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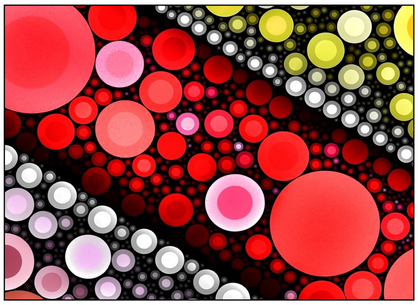
December 2014



Innovation and Entrepreneurship

Welcome to the December 2014 issue of the *Technology Innovation Management Review.* This month's editorial theme is Innovation and Entrepreneurship. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

Carleton University

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Overview

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

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

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

Contribute

Contribute to the TIM Review in the following ways:

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

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

Editorial: Innovation and Entrepreneurship

Chris McPhee, Editor-in-Chief

Welcome to the December 2014 issue of the *Technology Innovation Management Review*. This month's editorial theme is **Innovation and Entrepreneurship**.

This issue includes five articles, the first four of which are a product of our ongoing collaboration with the International Society for Professional Innovation Management (ISPIM; ispim.org), a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management. Earlier versions of these four papers were presented at the first ISPIM Americas Innovation Forum (americas.ispim.org) from 5–8 October, 2014 in Montreal, Canada.

In the first article, **Jens-Uwe Meyer**, Managing Director of Innolytics, identifies four types of innovation cultures, each of which fosters a different degree of organizational creativity. Using exploratory factor analysis informed by a literature review, empirical data from a survey of 200 staff members of German, Austrian, and Swiss companies was analyzed. As a further output of the study, Meyer describes a new innovation management tool (Innolytics) to help companies initiate and implement innovation projects that vary greatly in the type, speed, and degree of innovation.

Next, **Asceline Groot**, Senior Communications Officer at ASN Bank, and **Ben Dankbaar**, Emeritus Professor of Innovation Management at Radboud University Nijmegen in the Netherlands, ask: "Does social innovation require social entrepreneurship?" They argue that every entrepreneurial action results in some measure of social innovation, regardless of the intentions of the entrepreneur. Thus, instead of labelling some enterprises as "social", Groot and Meyer propose that all enterprises should be measured on their social impacts, not their social intentions. They support their arguments by examining the social impact and viability of 20 enterprises widely considered as "social".

Then, **Finn Hahn**, a Product Development Engineer at Egatec A/S in Odense, Denmark, and **Søren Jensen** and **Stoyan Tanev**, Associate Professors at the University of Southern Denmark, examine the disruptive potential of value propositions in the 3D printing technology sector. By classifying existing business opportunities and examining the market offers of startups, they assess the degree of attractive and disruptiveness of the associated value propositions. Their article provides empirical support for the conceptualization of the degree of disruptiveness of the value proposition as a metric for the evaluation of the business potential of new technology startups.

In the fourth article, **Dap Hartmann**, Associate Professor of Innovation Management and Entrepreneurship at Delft University of Technology in the Netherlands, reports on the impact of a "Turning Technology into Business" course in which graduate students create companies to commercialize technologies based on university-owned patents. Hartmann outlines the structure and the main content of the course and explains the selection process of both the patents used in the course and the students admitted to the course. The article includes a case study and lessons learned by students and course organizers.

Finally, **Pinaki Pattnaik** and **Satyendra Pandey**, professors from the Centre for Management Studies at Nalsar University of Law in Hyderabad, India, examine three questions about university spinoffs: i) what are they?, ii) why are they needed?, and iii) how are they created? After examining how university spinoffs are created by reviewing three existing models of university spinoff creation, the authors propose a more comprehensive multistage model.

Upcoming issues

In further collaboration with ISPIM, we are pleased to announce plans for a special issue of the TIM Review on the theme of **Living Labs**, which will feature articles from the upcoming ISPIM Innovation Conference (conference.ispim.org) from June 14–17 in Budapest, Hungary. Please examine the call for papers (tinyurl.com/o5mlqem) for the Living Labs conference track, and note that the submission deadline is January 9th, 2015. The special issue is scheduled for late 2015, and the guest editors will be **Seppo Leminen**, **Dimitri Schuurman**, **Mika Westerlund**, and **Eelko Huizingh**, from Laurea University of Applied Sciences in Finland, Ghent University in Belgium, Carleton University in Canada, and the University of Groningen in the Netherlands, respectively.

Editorial: Innovation and Entrepreneurship

Chris McPhee

Another call for papers for an upcoming special issue of the TIM Review was recently featured on Open-Source.com (tinyurl.com/lg9244e). The article is a follow-up on a post in which the TIM Review was featured as one of five open access journals recommended for open source enthusiasts. This special issue is on **Open Source Strategy** and is scheduled for publication in May 2015. The guest editor is **Mekki MacAulay** from York University in Toronto, Canada. We encourage you to contact us right away if you would like to contribute an article.

In January, we revisit the theme of **Cybersecurity**, which we covered in October (timreview.ca/issue/2014/october) and November (timreview.ca/issue/2014/november). We received so many submissions for the first two issues, that we decided to schedule a third issue. We welcome back **Tony Bailetti**, Director of Carleton University's Technology Innovation Management program (TIM; timprogram.ca) and Executive Director (Acting) of the VENUS Cybersecurity Corporation (venuscyber.com), as guest editor.

