knowledge (for complex problem solving) resides within multiple professionals, plain knowledge acquisition is neither sensible nor adequate.

Inter-organizational knowledge integration requires common knowledge and understanding (Grant, 1986), therefore it also requires overcoming the possible knowledge boundaries between organizations (Carlile, 2004). To overcome these knowledge boundaries, boundary objects are needed and should be taken into account when designing processes for knowledge integration. Boundary objects are “a sort of arrangement that allow different groups to work together without consensus” and are the “stuff of action” (Star, 2010). In other words, boundary objects aid the collaboration of various experts by letting them communicate and work on a target that is not yet mutually perceived. Besides being concrete, boundary objects may also be metaphorical and intangible, such as figures of speech or re-naming a concrete phenomenon in an illustrating manner, yet even so can play a significant role, especially in the sharing of tacit knowledge and understanding between people (Koskinen, 2005).

Tiwari has framed her model and empirically tested it in a large project network with a “transaction network” type of explicit knowledge transfer. Although our focus is on co-creation networks, the general nature of Tiwari’s model allows us to use it as our theoretical framework and then expand it with the use of boundary-spanning elements (boundary objects).

### Method and Case Description

We chose a case study approach (Dyer et al., 1991; Siggelkow, 2007; Weick, 2007) to further develop and test the knowledge integration process for networked innovation in project networks. First, we examined the literature on networked innovation theory, knowledge management processes (including knowledge integration based on communication and knowledge sharing) and boundary objects. Then, we selected a networked innovation project as the case study. The particular project (described below) was chosen because of its idiosyncrasy: it involved multiple stakeholders collaborating simultaneously, which is rare in research on innovation processes (cf. Kazadi et al., 2015). Therefore, having participants from multiple corporations concurrently yielding a real-life networked innovation with significant impacts on the whole network gives unique



**Figure 1.** Knowledge integration in a project network (adapted from Tiwari, 2015)

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information about knowledge integration for networked innovation. Thus, the case is interesting from both academic and practical viewpoints.

Tiwari's model was tested by observing one focal company from a point early on in its quest for a solution to a major production-automation problem and the related subsequent series of workshops in its project network. Workshops as a setting for yielding networked innovations presume that learning will occur via active participation and involvement, because workshops have many benefits for interactive learning and teaching in small groups. Workshops typically also facilitate problem solving, decision making, communication skills, and "thinking on your feet" (Steinert, 2010). For studying knowledge integration, workshops provide the needed observable collaborative environment in which the same information in the same form (by utilizing the same boundary objects) is conveyed to all participants simultaneously, further allowing concurrent communication. Thus, workshops create opportunities for the creation of collective understanding.

The research material was gathered from multiple sources. The entire chain of events and workshops were observed by three researchers and recorded as memos. By using the memos, the process of the workshop series and its resemblance to Tiwari's model was detected.

Also, the networked innovation outcomes, as well as the boundary objects, were discovered by the researchers during the workshops. The information on the relevance of both the knowledge integration process and the discovered boundary objects were collected from the project network stakeholders through a "Webropol" online survey. The online survey included a questionnaire with 57 questions, 52 evaluations on the scale of 5 (completely agree) to 1 (completely disagree), and 5 open-ended questions regarding:

- the problem area, the workshops such as the amount of events and their scheduling, and the boundary objects
- cooperation with others and with other organizations in workshops and during the process
- gaining of new knowledge from the workshops, utilizing the gained new knowledge, and the effects and follow-up of the new knowledge

The link to the online survey was sent to all 26 different participants of various workshops. We received only 7

responses, however, they were from different stakeholders: two were from focal company representatives, two were from suppliers, and three were from research partners. The survey material was analyzed using spreadsheet computation. Both the data collection and analysis were carried out in both research material and researcher triangulation because three researchers participated in all of the workshops and material collection as well as in the analysis.

### *Case description*

The concrete case of networked innovation was carried out in a multi-stakeholder project. The multi-stakeholder environment included a multi-national industrial production company as the focal company, its three suppliers, one customer, and university researchers from various fields. The focal company is a large global machinery producer, and the project involved the participation of one of its subsidiaries, a world-class machinery production unit, which produces products that are more unique than mass production pieces. The turnover of the subsidiary is 500 million euro, it employs 600 people, and it delivers maritime products worldwide: indeed, 99% of its products are exported. The customer involved in this case is a vast foreign shipyard with various operations. The technology supplier is family-owned industrial forerunner, with system deliveries to 50 countries, exporting 90% of its products with yearly turnover of 35 million euro, with 136 personnel. The two other suppliers were subcontractors that deliver large metal machinery pieces. One subcontractor was family-owned, employing over 100 people, with yearly turnover of 20 million euro. The other employs approximately 70 people, with turnover of 15 million euro. The university researchers were from two technical universities and included experts on manufacturing technologies, production processes, and industrial engineering. The facilitators were three researchers with industrial and knowledge management backgrounds.

The industry in which the focal company operates is quite conservative, thus the changes are slow, yet their change effects, including economic effects, are significant. The focal company was in need of expert knowledge regarding the implementation of automation in the production process, which they did not possess internally. Therefore, stakeholders were brought together to collaboratively innovate in a complex product and production process development project. The networked organization (i.e., the case company) contemplated a major manufacturing investment that would alter their production process, and early on they no-

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ticed that they did not have all the internal capabilities needed to come up with decisions required by the investment. In a process aiming to accomplish a functional solution for a production system, which later expanded to include new product solutions, the goal of the case was to integrate the various types of expert knowledge that would benefit not only the focal company but the entire network. The process involved various operations of the focal company (i.e., internal stakeholders, such as R&D, procurement, and production). The customers, the suppliers, the technology supplier, and the research institutes operated as external stakeholders (Figure 2).

The knowledge integration case aiming at networked innovation was carried out in a project of temporary R&D and innovation that concerned product and production process development within the network. In the project, a new production method was introduced to the focal company and its stakeholders. This new production method required both deployments of a new technology and changes to the product design, too. Consequently, the new product design had implications to the production processes of the suppliers. As neither the focal company nor its suppliers were familiar with the newly selected production technology, both product and production changes required acquiring new technical expertise, possibly from university researchers and technology suppliers. Thus, the chain of requirements led to a collaborative, co-creative devel-

opment process with multiple stakeholders participating workshops and thus necessitating knowledge integration that rested on communication and knowledge sharing.

### Results

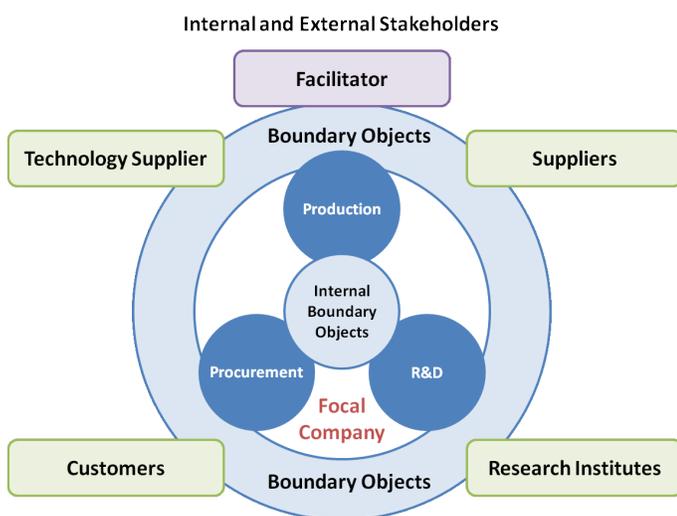
Our results were generated from: i) the knowledge integration process in co-creation network with the used boundary objects and ii) the results of an online survey with respondents from the various stakeholder organizations of this co-creative process. The questionnaire within the survey dealt with the practical relevance of expert knowledge integration process as well as the six boundary objects and activities applied in the process. The results also cover the business network accomplishment of the knowledge integration process: the networked innovations.

#### *The expert knowledge integration process with boundary objects*

The knowledge integration process had three main phases, corresponding to Tiwari's (2015) model: knowledge identification, knowledge acquisition, and knowledge utilization. However, these three main phases could be broken down to a further eight stages when knowledge integration is carried out in co-creation network for networked innovation (Figure 3).

In the first part of the "knowledge identification" phase, the main problem was clarified in the focal company internally. Next, "coordinated knowledge identification" was carried out in collaboration with the focal company and the facilitator (the university researchers), aiming at locating the needed and available external know-how. Then, in the "coordinated knowledge acquisition" phase, the expert knowledge was coordinated by the facilitator by mapping and contacting the appropriate experts. The next five stages, ideation, innovation, analysis, conclusions, and proposals, and the actions of "knowledge utilization", included wider multi-stakeholder participation. In this final phase, there were three workshops:

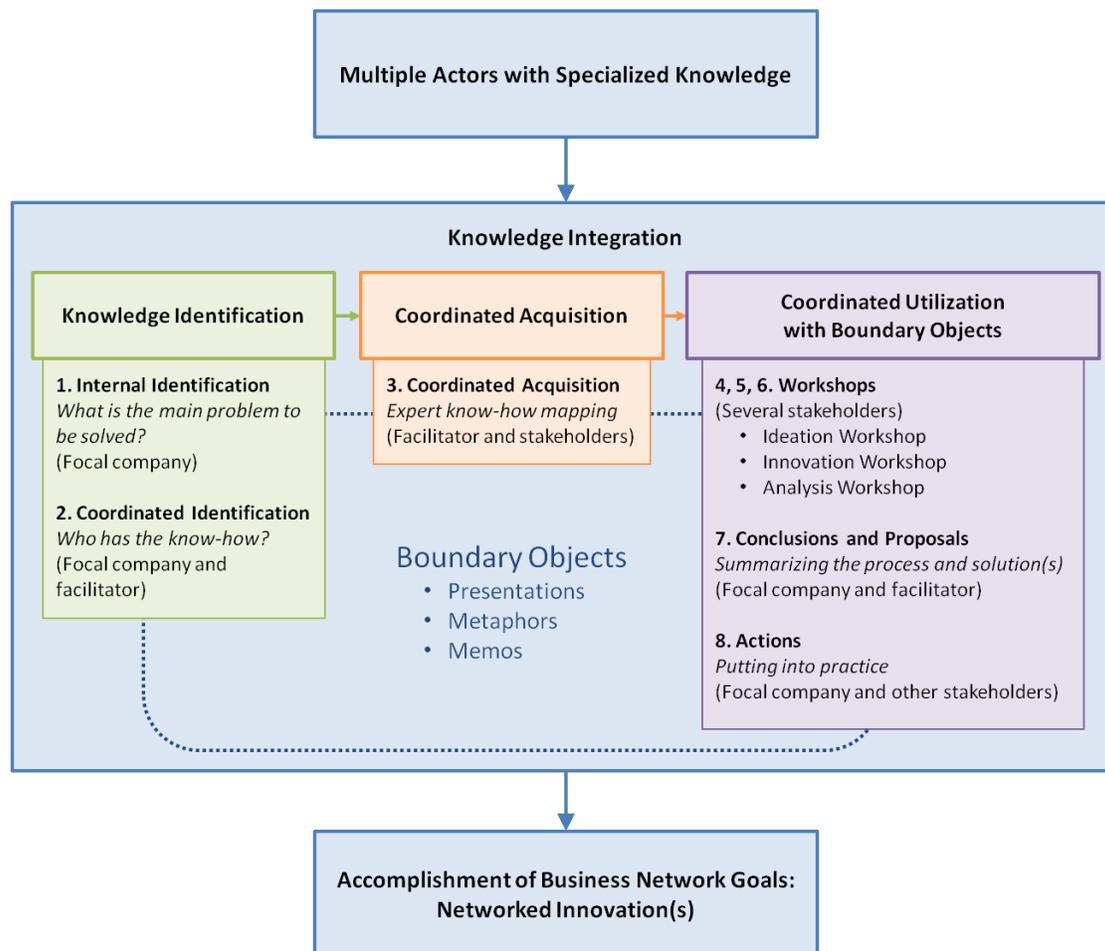
1. *Ideation*: In the first workshop, a common mindset was created by open discussion with five focal company representatives and seven technical university experts with two presentations of the problem area. The plan for the further workshops and the topic to be covered was created.



**Figure 2.** Case context: networked innovation carried out in a multi-stakeholder project with boundary objects

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**Figure 3.** The knowledge integration process for networked innovation in a co-creation network

2. *Innovation:* In the second workshop, the focal requirements and objectives in relation to the problem at hand were discovered with the help of boundary objects of six expert presentations, two metaphors, and a memo prepared and distributed right after the workshop. Altogether 21 people participated in this workshop.
3. *Analysis:* The ideas were analyzed and sorted in the final workshop, by discussion again with the help of boundary objects of three supplier presentations, two metaphors, a factory tour, and a memo prepared and distributed right after the workshop. Altogether 17 people participated in this workshop.

After the workshops, the solutions, as well as the knowledge integration process, were summarized in close cooperation between the focal company and the facilitator. In the final stage, “actions”, the created

knowledge was put into practice: the solutions of the knowledge integration process were utilized, depending on each separate stakeholder.