But, for now, we look back at the most popular articles from the TIM Review's third year. Table 1 ranks the most popular articles published in the 12 issues between October 2013 and September 2014, based on traffic to timreview.ca over this period. This method strongly disadvantages more recently published articles, so the table also includes five trending articles that would appear in the main list if only recent traffic were considered. If you missed any of these articles when they first came out, I encourage you to add them to your reading list. Our full archive of articles is available on our website at: timreview.ca/issue-archive

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

Chris McPhee
Editor-in-Chief

About the Editor

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

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Keywords: innovation, entrepreneurship, innovation culture, innovation capacity, social innovation, social entrepreneurship, 3D printing, value propositions, business models, disruption, patents, commercialization, university technology transfer, spinoffs

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Chris McPhee

Table 1. Most popular TIM Review articles published from October 2013 to September 2014*

Rank	Article (http://timreview.ca/article/)	Author(s)	Issue
1	**From Idea Crowdsourcing to Managing User Knowledge** (timreview.ca/article/750)	Rajala et al.	December 2013 *Living Labs and Crowdsourcing*
2	**Risk Management in Crowdsourcing-Based Business Ecosystems** (751)	Kannangara & Uguccioni	December 2013 *Living Labs and Crowdsourcing*
3	**3D Printing: A Revolutionary Advance for the Field of Urology?** (772)	Neu	March 2014 *Emerging Technologies*
4	**Formulating an Executive Strategy for Big Data Analytics** (773)	Palem	March 2014 *Emerging Technologies*
5	**The Businesses of Open Data and Open Source: Some Key Similarities and Differences** (757)	Lindman & Nyman	January 2014 *Open Source Business*
6	**Corporate Lifecycles: Modelling the Dynamics of Innovation and Its Support Infrastructure** (733)	Koplyay et al.	October 2013 *Managing Innovation*
7	**Developing a Social Network as a Means of Obtaining Entrepreneurial Knowledge Needed for Internationalization** (827)	Han & Afolabi	September 2014 *Insights*
8	**Collaborative Idea Management: A Driver of Continuous Innovation** (764)	Bank & Raza	February 2014 *Seeking Solutions*
9	**Open Innovation Processes in Living Lab Innovation Systems: Insights from the LeYLab** (743)	Schuurman et al.	November 2013 *Living Labs*
10	**Using Boundary Management for More Effective Product Development** (734)	Thomson & Thomson	October 2013 *Managing Innovation*
11	**A Living Lab as a Service: Creating Value for Micro-enterprises through Collaboration and Innovation** (744)	Ståhlbröst	November 2013 *Living Labs*
12	**Linking Living Lab Characteristics and Their Outcomes: Towards a Conceptual Framework** (748)	Veeckman et al.	December 2013 *Living Labs and Crowdsourcing*
13	**IT Consumerization: A Case Study of BYOD in a Healthcare Setting** (771)	Marshall	March 2014 *Emerging Technologies*
14	**Innovation in Services: A Literature Review** (780)	Morrar	April 2014 *Service and Innovation*
15	**Actor Roles in an Urban Living Lab: What Can We Learn from Suurpelto, Finland?** (742)	Juujärvi & Pesso	November 2013 *Living Labs*
↑	**The Government of India's Role in Promoting Innovation through Policy Initiatives for Entrepreneurship Development** (818)	Abhyankar	August 2014, *Innovation and Entrepreneurship in India*
↑	**Widening the Perspective on Industrial Innovation: A Service-Dominant-Logic Approach** (791)	Korhonen	May 2014 *Service and Innovation*
↑	**Entrepreneurship Education in India: A Critical Assessment and a Proposed Framework** (817)	Basu	August 2014, *Innovation and Entrepreneurship in India*
↑	**Conceptualizing Innovation in Born-Global Firms** (826)	Zijdemans & Tanev	September 2014 *Insights*
↑	**Product and Service Interaction in the Chinese Online Game Industry** (789)	Ström & Ernkvist	May 2014 *Service and Innovation*

*The rankings are based on website traffic to timreview.ca from October 1, 2013 to September 30, 2014. The list also includes 5 recently published articles (denoted by ↑) that would appear in the main list if only traffic from June 1, 2014 to November 30, 2014 were considered.

Strengthening Innovation Capacity through Different Types of Innovation Cultures

Jens-Uwe Meyer

"There are two kinds of adventurers: those who go truly hoping to find adventure and those who go secretly hoping they won't."

William Least Heat-Moon (Trogdon)
Travel writer and historian

In times of increased market dynamics, companies must be capable of initiating and implementing innovation projects that vary greatly in type, speed, and degree of innovation. Many companies do not succeed. This article introduces Innolytics, an innovation management tool that allows companies to successfully face this challenge by analyzing their innovation culture and managing its development in the right direction. Analyzing empirical data from 200 staff members employed by German, Austrian, and Swiss companies using exploratory factor analysis, four types of innovation cultures were identified, each of which foster a different degree of organizational creativity. Proactive innovators (21%) promote organizational creativity at a high level and across all categories. Strategic innovators (26%) foster innovation by focusing on their strategy and their value system. Innovative optimizers (36%) promote more adaptive levels whereas operational innovators (16%) promote low levels of organizational creativity. Each type enables a company or a business unit to manage different degrees of innovation projects. The Innolytics tool introduced and described in this article will enable companies to better meet the challenges of rapidly changing markets.

Introduction

In dynamic markets, companies must manage a greater variety and a higher speed of innovations (Bjork, 2012). In the course of this effort, the different requirements for processes and abilities can quickly overstrain an organization's capacities (Benner & Tushman, 2002). The current understanding of innovation management is characterized by process-oriented approaches (cf. Cooper, 1994; Cooper & Kleinschmidt, 2001; Drucker, 1985) that focus on the establishment of innovation processes and the definition of roles as well as the establishment of key performance indicators (Cooper & Kleinschmidt 1996, 2001). These approaches nevertheless demonstrate their limits in dynamic market environments.