Within the three multi-stakeholder workshops (ideation, innovation, and analysis) of “knowledge utilization”, six boundary objects (four concrete and two metaphorical), were discovered and used. The concrete boundary objects included workshop memos, pictures and blueprints, presentations, and a factory tour (in the third workshop). The metaphorical boundary objects were “Metaphor 1”, representing the new structure to be developed and “Metaphor 2”, representing the former structure. In the co-creation network, where the aim was to produce networked innovation, the boundary objects were particularly useful in the knowledge utilization phase, where the knowledge is actually put to use. This finding supports Tiwari’s (2015) perception of the emphasis on knowledge integration in a project

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network being the ongoing collective process through social engagements and knowledge integration being the ability to “transform knowledge into action”.

### *Feedback: The practical relevance of the knowledge integration process and applied boundary objects*

Feedback from the case process was gathered through an online survey. The questionnaire included questions about the number and duration of joint events, the ability of joint events and workshops to support and increase knowledge sharing, as well as impressions about cooperation with others during the process. According to the feedback, the number and duration of joint events were sufficient. The joint development events were found useful for creating new knowledge, sharing knowledge, and increasing openness between stakeholders. This kind of multi-stakeholder knowledge coordination and collaboration was also found to be a useful way of solving similar problems in the future. However, information given prior to the events as well as the collaboration between companies and universities, and between universities was evaluated lower than other aspects of the entire process: this information was found to be inadequate and did not help the participants to prepare for the meetings.

Feedback about the boundary objects used in the case process was also gathered through the online survey. All of the applied boundary objects were considered useful in terms of the overall evaluations. The boundary objects that were most helpful in clarifying the problem in the workshops were pictures and blueprints. Presentations were also deemed similarly helpful, but to a lesser extent. Additionally, the metaphorical boundary objects of “Metaphor 1” for the new structure and “Metaphor 2” for the former structure also helped clarify the problem. Memos from the three workshops and the factory tour were considered less effective boundary objects. However, due to the small sample size – only seven participants responded to the online survey – the differences were not statistically significant. But, the results suggest that providing or producing vivid illustrations of the problem to be solved would be helpful, especially if the problem is a technical one. Also, creating a metaphor or two of the problem or generated solution may advance the discussion and comprehension. From a process development viewpoint, the feedback on the process used in the case was very encouraging: participants at the focal company informed us that this networked innovation process may next be applied to other development projects within the company.

In summary, by applying various boundary spanning objects and activities, this knowledge integration process shows promise for enhancing communication and knowledge sharing of versatile expertise in endeavours demanding collaboration. The process is also potentially applicable to other types of networked innovation situations.

### *Networked innovation outcomes: The manifestation of the knowledge integration process in practice*

In practice, the outcomes of the knowledge integration process take the form of networked innovation of new technical solutions and operating models. However, the process outcomes also emerge as new business opportunities. Table 1 presents the case customer company’s objectives, the external stakeholders’ contributions, and the corresponding outcomes of knowledge integration process.

As shown in Table 1, the main networked innovation outcomes (i.e., the main outcomes for the project network of the knowledge integration process) are:

- a new product structure to be produced using automation, resulting in cost savings with, for example, diminished production times and improved quality and relocation of component production to subcontractors
- new research tasks and business cases between suppliers as well as universities and suppliers
- awareness of a new method for integrating knowledge during multi-actor collaboration, which can be used in other cases as well

Noteworthy in the outcomes is that not only the focal company gained from the process but other organizations in its network too. Both suppliers and universities found new projects to collaborate on in the future.

To sum up the results, Tiwari’s model, with its three major phases of knowledge identification, knowledge acquisition and knowledge utilization, was applied to the knowledge integration process for networked innovation in a co-creation network. However, the three knowledge integration phases were divided into eight smaller stages. For networked innovation in a co-creation network, when the emphasis is on communication and cross-learning requiring boundary spanning, the model does benefit from the use of boundary objects, especially in the knowledge utilization phase. The boundary objects applicable to enhancing communica-

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**Table 1.** Objectives, contribution, and outcomes of the knowledge integration process

Case Company's Objectives	Outcome(s)
More intensive supplier participation in customer's R&D activities	Supplier involvement in knowledge integration workshops – continuing in the future
Integration of R&D activities into manufacturing activities	More open internal discussion, opening up towards suppliers
Improved networking ability	New business cases between suppliers as well as between universities and suppliers
External Stakeholders' Contribution	Outcome(s)
Ideation based on specialist views	Common interest detected; focal company's main problem formulated
Value analysis and alternative technical decisions based on scenarios	New product structure stated
Forming a standard connection plan; ideation of cost-effective manufacturing decisions for suppliers	New product structure enabling cost savings (e.g., diminished production times and improved quality, requiring increased focus on assembly, shifting component production to subcontractors)
Research Unit's Contribution	Outcome(s)
Model/framework/way of acting for future co-operation	A new method: knowledge integration with multi-actor collaboration; can be used for cooperation in other cases as well

tion and knowledge sharing in co-creation networks yielding networked innovation were both concrete and metaphorical. Furthermore, providing or producing vivid illustrations of the technical problems at hand were found useful. Also, creating metaphors relating to the problem or generated solution advances the discussion and comprehension in the co-creation process. Additionally, the co-creative knowledge integration process yields multiple types of networked innovations, not only concrete solutions for products and production processes but also new links between stakeholders, thus creating opportunities for further collaboration in business and research.

## Discussion and Conclusion

### *Theoretical contribution and limitations*

This article contributes to the concept of networked innovation by highlighting the knowledge management processes involved. The contribution regards the expert knowledge integration in co-creation networks by enhancing Tiwari's knowledge integration model with boundary objects. The significance of the boundary ob-

jects is to enhance knowledge and organization boundary spanning within the knowledge integration among multiple stakeholders.

Although a co-creation network was a new environment for testing Tiwari's knowledge integration model, naturally this study does have its limitations. The empirical testing was carried out with a single case in a co-creation network; other networks and network types should be involved in future studies and in the further development of the process. Also, the online survey was completed by only seven people, which limits our scope for statistical analyses. Additionally, in this case, six boundary objects were discovered and used; however, other cases might bring forward other usable boundary objects to study.

We presume that the findings will benefit academics studying knowledge management practices, including knowledge integration, especially in the context of collaborative and networked innovation by highlighting the role of the boundary objects as the knowledge and organization boundary-spanning elements. Prior re-

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search has shown that the cross-learning type of knowledge integration provides a platform for learning and knowledge sharing. Our results emphasize that communication, which is essential in cross-learning type of knowledge integration, can be enhanced with boundary objects.

### *Practical and managerial implications*

Practitioners operating in industrial settings, particularly in those relating to industrial product and production process development, who are aiming to enhance innovation operations by involving various stakeholders, may benefit from this study. In some cases, losing control of core capabilities or information might be the downside of open innovation, but in our case, the networked innovation process with knowledge integration in a project network worked and generated the desired results for the focal company and its stakeholders. This finding might encourage other innovation-requiring companies to open up their closed innovation system to other stakeholders, such as suppliers, customers, universities, and research institutes, while still keeping control over their company's confidential and core capabilities.

Additional information on the character of networked innovation showed that the co-creative knowledge integration process yielded another type of output beyond product and production process changes or enhancement: new links between stakeholders. Thus, it creates opportunities for further collaboration both in business and research. This knowledge might encourage other stakeholders to participate in networked innovation cases, where the direct gain for the company or research institute could be hard to anticipate in advance.

A real-life co-creation network case with substantial impacts on the whole network gives unique insights about knowledge integration for networked innovation. In practice, setting up networked innovation is easier when the companies and project networks have a mechanism that enables learning and collaboration: an environment or platform, such as a process or method, which guides them through a chain of events and

brings the stakeholders together to share their knowledge, which in many cases is tacit. Therefore, this study gives general guidelines on how to kick off the networked innovation. Yet, the process is flexible and can be adjusted to the problem and network at hand.

### *Further research*

Networked innovation as a concept and its knowledge management processes need further research; our approach to knowledge integration is just one of many potential approaches. Also, Tiwari's model of knowledge integration process needs further testing at least in co-creation networks and potentially also with transaction networks. In our case, the discovered boundary objects were both concrete and metaphorical. Some of the boundary objects were found to be more applicable than others, and this finding contributes new knowledge of the use of boundary objects in knowledge integration. Yet, there is a wide range of usable boundary objects to be further studied in co-creation networks aiming to yield networked innovation. We find our results encouraging, and we hope that they will encourage others to undertake further research along these lines.

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# Boundary Objects as Part of Knowledge Integration for Networked Innovation

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**Keywords:** networked innovation, co-creation network, knowledge integration, cross-learning, boundary object

# The Concept of the Entrepreneurial University Applied to Universities of Technology in Austria: Already Reality or a Vision of the Future?

Martin Sperrer, Christiana Müller, and Julia Soos

“ *The biggest risk is not taking any risk...  
In a world that is changing really quickly,  
the only strategy that is guaranteed to fail  
is not taking risks.* ”

Mark Zuckerberg  
Founder of Facebook

The concept of the "entrepreneurial university" is now recognized as a major driver for self-development and innovation and as an appropriate response to succeeding in highly turbulent and unpredictable markets. This article outlines and evaluates the current implementation of this concept at the universities of technology (TU) in Austria. First, to evaluate the status quo, a review of existing programs and initiatives was undertaken at the three universities comprising the "TU Austria": TU Graz, TU Wien (Vienna), and MU Leoben. Second, a questionnaire was designed on the basis of the HEInnovate framework and sent to representatives of the three universities and resulted in responses from TU Graz and TU Wien. The results underscore that the model of the entrepreneurial university represents the next step of development in higher education. Moreover, it demonstrates that there is still room for improvement at the TU Austria, especially in terms of fostering an entrepreneurial spirit among students.

## Introduction

The idea of launching a startup company has surely crossed every person's mind at least once: becoming an entrepreneur promises personal fulfillment, interesting challenges, as well as financial success... if you are lucky. In Austria alone, 37,120 startup companies were founded in the year 2014 (BMWF, 2015). Although this number seems to be high, the entrepreneurial activity in Austria is still low compared to "entrepreneurial countries" such as the United States (Singer et al., 2014). Especially from technical degree programs, only very few alumni decide to become entrepreneurs. This might be due to the lack of programs in the field of entrepreneurial education. The European Commission (2008), however, claims that it is technical and creative students that would benefit most from an entrepreneurial education. The European Commission goes even one step further and states that most of the innovative and useable ideas are coming from non-business studies (European Commission, 2008). In order to foster

innovation and entrepreneurship across Europe, they created the European Institute of Innovation and Technology (EIT) in 2008. Within knowledge and innovation communities (KICs), the EIT brings together diverse partners (e.g., universities, research labs, companies) to develop innovative products and services, found companies, and so on (EIT, 2016). The universities of the TU Austria ([tuaustria.ac.at/en/](http://tuaustria.ac.at/en/)) participated in this initiative and were either coordinating a knowledge and innovation community or were partners in one. For example, TU Graz was coordinating a knowledge and innovation community focusing on sustainable energy and climate change mitigation, whereas both TU Wien and Montan University Leoben were partners in one focusing on raw materials. Another valuable network is the Conference of European Schools for Advanced Engineering Education and Research (CESAER; [cesaer.org](http://cesaer.org)) – a non-profit association of leading European universities with the goal to foster excellence in engineering education and research and innovations through close cooperations with industry.

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The model of the "entrepreneurial university" is currently recognized by experts as a major driver for self-development and innovation and as an appropriate response to succeeding in highly turbulent and unpredictable markets (Hannon, 2013). Consequently, the question arises: should the topic of "entrepreneurship" be reinforced in higher education? To answer this question, this article examines the current implementation of the concept of the entrepreneurial university at the TU Austria. Furthermore, it investigates possible improvements of the existing entrepreneurial approaches. The respective research questions that this investigation addresses are:

- *How is the concept of the entrepreneurial university defined and who are the stakeholders of this concept?*
- *Is TU Austria already entrepreneurial?*
- *In which way(s) could the implementation of the entrepreneurial university be improved in the TU Austria?*

The investigation highlights the essential points about the discussion on the entrepreneurial university and provides a list of tools for entrepreneurial approaches. As far as existing entrepreneurial approaches in higher education in Austria are concerned, this article presents and discusses the results of a status-quo investigation among the TU Austria universities. Based on the collected information, it evaluates the current situation and offers specific recommendations for improvement. Future students (including potential entrepreneurs), as well as the academic and administrative staff of the TU Austria universities, stand to benefit the most from this study because it focuses on these institutions, but the general findings will also be of interest to equivalent stakeholders outside Austria. Therefore, this article is of interest to all universities that would like to understand how to become an entrepreneurial university and how to overcome implementation obstacles.

### Literature Review: The Concept of the Entrepreneurial University

Researchers generally agree on the high potential of entrepreneurial universities in today's highly turbulent and unpredictable markets (Hannon, 2013). However, there are critics who doubt that the technical sector is the right place to implement an entrepreneurial university because the concept includes numerous elements of business education and it influences the autonomy of the universities (Krimsky et al., 1991). In

addition, the model corresponds to an image of perfection that everyone wants to achieve but few know how to implement. The entrepreneurial university is a multifaceted process of continuous improvement; therefore, it is also difficult to define strict guidelines for its implementation (OECD, 2012). Given that the diversity of entrepreneurial approaches taken by universities is one of the concept's most important features (Fayolle & Redford, 2015), a clear definition would be likely unachievable. However, for the purpose of our investigation, it was necessary to identify the salient features of the concept. The European guiding framework for entrepreneurial universities, called "HEInnovate", is published by the OECD and the European Commission and includes the most important features for self-assessment of higher-education institutions (OECD, 2012).