Processes gain great importance when managing complex projects with a diversity of participants, such as the development of innovative technologies (Cooper, 2014; Högman & Johannesson, 2013). Structured routines render advantages in terms of effectiveness but may hinder the development of something new (Junarsin, 2009). The strength of innovation processes appears to be in the ability to manage the innovation routine. Such a strategy of slow incremental change can be absolutely promising provided that the environment is stable or changes slowly (Tushman & O'Reilly III, 1996). Nevertheless, this strategy is not always the most productive approach to meeting the demands of dynamic markets because innovation is not necessarily a linear process (Rickards, 1996). The farther a project strays from this routine and the higher its degree of uncertainty, the greater the demand is for more encompassing instruments that promote more far-reaching forms of innovation.

Background

Numerous authors describe the influence of the innovation culture on the innovative capacity of companies and company units (e.g., Ekvall, 2006; Lin & Liu, 2012;

Naranjo et al., 2010). Category systems that outline the supporting framework conditions for creativity and innovation have been developed over recent years (e.g., Amabile et al., 1996; Khandwalla & Mehta, 2004; Robinson & Stern, 1997). These works assume that a company possesses an innovation culture to either a greater or lesser degree and that either a higher or lower innovative capacity can be derived from it (Dobni, 2008; Martins & Terblanche, 2003).

Nevertheless, different types of innovations require different framework conditions (Junarsin, 2009; Leifer et al., 2000). According to Ekvall (2006), different degrees in organizational creativity are required for the achievement of different innovation goals. And, according to Tushman and O'Reilly (1996), different cultures that promote different degrees of creativity can exist in a single company. But, current research does not provide a systematic and sufficiently deep understanding of the various cultural conditions that foster different levels of creativity as a prerequisite for being able to manage different degrees of innovation in highly dynamic markets. The purpose of this article is to develop an empirically-based comprehensive model in order to close this gap. For this purpose, the following hypotheses are established on the basis of a literature analysis:

Hypothesis 1: *There are several degrees of organizational creativity. Each degree promotes a specific quality, scope, and radicality of innovation.*

Hypothesis 2: *Organizational units with different degrees of organizational creativity can be determined on the basis of characteristics and can be summarized into innovation types.*

Hypothesis 3: *Through the establishment of a management model based on types of innovation, companies can increase their ability to simultaneously develop different levels of innovation at varying speeds.*

Theoretical foundations and classification
Up to the early 1990s, research had not yet provided broadly based scientific frameworks that explain the relationship between the work environment and creative achievements of staff members (Amabile, 1988; Woodman et al., 1993). A new research direction has since emerged as the field of organizational creativity that focuses less on the creative performance of an individual, but more so on the creative performance of an organization (e.g., Puccio & Cabra, 2010; Zhou & Shalley, 2008).

The number of studies on the subject of creativity has been continually accelerating over recent years (Runco & Albert, 2010). Kozbelt, Beghetto, and Runco (2010) provide a comparative review of creativity theories and divide them into 10 categories. This work is a convergence of psychometric theories, typological theories, and system theories. Psychometric theories are based on the assumption that creativity can be measured using criteria (Kozbelt et al., 2010). Typological theories assume that there are different types of creative individuals and working styles (Kirton, 1976, 1989; Kozbelt, 2008; Martinsen, 1995). System theories are based on the assumption that creativity can be influenced by the system surrounding it (Kozbelt et al., 2010).

This article examines the question of how companies and company units can influence their innovative capacity at a system level by developing typologies of organizational creativity with the support of psychometric techniques.

Definitions

Individual creativity
The foundational element in this article is Amabile's (1996) componential model, which includes three major components of creativity: expertise, creative thinking, and intrinsic task motivation. This definition of creativity may be limited because the level of creative efficiency appears to be additionally influenced by specific character traits:

- Independence, independent judgment, autonomy (Amabile, 1996; Barron & Harrington, 1981; Roth, 2001)
- Self-discipline or self-direction, highly achievement-motivated, perseverance in face of frustration, high energy (Amabile, 1996; Csikszentmihalyi, 2006; Kaufman & Sternberg, 2006; Roth, 2001)
- Orientation toward taking risks (Amabile, 1996; Farson & Keyes, 2002)
- Preference toward breaking the rules (Csikszentmihalyi, 2006)
- Largely unconcerned with regard to social acceptance (Amabile, 1996)
- Self-confidence (or self-efficacy) (Barron & Harrington, 1981; Hill et al., 2008; Prabhu et al., 2008)

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For the purposes of this research objective, an expansion is made on Amabile's consideration of the relationship between creativity and intelligence (Amabile, 1996; Sternberg, 1996). According to Roth (2001), high creativity requires an above-average, particularly linguistic, intelligence. The concept of creative intelligence is applied within the literature (e.g., Buzan, 2001; Carr-Ruffino, 2001; Dewey et al., 2011). This intelligence may determine the degree of creative efficiency that moves between moderately creative achievements (Amabile, 1996) and truly creative breakthroughs (Feist, 2010).

Within the scope of this research project, individual creative potential is defined as a collection of creative abilities and character traits that enable achievements that are considered in a defined social context as new and useful and that the degree and the area of these creative achievements are strongly influenced by creative intelligence and individual expertise (Figure 1).