Despite the lack of a clear definition, the literature distinguishes between the entrepreneurial university, which is a concept that affects all parts of higher education, and "entrepreneurial education". The latter term is applied at all levels of education and could be seen as a component or tool of the entrepreneurial university. Also, within an entrepreneurial university, two important actors need to be distinguished: the academic entrepreneur and the entrepreneurial academic (Alexander et al., 2015). Academic entrepreneurs are academics that engage "in formal commercialization activities which often result in patent creation, license sales and or the creation of new ventures and spin out firms". In contrast, entrepreneurial academics participate in a wider range of activities that link the university with other organizations, particularly in industry. Thus, the entrepreneurial university is not just a new version of business programs with the aim to launch startups. It is more like an attitude that opens new possibilities for students as well as faculty members. Certainly, these are not the only groups who benefit from this model; there are many different stakeholders (see Box 1). The motivation of entrepreneurial academics plays a particularly important role in connecting different stakeholders.

Although we have some idea of the key features of the entrepreneurial university, what is lacking is knowledge of the best ways to develop and implement new programs. There is also a lack of information regarding Austria, where only a few studies (e.g., Daxner & Kailer, 2009) consider the current national situation and, to our knowledge, none specifically reference the concept in relation to Austrian universities of technology.

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**Box 1.** Stakeholder trends reflecting a shift toward the entrepreneurial university (cf. Gibb & Haskins, 2014)

### *Traditional stakeholders/funders*

- research funders
- public higher education funding bodies
- central government
- peer assessment groups

### *Emerging dominant stakeholders*

- students
- parents
- councils and boards
- schools and colleges

### *Increasingly prominent stakeholders*

- alumni
- international agencies
- development agencies
- local government and community
- associations/non-governmental organizations
- academic institutions
- media
- business

In Austria, as elsewhere, different types of institutions provide entrepreneurial education. Austrian universities, for instance, have worked hard to become more entrepreneurial and have recently started to include the concept of the entrepreneurial university in their strategies. Nevertheless, entrepreneurship at the TU Austria is still in the early stages of development, and Austria generally lags behind other countries in establishing entrepreneurial approaches in higher education. For example, concerning the technical field in Europe, the University of Twente in the Netherlands has a long entrepreneurial history and has come very close to what we would consider an entrepreneurial university. Therefore, we undertook intensive research into the programs offered by the University of Twente in order to collect proven concepts.

Outside of Europe, the Massachusetts Institute of Technology (MIT) is an example of best practice in implementing the entrepreneurial university concept. The Martin Trust Center for MIT Entrepreneurship was founded in 1990 and offers more than 60 courses on a variety of topics. MIT follows a team-based approach with the focus on problem solving and a close connection with companies. The success is reflected in the

numbers: in the first decade of the 2000s, MIT alumni started about 12,000 new firms and 18,000 are projected for the current decade. (Roberts et al., 2015) The success of MIT's entrepreneurial activities is a combination of several factors, such as excellent interdisciplinary research and research in practical fields, a strong network that includes ties to government and industry or the commitment to entrepreneurship programs (O'Shea et al., 2007).

### *Stakeholders of the entrepreneurial university*

Following the famous triple helix model from Etzkowitz and colleagues (2008), the interest groups of the entrepreneurial university can be condensed to three key stakeholder categories: university, industry, and government. However, as can be seen in Box 1, the stakeholders are as multifaceted as the entrepreneurial university itself. Key stakeholders include, for example, the local government and the community, which can bring substantial benefits to the entrepreneurial university. It has been shown that entrepreneurs mostly take action in the region they have studied and, as a consequence, the local area can experience a boom (Kulicke & Görisch, 2003). Therefore, locals should be very interested in implementing this model. And that is just one example: benefits like this can be found for all kinds of stakeholders. Current students as well as internal university stakeholders such as faculty members also benefit from and contribute to the entrepreneurial university. Professors can act as mentors for startups and may also realize their own ideas in cooperation with their students. Within an entrepreneurial university, close relationships are established with companies, which help ensure that students receive an up-to-date and relevant education. Nevertheless, some companies may view new academic ventures as potential competitors and might prefer to limit the roles of universities to research and consulting services (Etzkowitz et al., 2000). However, this outdated view is completely contrary to the concept of the entrepreneurial university and would restrict economic progress.

### *The HEInnovate framework*

One of the essential parts of the questionnaire consists of the HEInnovate framework, which also concentrates on higher education (HE). This self-assessment tool for implementing the model of the entrepreneurial university was developed by the European Commission and the OECD to support higher education. Using this tool, a university can rate itself on a scale ranging from 0 (very weak) to 10 (very strong) in the following seven areas (European Commission, 2011):

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1. Leadership and governance
2. Organizational capacity, people, and incentives
3. Entrepreneurship development in teaching and learning
4. Pathways for entrepreneurs
5. University–business/external relationships for knowledge exchange
6. The entrepreneurial university as an internationalized institution
7. Measuring the impact of the entrepreneurial university

For our questionnaire, we were able to adopt the framework without needing to tailor it to the Austrian context by using the detailed specifications as offered by the framework.

## Methodology

Our studied involved four main steps:

1. First, we clarified how the multifaceted entrepreneurial university is defined in the context of Austrian universities of technology. To do this, we conducted a detailed review of the relevant literature based on recommendations and online searches using the keywords “entrepreneurial education”, “entrepreneurial university”, and “stakeholders of the entrepreneurial university”, as well as each keyword in the context of TU Austria, TU Wien, TU Graz, and MU Leoben.
2. Next, we examined current practices to improve access to entrepreneurship for students and academic staff of Austrian universities of technology. By reviewing online information provided by the universities, we were able to create mind-maps of TU Graz, TU Wien, and MU Leoben that showed their programs and relationships with other institutions. Afterwards, we used the mindmaps and our literature review to create a list of relevant questions to include in a questionnaire customized to each university. The following questions were posed:
  - When was the first time that students/employees of your university were confronted with the topic of “entrepreneurship”?
  - To what extent (percentage) are students and employees aware of programs known that support entrepreneurship?
  - Currently, there is a trend of becoming an “entrepreneurial university”. What does your university do to meet this model?

3. In the third step, we presented a customized questionnaire – including the mind-map, HEInnovate framework, and additional questions – to a contact person at each university. Each person completing the questionnaire held the same or a comparable position (i.e., head of an institution) at their university and was familiar with their university’s strategy. We also ensured that the respondent was already familiar with the relevant concepts of the entrepreneurial university and technology transfer.
4. Finally, we received and analyzed the responses from the representatives of TU Graz and TU Wien, including any gaps that were identified in the mind-maps. Unfortunately, the representative of MU Leoben did not provide a completed questionnaire.

## Results

The results provide insights into what is actually being done in terms of implementing the concept of the entrepreneurial university in two universities of technology in Austria. Table 1 provides an overview of the self-assessment provided by the representatives of TU Graz and TU Wien. Notably, these results show strong similarities in the answers relating to the HEInnovate framework.

One of the few differences appeared in the first segment, which asks whether entrepreneurship is a major part of the university strategy. In the point system of the HEInnovate framework, which ranges from 0 (very bad) to 10 (very good), the TU Wien gave itself an 8 for this segment, whereas TU Graz gave itself a 4. Nevertheless, despite TU Graz giving itself such a low score, we identified several points within the TU Graz strategy that align with the characteristics of an entrepreneurial university. And, regarding their commitment to implementing the model of the entrepreneurial university, both universities give themselves a high ranking.

Concerning faculty autonomy, both universities placed themselves in the lower half of the scale. Here, the university representatives see room for improvement.

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**Table 1.** Overview of current practice at TU Graz and TU Wien

TU Graz	Segment	TU Wien
○	Entrepreneurship is a major part of the university strategy	+
+	Commitment to implementing the entrepreneurial university	+
○	Autonomy of the faculties and units	-
⊕	Flexibility	⊖
-	Financial strategy to support entrepreneurial development	○
○	Faculty staff receive special training and is motivated (with rewards)	-
⊖	Implementation of entrepreneurial approaches by the faculty	○
+	Collaboration with external stakeholders	+
⊕	Practically relevant training programs	-
+	Incubators	+
+	Internationalization as a key part of the university's entrepreneurial strategy	○
+	International mobility programs	+
-	Measuring the impact of the entrepreneurial university	-

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The framework answers also reveal that, unlike TU Wien, TU Graz lacks a specific finance support strategy for entrepreneurial development, but it offers proportionally more of its funding for staff and students to support entrepreneurial activities. Thus, TU Graz may be putting greater emphasis on motivating its employees to “live” the model of the entrepreneurial university. But again, both universities still have room for improvement in this area.

The results also show that the universities have developed excellent relationships with external stakeholders and incubators. For example, both universities participate in the Austrian AplusB (Academia plus Business) incubator network that works closely with the higher-education sector and includes seven sites near the different universities. This network provides launch support to startups that already have a business idea (AplusB, 2016).

However, the results also reveal shortcomings in essential areas such as idea creation, implementation of an entrepreneurial spirit, and in provision of an entrepreneurial education in general. Both universities performed badly in terms of measuring the impact of their entrepreneurial programs. Thus, the impact of entrepreneurial teaching and learning activities are not assessed.

### Discussion and Conclusion

In terms of fostering an entrepreneurial spirit and promoting entrepreneurship, the TU Austria has to make much greater efforts. By implementing mentoring systems, open spaces within incubators, and knowledge transfer centres, a network between institutions and organizations involved in the startup scene can be established. All universities of the TU Austria are already part of such networks, which are useful on the way becoming an entrepreneurial university. Nevertheless, the encouragement of an entrepreneurial spirit on the entire university campus should be an equal goal. Such an entrepreneurial spirit is helpful for students in identifying opportunities for personal growth and starting their own business as a further career opportunity (Volkman et al., 2009). The implementation of such a campus-wide spirit also has obstacles: not all students take courses in entrepreneurship and there may be a lack of entrepreneurial experience among faculty members. Furthermore, traditional (lecture-based) methods of education are not “state of the art” in entrepreneurial education. Students need access to broad opportunities for entrepreneurial education that are intensively promoted.

To further encourage the development of entrepreneurial mindsets in young people, the education system in Austria should implement entrepreneurship education tools at a much earlier stage in the education process of students. Currently, tools for entrepreneurial education and promotion of their availability starts predominantly at the master's level.

Universities in Austria should also encourage contests and friendly competitions. For example, in the United Kingdom, the National Centre for Entrepreneurship in Education launched the “Entrepreneurial University of the Year” program in cooperation with the *Times Higher Education* (Hannon, 2013). Another possibility is to start a student's club like the Cambridge University Technology and Enterprise Club (CUTEC) in Cambridge. This is a startup café that offers traineeships, promotes entrepreneurship at the university campus, and supports entrepreneurial campaigns and research (Hofer et al., 2010). To achieve even greater awareness of entrepreneurship among the students, interesting awards and prizes such as an exclusive party for the winning university could be offered.

Finally, it can be said that the model of the entrepreneurial university is already implemented in some parts of the TU Austria and is not just a vision of the future. Good cooperation with companies and with the Austrian AplusB incubator network are examples of the model is taking hold. Further entrepreneurial activities are being undertaken in the three universities of the TU Austria. For example, the TU Graz offers the course “Gründungsgarage”, where students with a startup idea receive personal coaching from experts and participate in several workshops on business plans, business models, etc. On the way to becoming an entrepreneurial university, the TU Graz started an initiative together with the University of Graz to complement each other's efforts in becoming an entrepreneurial university.

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# Q&A

Anna Trifilova, John Bessant, and Allen Alexander

## **Q.** *How Can You Teach Innovation and Entrepreneurship?*

**A.** There is a plethora of textbooks on innovation and entrepreneurship, with many universities and consultants offering courses dealing with the subject. Their goal is to enable individuals to become entrepreneurs or for their organizations to create value from knowledge (innovation). A problem with much of this educational material is that it remains rather abstract and relies on the individuals to be able to put their learning into practice. This is a stumbling point for many organizations, where learners know how they must act as a result of their training and education but they lack the ability to do it. Learners gain considerable “explicit” knowledge, they fail to gain the tacit element that helps them to apply it.

We suggest that the challenge underlying the question of “How can you teach innovation and entrepreneurship?” relates to the mode of delivery and that there is a need for different approaches that enable the conversion from explicit to tacit knowledge. To address this important question about how innovation and entrepreneurship can be taught – effectively – we have undertaken a research project called “Teaching and Coaching Innovation Innovatively”, or “TACIT” (see Box 1). Our project, however, is not a criticism of the current provision – indeed several of the individuals are part of the “traditional” delivery system. Rather, it is a recognition that such provision misses some key elements and in particular that there is a need to engage individuals in developing their personal skills to support change in their organizations. We suggest that they need to gain “tacit” knowledge, which is defined by an “ability to act”, in this case in innovation and entrepreneurship and develop the ability to realize value creation from good ideas. This, however, is a significant challenge – the contemporary models for education do not lend themselves to learning-by-doing and skills development.