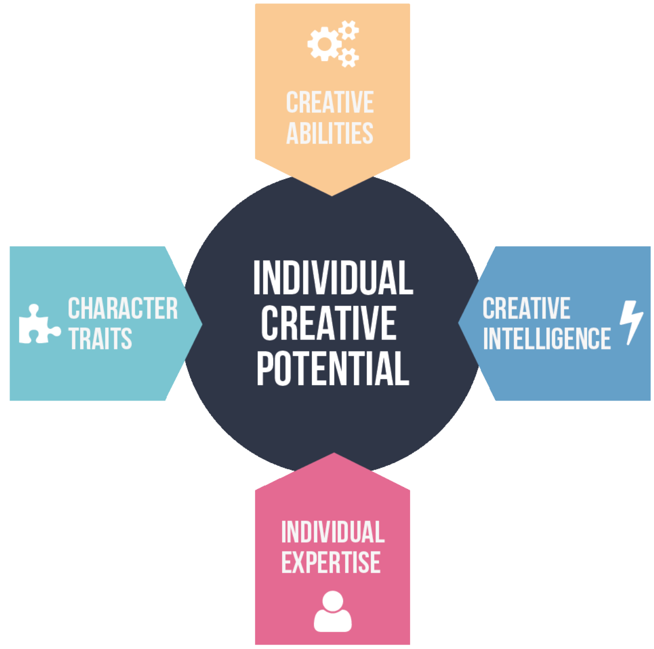

Figure 1. Individual creative potential and its influences

Definition of organizational creativity
Many terms are explored in the literature regarding innovation and creativity at a systemic level: innovativeness, organizational creativity, entrepreneurial creativity and corporate creativity, creative climate, innovation supportive culture, and innovation culture (e.g., Dobni, 2008; Ekvall, 1996; Robinson & Stern, 1997). A precise distinction between these terms is hardly possible on the basis of the present literature. The concept of innovation culture is defined within the scope of this article as the social environment that enables staff members to develop ideas and implement innovations. The concept of organizational creativity consists of two abilities: i) the ability to create this social environment as well as ii) the ability to utilize and exploit the resulting individual creativity of staff members.

Design and Methodology

For the analysis of the factors that promote organizational creativity referred to in the literature, authors have been selected who have followed the approach of listing all of the relevant factors and designating the factors that can be traceable and fully categorized:

- KEYS (Amabile et al., 1996)
- Six Factors Promoting Corporate Creativity (Robinson & Stern, 1997)
- Culture and Climate for Innovation (Ahmed, 1998)
- Design of Corporate Creativity (Khandwalla & Mehta, 2004)
- Model of Engagement in Creative Action (Unsworth & Clegg, 2010)
- Key Issues Around Creating a Culture for Design, Creativity, and Innovation (von Stamm, 2005)
- Working Climate and Creativity (Ekvall & Tangeberg-Andersson, 1986)
- The Creativity Audit (Rickards & Bessant, 1980)
- Measuring the Perceived Support for Innovation in Organizations (Siegel & Kaemmerer, 1978)
- Organizational Creativity and Innovation (van Gundy, 1987)
- Needed Research in Creativity for Business and Industry Applications (Basadur, 1987)
- Exploratory Study for Creative Climate (Cabra et al., 2005)
- Measuring Climate for Work Group Innovation (Anderson & West, 1998)

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• Characteristics of an Organizational Environment Which Stimulates and Inhibits Creativity (Soriano de Alencar & Bruno-Faria, 1997)

The 14 models include a total of 110 main categories – some of which are further divided into subcategories by the authors. These categories have been grouped into clusters applying Amabile's line of thought, after which the generation and development of ideas can be supported at multiple levels of an organization (Amabile et al., 1996). For classification purposes, Kromey's (2002) principle of operational interpretation was applied:

1. The organizational level includes factors of overriding importance that affect the entire organization or organizational unit.

2. The management level includes factors that can be directly influenced by the supervisor of an employee, such as the promotion of ideas by superiors.

3. On the employee level, creativity can be promoted in relation to the tasks and projects employees and teams are working on.

4. The level of the work environment includes factors that are perceived and interpreted by individuals in their personal working environment.

These four levels were associated with the 110 categories designated by the authors above as main categories. The categories were then grouped into the four levels with ten new categories and a total of 48 newly created items (Table 1).

A questionnaire was developed for the survey, and the collected data were coded on a scale from 1 to 6. After performing the factor analysis, the data were re-coded for clarity: values 1 to 3 were given the values -3 to -1 and the values of 4 to 6 were given the values 1 to 3. Incomplete datasets were removed from the analysis. All items were weighted equally. With the help of this questionnaire, nearly 200 staff members responsible for innovation in companies from Germany, Austria, and Switzerland were questioned as to the extent to which the characteristic features listed in Table 1 promote organizational creativity in their scope of action.

The base population from which the sample drawn is formed companies that are referred to as "innovation-active" by the Center for European Economic Research (Rammer et al., 2011), a group that represents nearly 57% of all companies. The surveys were sent to staff members of these companies who deal with innovation due to their job description (e.g., idea manager, innovation manager, business development, research and development) or for another reason.

The survey fulfills the requirements of specific representativity (Moosbrugger & Kelava, 2012) as well as the quality criteria for objectivity, reliability, and validity.

Thirty-eight percent of the survey respondents are employed in companies that have between 51 and 1,000 staff members, 32% are in companies between 1,000 and 10,000 staff members, and 30% are employed in companies with more than 10,000 staff members. The majority (67%) is directly responsible for innovation. Fourteen percent of the interviewees belong to the management or the boards of directors. Nineteen percent come from the marketing and public relations (8%) departments, distribution (4%), product management (5%), or production (4%). Nearly two-thirds of the interviewees are executives.

To clarify the primary objective of this research project – to determine the extent to which different degrees of organizational creativity can be defined – the underlying data material has been analyzed with the aid of an exploratory factor analysis as a hypothesis-generating process (Moosbrugger & Schermelleh-Engel, 2012; Noack, 2007).