In terms of state of the art, we see that learning in times of constant change increasingly challenges educational institutions and business organizations alike. In contrast to past decades, knowledge has become more complex, contexts change faster, and knowledge

is required in different contexts at the same time. Memorizing information and applying established methods within single fields is no longer sufficient where problems span cultural and functional boundaries (Brown & Vaughan, 2010; Kolb & Kolb, 2010; Mainemelis & Ronson, 2006; Thomas & Brown, 2011).

Our research focuses on the learning challenges that organizations and individuals face in developing understanding and skills for teaching, learning, and managing innovation. In particular we wish to explore the range and efficacy of different delivery modes and to provide methodologies for better matching context with such delivery modes. The design of the project reflects some core principles in innovation management: co-creation with partners and users and learning through prototyping and iterative experimentation. We will deliver several phases of work, each engaging all partners within the alliance and building on shared knowledge and experience. Below, we briefly introduce the teaching approaches for innovation and entrepreneurship that we are examining and developing inside our research project.

### **1. Storytelling**

All innovation projects, whether new concepts at the start-up stage of a new business or development projects within established organizations, require “pitching” the idea to others to secure resources, commitment, and support. This requirement places emphasis on the need to develop a compelling narrative that can unfold as the innovation develops; recent years have seen an upsurge of interest in this approach and in the tools and techniques which can support it. How could we use the skills of storytelling to improve aspects of innovation management? Making more persuasive pitches? Developing a storyboard for entrepreneurial ideas? Carrying forward useful innovation management lessons from past experience within the organization.

Our current research involves testing the use of storytelling approaches amongst a sample of inexperi-

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### Box 1. The TACIT Project

Teaching and Coaching Innovation Innovatively (TACIT) is a 3-year European Union Knowledge Alliance (2016–2018) project under the Erasmus+ programme. The objective of our project is to combine the efforts of business and university educators to create new learner-centred teaching methods, open up new learning opportunities, and develop the practical application of entrepreneurial skills. This will be framed as an innovative teaching module to be embedded in the existing curricula of higher-education institutions and in the corporate training programs.

The project is designed to develop and test mechanisms that can be used to build tacit knowledge in individuals around innovation and entrepreneurship. Our focus is not on developing a new core curriculum, but rather on taking the important elements of existing curricula and focusing on exploring more effective delivery mechanisms. In particular we are trying to capitalize on the shift in thinking towards new modes of delivery (e.g., the “flipped classroom” and the shift to massive open online courses (MOOCs)) but we are also exploring pedagogies that develop the individual’s ability to face and adapt to the innovation and entrepreneurship challenge.

The project design reflects some core principles in innovation management, including co-creation with partners and users and learning through prototyping and iterative experimentation. As people’s culture of learning is largely coined through the educational institutions, it seems natural to follow a threefold approach where research, teaching, and practice are understood as interdependent dimensions of knowledge, knowing, and learning (Sproedt & Heape, 2014). Participatory innovation (Buur & Matthews, 2008) brings these different strands together in the development and application of research-based teaching and teaching-based research for, with, and about innovation practice in organizations.

Partners in the TACIT project include: Aachen-Münchener, ASIIN, BMW, ISPIM, LEGO, Lufthansa Systems, Nokia and NHS Foundation Trust together with University of Exeter (UK); Southern Denmark University (Denmark), Leipzig Graduate School of Management (Germany) and RWTH International Academy, Aachen (Germany).

enced entrepreneurs in several different contexts including in emerging economies, among social entrepreneurs, and with students. We are evaluating different storytelling tools and supporting frameworks (including innovation theatre, scenarios and simulation, design thinking laboratories, and variants on approaches using the business model canvas) and we are developing a methodology through which the issue of such techniques can be embedded as part of entrepreneur training and support. The approach will use individual and group-based techniques to develop and communicate stories using a variety of tools. In short, storytelling could be used to:

- extend the capacity for articulating and exploring innovation projects – for example in preparing for pitching ideas
- understand, explore, and define innovation opportunities and the challenges in delivering solutions by using a narrative approach
- understand different stakeholder perspectives

### 2. Walking the Talk – Peripatetic Learning

The great Greek philosopher Socrates had an idea that neuroscientists are now supporting – we are receptive to ideas when we are moving. Couple that with a truism, that changing our context makes us see things differently – and there is the basis for a new approach to learning about managing innovation. The core approach here is to use guided walks through landscapes which are full of examples of innovation – and explore them while in the open air, walking and discussing them away from the classroom context. In our project course, the aim is to create two fundamental learning outcomes:

- understanding of a number of key innovation theories, brought to life by viewing them using real, but historic examples, for example in an industrial/natural heritage environment
- consideration of the modes of transferring knowledge and creating deep learning using a case-based learning technique – but one that is presented in an unfamiliar learning environment (i.e., not in the classroom or on company premises) to create a rewarding and a novel learning experience

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### 3. Future-Based Learning

Innovation is about creating alternative futures and a powerful set of tools exist around scenarios and other projective techniques; some of these have been embedded in powerful methodologies such as Shell's Game changer programme or the Future Agenda consortium. This strand of work will set up an Imagining the Future Laboratory – a place where participants imagine alternative futures and explore within them opportunities and challenges which can form the basis of novel product or service concepts. From these rich pictures tools for “back-casting” and road-mapping can be used to develop clear pathways to take innovation opportunities forward. This method helps the learners to:

- embed a capacity for "futures thinking" across the organization
- explore specific trends that might have a disruptive impact on the organization, and develop appropriate responses to those disruptions
- explore alternative future scenarios and work from those towards viable innovation strategies to minimize threats and maximize opportunities
- understand the role futures thinking plays in developing an organization's innovation strategy

### 4. Entrepreneur Laboratory

There has been an explosion of interest in startups and how to engage and enable new ventures. They involve developing novel value propositions and expanding them into robust business models that can realize the potential value for end users. Coupled with powerful new approaches around rapid prototyping of minimum viable products, getting early feedback to refine ideas, and pivoting towards a solution, they provide a fast track to developing and implementing innovation. But such “boot camp” models are not just relevant to startups and high-tech enterprises. They can help existing organizations rethink how they come up with and carry forward business cases. Building on the experience of partner companies such as BMW, Nokia, and Lego, this strand of work will explore in a practical way how to bring the entrepreneurial lab into the mainstream.