Findings

The results of the factor analysis show that there is a close relationship between the individual categories. Patterns could be found in the collected datasets. Respondents who, for example, evaluated their communication structures as being highly supportive of innovation almost always assessed their working climate and their risk culture as being equally supportive of innovation. There was also a strong correlation on the negative scale: respondents who evaluated their communication structures as being obstructive to innovation almost always assessed their working climate and their risk culture as being equally obstructive to innovation.

In evaluating the results of the exploratory factor analysis, four types of clusters were determined (Table 2). Their specific attributes, as evaluated on a scale from 1 to 6, can be described in the following way:

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Table 1. Model levels, categories, and items *(continued on next page...)*

Level	Category	Items and Descriptions
Organization	**Strategy**	The goal formulated by the top management team to strive for and promote innovations.
		1. *Future strategy:* Offensive, future-oriented strategy from which innovation requirements are derived. 2. *Innovation awareness:* The awareness of the need for innovation. 3. *Innovation aspiration: The* aspiration to implement breakthrough innovations. 4. *Engagement of the top management:* The degree to which the top managers develop their own innovation activities. 5. *Sustainability:* The sense that the innovation strategy over a long period of time is a determining factor. 6. *Strategy communication:* The magnitude to which the strategy is communicated and develops a leading influence.
	Values	Overriding factors: convictions and values.
		1. *Own responsibility:* The sense of being personally responsible for innovation. 2. *Acceptance of contradictions:* To manage the attitude in spite of possibly contradicting information. 3. *Lived philosophy:* The magnitude to which innovators show a personal conviction. 4. *Value of creativity:* The degree to which new ideas as well as creative thinking and action are valued. 5. *Courage for radical ideas:* The magnitude to which existing views are questioned and radical ideas are recognized. 6. *Readiness for change:* The degree to which a readiness exists to accept changes concerning the structures and the scope of one's own duties.
Management	**Structures**	Creation of management structures with which creativity can be promoted.
		1. *Hierarchies:* Permeability of hierarchy levels in the company. 2. *Management structures and organization structures:* Innovation-promoting management structures and organizational structures. 3. *Control avoidance:* The possibility to work around the rules if required. 4. *Decisive speed:* Speed of the decision-making processes. 5. *Creativity-promoting practices and processes:* Practices and processes that actively promote creativity and innovation.
	Style	A management style that promotes creativity and innovation.
		1. *Innovation goals:* The measure to which concrete innovation goals are defined for individual staff members. 2. *Active promotion:* The degree to which executives actively promote creative ideas and innovation projects. 3. *Stimuli:* The magnitude to which executives expose staff members to stimulative influences. 4. *Encouragement:* The encouragement of staff members to transcend the limits of what is currently feasible. 5. *Autonomy:* The magnitude to which executives grant autonomy to their staff members.
	Resources	The granting of resources.
		1. *Temporal resources:* The granting of time freedoms. 2. *Financial and material resources:* The granting of money and materials. 3. *Internal synergies:* The possibility to fall back on the resources of other departments. 4. *External resources:* Inclusion of external resources. 5. *Training / tools:* The possibility for training.

Table 1. Model levels, categories, and items *(...continued from previous page)*

Level	Category	Items and Descriptions
Staff	**Team composition**	Composition and working style of teams.
		1. *Diversity:* The magnitude of technical and cognitive diversity. 2. *Innovation-promoting staff:* The integration of innovation drivers and unconventional thinkers. 3. *Criticism culture:* Discussions regarding the right course. 4. *Mutual support:* The magnitude of mutual support.
	Incentives	The creation of incentives in order to expedite innovation.
		1. *Measurement of ideas:* The measurement of staff members in terms of the number and the quality of their ideas. 2. *Career mechanisms:* Long-term career perspectives for creatively and innovatively managing staff members. 3. *Reward of results:* To recompense the preference for results rather than compliance. 4. *Reward of successful innovation:* The degree to which innovation success is recompensed.
Environment	**Communication**	Innovation-promoting communication.
		1. *Lateral communication:* Cross-divisional, lateral communication. 2. *Internal informal networks:* The formation of informal networks. 3. *External relationships:* The forming of external relationships. 4. *Meeting culture:* The magnitude to which meetings serve the development of new ideas.
	Risk culture	Readiness to take risks.
		1. *Mistake acceptance:* The acceptance of mistakes. 2. *Readiness to learn:* The readiness to learn from mistakes. 3. *Mistake quality:* The distinction between different types of mistakes. 4. *Unofficial projects:* The frequency of unofficial innovation projects. 5. *Experimental readiness:* The magnitude to which experiments are carried out.
	Working climate	The personally perceived climate in the work environment.
		1. *Motivated environment:* The extent to which colleagues are motivated. 2. *Informal contact:* Informal contact with one another. 3. *Openness to problems:* Positive setting in the face of problems and difficulties. 4. *Perceived dynamism:* The perceived degree of dynamism.

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Table 2. The four innovation types revealed through factor analysis

Innovation Type	Organization Level	Management Level	Staff Level	Environment Level
Mean value of all interviewees	**1.0**	**1.1**	**0.9**	**0.6**
Standard divergence	± 2.1	± 2.0	± 2.0	± 2.1
Type 1	**2.0**	**1.9**	**1.9**	**1.6**
Standard divergence	± 2.4	± 2.3	± 2.4	± 2.5
Type 2	**1.5**	**1.2**	**1.0**	**0.7**
Standard divergence	± 1.9	± 1.9	± 1.6	± 2.0
Type 3	**0.7**	**0.8**	**0.7**	**0.1**
Standard divergence	± 1.9	± 1.9	± 1.9	± 2.0
Type 4	**0.0**	**0.5**	**0.4**	**0.0**
Standard divergence	± 1.9	± 1.9	± 1.8	± 1.8

1. Innovation Type 1 (21% of the interviewees) is characterized by clear evaluation tendencies as regards the features that strongly foster creativity: for all 10 items, statements that represent a culture that fosters organizational creativity achieved high values.

2. Innovation Type 2 (26% of the interviewees) ranks an average of 0.7 points lower than the first innovation type. Overall, the values fostering creativity are therefore assigned a lower, albeit not homogeneous, level. Of the 10 different categories, strategy, values, management styles, and team composition achieve higher values than the other categories.

3. For Innovation Type 3 (36% of the interviewees), the mean values on the evaluation scale are an average of 0.4 points lower than Innovation Type 2 and 1.1 points lower than Innovation Type 1. The evaluation level for the categories of strategy, values, management structures, team composition, and incentives is largely homogeneous.

4. Innovation Type 4 (16% of the interviewees) differs in all categories by 0.4 points from Innovation Type 3, by 0.8 points from Type 2, and by 1.5 points from Type 1. The categories of strategy, values, management structures, resources, incentives, communication, risk culture, and working climate are characterized by a largely homogeneous evaluation level on the lowest level.

The innovation aspiration (Figure 2) is valued at an average of 1.6 (± 2.6) for Innovation Type 1, but with Innovation Type 4, it is valued at 0.9 (± 1.8). Whereas Innovation Type 1 achieves high values with the courage for radical ideas (1.6 ± 2.5), the survey respondents who are assigned to the Innovation Type 4 see danger within radical ideas (0.4 ± 2.0).

Two questions of the survey were directly aimed at determining the degree of innovation the respondent aspires to achieve and the respondent's attitude to radical ideas. When comparing the values achieved by the different innovation types for both questions, a correla-

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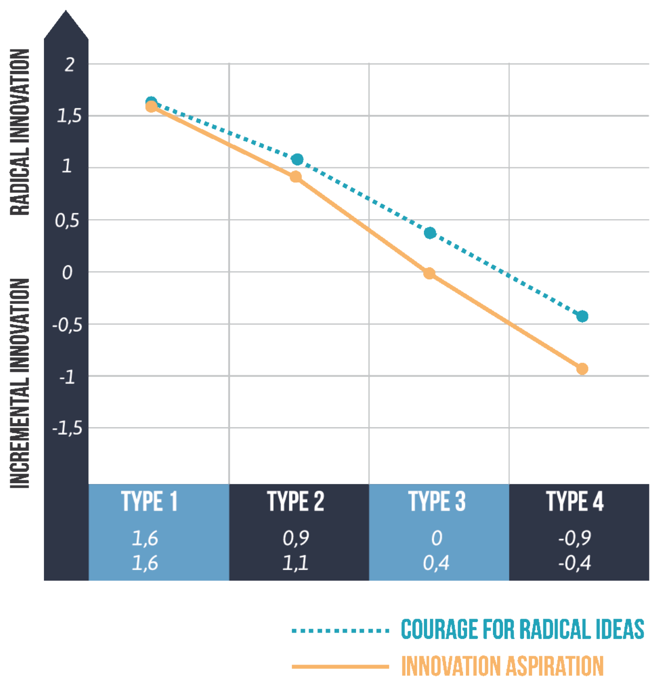

Figure 2. Continuous decrease in the targeted innovation degree

tion becomes apparent: the aim to establish ground-breaking new products on the market and the courage to adopt radical ideas decline steadily. Although Innovation Type 1 evaluates the aim to be the first to establish ground-breaking new products on the market with an average of 1.6 (± 2.6), Innovation Type 4 shows a clear tendency towards incremental innovations and improvements (-0.9 ± 1.8). Whereas Innovation Type 1 achieves high values with the courage for radical ideas (1.6 ± 2.5), respondents that are assigned to the Innovation Type 4 see a danger within radical ideas (0.4 ± 2.0).

Discussion

The types of innovation cultures were assigned names according to their defining characteristics:

1. Innovation Culture Type 1 is designated as "the Proactive Innovator". Proactive Innovators are entirely oriented toward innovation and can expedite more far-reaching innovations can develop innovations faster than the other innovation types.

2. Innovation Type 2 is designated as "the Strategic Innovator". Through the concentration on the organization level, Strategic Innovators can implement effectively. Through the strong top-down component, they may adapt themselves more slowly to changed market circumstances than Proactive Innovators.

3. Innovation Type 3 is designated as "the Innovative Optimizer" due to the middle values in all categories. The Innovative Optimizer is oriented toward advancing incremental innovations.

4. Innovation Type 4 is designated as "the Operational Innovator" due to the below-average visionary orientation. This type is rather aligned toward the operational business.

Confirmation of the hypotheses
The culture of the companies that strive for a high degree of innovation differs significantly from those that aspire toward a lower degree of innovation. The perception that an organization's innovative capacity is only either low or high lacks dimension and is therefore limiting. In order to enable an organization's leadership to manage innovation in highly dynamic markets, it seems to be much more effective to think of suitable degrees of organizational creativity in relation to the specific innovation goals of a company. It can therefore be concluded that the idea that there is a consistent and clearly defined mechanism with which the management can positively impact the innovative capacity through organizational creativity does not sufficiently cover the many dimensions and variables of innovation itself.

Conclusion

The results of this research are of great practical relevance to the managers of companies. The innovation types developed in this research should enable managers to understand which mechanisms can be activated in different intensities to achieve defined innovation goals. The results should shift the focus in innovation management from the procedural consideration to the establishment of management models that envision company units with varying degrees of organizational creativity.