Using tools and techniques from the lean startup approach and developing and testing innovation concepts through agile processes such as minimum viable product, this method provides learners with:

- exposure to tools and techniques to help them develop ideas via a series of "controlled experiments" that explore and test hypotheses about markets, technologies, etc.
- understanding of the role that prototyping, fast intelligent failure, and other agile approaches play in moving innovation proposals forward
- embedded capacity for entrepreneurial thinking and behaviour across the organization
- a startup frame of thinking for larger established organizations
- traction on novel projects and the opportunity to explore, refine, and progress them rapidly

### 5. Innovation Theatre

“All the world's a stage”, as Shakespeare pointed out, and one part of that stage is where the drama of innovation is being played out. So there is considerable scope for using not only the metaphor but also some of the tools and techniques from the world of theatre to explore the characters, scripts, and scenery of innovation in different contexts – and to develop new tools and approaches to working with innovation. In particular, we will draw on experience at the University of Southern Denmark, which has worked for years on using theatre-based approaches to improve understanding and performance in real organizations.

Processes of innovation are, to a large extent, happening in the communicative interaction between the involved stakeholders. Engaging people in improvised theatre invites participants to challenge taken-for-granted assumptions and patterns of communicating, which allows emergence of something new. This method:

- immediately provides learners with new ways of interacting with each other
- enables access to a skill set different than the cognitive, judgment-driven discrimination typically honed in the business classroom
- helps practitioners generate creative responses to client demands, facilitate meetings, and offer ideas to superiors
- helps future managers develop important organizationally valued skills

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### 6. Innovation Games

Play and playfulness are increasingly being recognized as powerful aids to creativity and innovation. Engaging people in playing games can be an effective way of enabling co-innovation and collaboration. The concept of “serious play” reflects this growing interest and this strand of work will explore the different ways in which games and structured play can provide new learning opportunities to develop innovation capabilities. These might range from simple live exercises through to more structured interactions and even online and virtual world gaming. Innovation games can be used in a variety of settings, from simple workshop experiences through to extended structured games.

Through doing, making, and relating to the games, the participants iteratively learn to grasp meaning across boundaries and to create practical, usable knowledge. Games can be used for:

- initiating innovation that involves people with different agendas/perspectives
- challenging repetitive patterns/procedures of practice
- creating a shared experience of social dynamics
- team building when the experience needs to be “graspable”
- providing a group of people with a direction for their mutual collaboration

### 7. Design Making

“Design thinking” has become one of the hot topics in the innovation field in recent years, reflecting both an approach to solving problems and a wide-ranging toolkit which people can use to embrace design methods. Organizations like IDEO have demonstrated the potential of this model in a variety of public and private sector innovation contexts, and it brings important new perspectives especially around user understanding and prototyping. This strand of work not only seeks to explore the ways in which design thinking can be used in learning how to manage innovation more effectively but also looks at “design making” – the range of approaches which enable user engagement in prototyping and concept testing of various kinds.

Engaging with tangible materials in conversational interaction between people, design making helps employ-

ees move beyond abstract talking to concrete acting in iterative processes of developing the thinking and action. For participants, design making as a technique:

- creates a space for collective exploration and exchange of ideas, while giving each participant a say in the process
- supports collaboration, discussion, and reflection
- instigates relevant associations
- cultivates participants’ ability to be creative
- creates a dynamic environment that opens up diverse interpretations of the materials, where participants are allowed to share radical/disruptive ideas

### 8. Project-Based Learning

Innovation is not an academic or theoretical matter – it is the practice of turning ideas into value. And much of what we have learned has come from reflecting on projects – successful or otherwise – and pulling out relevant lessons. This strand of work will look at the ways in which structured reflection can be used to capture learning from live innovation projects, and also how we can design reflection projects to help assess and enhance innovation management capability.

When traditional learning methods fail to transport “how-to” knowledge on innovation and entrepreneurship to practitioners, the project-based learning experience helps implement new methods and tools in innovation management. Project-based learning provides a learning-by-doing approach, which allows practitioners to accumulate first-hand tacit “how-to” knowledge in the areas of innovation and entrepreneurship. Real-life innovation problems of the company are tackled by small teams who are mentored throughout the full innovation/entrepreneurship process. Along their journey, multiple innovation tools and techniques are presented, used, and evaluated. As a requirement, project-based learning should be based on a collaborative or cooperative group approach using long-term and interdisciplinary methodology. The key criteria in project-based learning are authenticity, a driving question, constructive investigations, autonomy, and room for reflection.

Applying this method for teaching innovation, participants learn to tackle real-life problems of the company by drawing from many information sources and

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disciplines. Thus, they build the capacity to successfully conduct innovation projects and also acquire the capacity to explore new innovation methods on their own. Participants gain knowledge and skills by working for an extended period of time investigating and responding to an engaging and complex question, problem, or challenge. They are immersed in an inquiry experience that gets them thinking about and questioning the topic.

### Conclusion

The needs and requirements for education are permanently evolving, hence we are exploring needs, resources, and experience on both the supply and demand side and building up a clear understanding of where and how delivery could be improved around innovation and entrepreneurship.

The experience base of the project partners has already given us a rich perspective on the strengths and weaknesses of current education and training provision in the field of innovation and entrepreneurship. In particular, it highlights the need for project and practice-centred modes of working and for novel approaches to delivery, which challenge individuals and develop capacity for action at that level. Our project builds on this, develops and prototype a series of novel approaches to delivery, targeted at developing tacit knowledge and skills in innovation and entrepreneurship.

We are exploring the above-discussed novel modes of teaching. Each method has a respected pedagogical foundation, has been already tested in pilot form as part of TACIT knowledge alliance, and we gained some understanding when partners worked on them individually, before the project was formed. We will report more in the nearest future on the results achieved from this ongoing research.

There are limits to what can be done with conventional approaches to education and training around innovation and entrepreneurship and in particular more needs to be done to develop individual capacity for action through acquiring tacit knowledge. We argue this can be delivered through mechanisms which meet needs for:

- project-based learning, linked to the real challenges participants face in trying to make innovation happen
- recognition that different modes of learning; for many practitioners classroom style theory-based approaches do not work effectively

- experiential learning, offering different ways of closing the learning cycle between theory and practice
- skills-based learning, placing emphasis on what individuals working in organizations can actually do rather than focusing only on structures and processes to enable innovation
- practice-based learning, allowing experimentation and gradual capability development through prototyping
- building understanding of core principles around which individuals can configure solutions to the innovation challenge which work in their particular context

In terms of the wider benefit to enterprises, we recognize that innovation lies at the heart of what they do, from the initial stages of start-up through to the difficulties of building on their original ideas and developing new offerings, improving their processes and opening up new markets. The challenge of establishing a healthy business able to repeat the innovation trick and deliver a steady stream of change depends not on luck but on the ability to understand and enact innovation. Meeting this challenge requires learning and capacity building around entrepreneurship skills, and it requires us to further develop our understanding of how to teach innovation and entrepreneurship effectively such that our teaching enables learners to put the lessons into practice.

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