However, a limitation of this paper is the relatively small sample. One response per company does of course not properly describe the culture of that company. It is recommended to expand the sample and using a more complex process of investigation that covers statistically several management layers within the company. Moreover, future investigations on the subject of innovation should focus on the gradations of organizational creativity. The different degrees are insufficiently investigated in the literature.

For future research, it is encouraged that surveys similar to that conducted here are repeated – possibly with a higher number of participants. It would be a significant gain in knowledge to discover the extent to which more types of innovation can be defined. Due to the relatively low number of cases in this first research (200 interviewees), four innovation types naturally demonstrate a simplification.

In the meantime, on the basis of this preliminary study, a web-based analysis tool has been developed in German, and an English version will be available in 2015. This tool, which is called Innolytics (innolytics.de) – from "innovation analytics " – helps researchers and managers to measure, analyze, and continuously develop their own innovation capacity. For this purpose, the items discussed in this paper are converted into questions for different management levels and areas of expertise. This tool should help to enable the management of companies to identify and activate those factors that most efficiently improve the innovation capacity of different units. Given that different areas of expertise and business units within companies are usually subjected to different demands for innovation, Innolytics should help to enable the management to establish different innovation cultures in different divisions and business units.

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References

Ahmed, P. K. 1998. Culture and Climate for Innovation. *European Journal of Innovation Management*, 1(1): 30–42. http://dx.doi.org/10.1108/14601069810199131

Amabile, T. M. 1996. *Creativity and Innovation in Organizations (Note: 9-396-239).* Boston: Harvard Business School Publications.

Amabile, T. M. 1998. How To Kill Creativity. *Harvard Business Review*, 76(5): 77–87.

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

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

Barron, F., & Harrington, D. M. 1981. Creativity, Intelligence and Personality. *Annual Review of Psychology*, 32: 439–476. http://dx.doi.org/10.1146/annurev.ps.32.020181.002255

Basadur, M. 1987. Needed Research in Creativity for Business and Industry Applications. In S. G. Isaksen (Ed.), *Frontiers of Creativity Research: Beyond the Basics.* Buffalo, NY: Bearly Ltd.

Benner, M. J., & Tushman, M. 2002. Process Management and Technological Innovation: A Longitudinal Study of the Photography and Paint Industries. *Administrative Science Quarterly*, 47(4): 676–706. http://dx.doi.org/10.2307/3094913

Buzan, T. 2001. *The Power of Creative Intelligence.* London: Thorsons.

Cabra, J. F., Talbot, R. J. , & Joniak, A. J.. 2005. Exploratory Study of Creative Climate: A Case From Selected Colombian Companies and its Implication on Organizational Development. *Cuadernos di Administración*, 18(29): 53–86.

Strengthening Innovation Capacity through Different Types of Innovation Cultures

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Carr-Ruffino, N. 2001. *Building Innovative Skills: The Creative Intelligence Model.* Boston: Pearson Custom Publishing.

Cooper, R. G., & Kleinschmidt, E. J. 1996. Winning Business in Product Development: The Critical Success Factors. *Research-Technology Management,* 39(4) 18–29.

Cooper, R. J., & Kleinschmidt, E. J.. 2001. *Stage-Gate Process for New Product Success.* Brøndby, Denmark: Innovation Management U3.

Cooper, R. G. 1986. *Winning at New Products.* Boston: Addison-Wesley.

Cooper, R. G. 1988. The New Product Process: A Decision Guide for Management. *Journal of Product Innovation Management,* 3(3): 238–255.
http://dx.doi.org/10.1080/0267257X.1988.9964044

Cooper, R. G. 1994. Perspective Third-Generation New Product Processes. *Journal of Product Innovation Management,* 11(1): 3–14.
http://dx.doi.org/10.1016/0737-6782(94)90115-5

Cooper, R. G. 2014. What's Next?: After Stage-Gate. *Research-Technology Management,* 57(1): 20–31.
http://dx.doi.org/10.5437/08956308X5606963

Csikszentmihalyi, M. A. 2006. Systems Perspective on Creativity. In J. Henry (Ed.), *Creative Management and Development:* 313-335. London: Sage Publications.

Dewey, J., Kallen, H. M., Tufts, J. H., Moore, A. W., Brown, H. C., Mead, G. H., Bode, B. H., & Stuart, H. W. 2011. *Creative Intelligence.* Calgary, AB: Teophania Publishing.

Dobni, C. 2008. Measuring Innovation Cultures in Organizations: The Development of a Generalized Innovation Culture Construct Using Exploratory Factor Analysis. *European Journal of Innovation Management*, 11(4): 539–559.
http://dx.doi.org/10.1108/14601060810911156

Drucker, P. F. 1985. The Discipline of Innovation. *Harvard Business Review,* 63(3): 67–72.

Ekvall, G., & Tångeberg-Andersson, Y. 1986. Working Climate and Creativity. A Study of an Innovative Newspaper Office. *Journal of Creative Behavior*, 20(3) 215–225.
http://dx.doi.org/10.1002/j.2162-6057.1986.tb00438.x

Ekvall, G. 1996. Organizational Climate for Creativity and Innovation. *European Journal of Work and Organizational Psychology,* (5)1: 105–123.
http://dx.doi.org/10.1080/13594329608414845

Ekvall, G. 2006. Organizational Conditions and Levels of Creativity. In J. Henry (Ed.), *Creative Management and Development:* 195-205. London: Sage Publications.

Farson, R., & Keyes, R. 2002. The Failure Tolerant Leader. *Harvard Business Review,* 80(8): 95–104.

Feist, G. J. 2010. The Function of Personality in Creativity. In J. Kaufman & R. J. Sternberg (Eds.), *The Cambridge Handbook of Creativity: 1*13–130. New York: Cambridge University Press.

Hill, A., Tan, A., & Kikichi, A. 2008. International High School Students' Perceived Creativity Self-Efficacy. *Korean Journal of Thinking and Problem Solving,* 18(1): 105–115.

Högman, U., & Johannesson, H. 2013. Applying Stage Gate Processes to Technology Development – Experience From Six Hardware-Oriented Companies. *Journal of Engineering and Technology Management,* 30(3): 264–287.
http://dx.doi.org/10.1016/j.jengtecman.2013.05.002

Junarsin, E. 2009. Managing Discontinuous Innovation. *International Management Review,* 2(5): 10–18.

Kaufman, J. C., & Sternberg, R. J. 2006. The International Handbook of Creativity. New York: Cambridge University Press.

Khandwalla, P. N., & Mehta, K. 2004. Designs of Corporate Creativity. *Vikalpa,* 29(1): 13–28.

Kirton, M. J. 1989. A Theory of Cognitive Style. In M. Kirton (Ed.), *Adaptors and Innovators: Styles of Creativity and Problem Solving:* 1–33. New York: Routledge.

Kozbelt, A. 2008. Gombrich, Galenson, and Beyond: Integrating Case Study and Typological Frameworks in the Study of Creative Individuals. *Empirical Studies of the Arts,* 26(1): 51–68.
http://dx.doi.org/10.2190/EM.26.1.e

Kozbelt, A., Beghetto, R. A., & Runco, M. A. 2010. Theories of Creativity. In J. Kaufman & R. J. Sternberg (Eds.), *The Cambridge Handbook of Creativity:* 20–47. New York: Cambridge University Press.

Kromrey, H. 2002. *Empirische Sozialforschung. Modelle und Methoden der Datenerhebung und Datenauswertung.* 10. Aufl. Stuttgart, Berlin, Köln: UTB.

Leifer, R., McDermott, C. M., O'Connor, G. C., Peters, L. S., Rice, M., & Veryzer, Jr., R. W. 2000. *Radical Innovation: How Mature Companies Can Outsmart Startups.* Boston: Harvard Business School Press Books.

Lin, C. Y.-Y., & Liu, F.-C. 2012. A Cross-Level Analysis of Organizational Creativity Climate and Perceived Innovation: The Mediating Effect of Work Motivation. *European Journal of Innovation Management,* 15(1): 55–76.
http://dx.doi.org/10.1108/14601061211192834

Martins, E. C., & Terblanche, F. 2003. Building Organizational Culture That Stimulates Creativity and Innovation. *European Journal of Innovation Management,* 6(1): 64–74.
http://dx.doi.org/10.1108/14601060310456337

Martinsen, Ø. 1995. Cognitive Styles and Experience in Solving Insight Problems: Replication and Extension. *Creativity Research Journal,* 8(3): 291–298.
http://dx.doi.org/10.1207/s15326934crj0803_8

Moosbrugger, H., & Kelava, A. 2012. *Testtheorie und Fragebogenkonstruktion.* Berlin: Springer.

Moosbrugger, H., & Schermelleh-Engel, K. 2012. Exploratorische EFA und Konfirmatorische Faktorenanalyse CFA. In H. Moosbrugger & A. Kelava (Eds.), *Testtheorie und Fragebogenkonstruktion.* Berlin: Springer.

Naranjo, J., Valle, R. S., & Jiménez, D. J. 2010. Organizational Culture as Determinant of Product Innovation. *European Journal of Innovation Management,* 13(4): 466–480.
http://dx.doi.org/10.1108/14601061011086294

Noack, M. 2007. *Faktorenanalyse.* Institut für Soziologie, Universität Duisburg-Essen.

Prabhu, V., Sutton, C., & Sauer, W. 2008. Creativity and Certain Personality Traits: Understanding the Mediating Effect of Intrinsic Motivation. *Creativity Research Journal,* 20(1): 53–66.
http://dx.doi.org/10.1080/10400410701841955

Puccio, G. J., & Cabra, J. F. 2010. Organizational Creativity – A Systems Approach. In J. Kaufman & R. J. Sternberg (Eds.), *The Cambridge Handbook of Creativity:* 145–173. New York: Cambridge University Press.

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Rammer, C., Aschhoff, B., Crass, D., Doherr, T., Hud, M., & Köhler, C., Peters., B., Schubert, T, & Schwiebacher, F. 2011. *Indikatorenbericht zur Innovationserhebung 2011,* Zentrum für Europäische Wirtschaftsförderung im Auftrag des Bundesministerium für Bildung und Forschung.

Rickards, T., & Bessant, J. 1980. The Creativity Audit: Introduction of a New Research Measure During Programmes for Facilitating Organizational Change. *R&D Management,* 10(2): 67–75. http://dx.doi.org/10.1111/j.1467-9310.1980.tb00014.x

Rickards, T. 1996. The Management of Innovation: Recasting the Role of Creativity. *European Journal of Work and Organizational Psychology*, 5(1): 13–27. http://dx.doi.org/10.1080/13594329608414835

Robinson, A. G., & Stern, S. 1997. *Corporate Creativity – How Innovation And Improvement Actually Happens.* San Francisco: Berrett-Koehler Publishers.

Roth, G. 2001. *Fühlen, Denken, Handeln. Wie das Gehirn unser Verhalten steuert.* Frankfurt: Suhrkamp.

Runco, M. A., & Albert, R. S. 2010. Creativity Research: A Historical View. In J. Kaufman & R. J. Sternberg (Eds.), *The Cambridge Handbook of Creativity:* 3–19. New York: Cambridge University Press.

Siegel, S. M., & Kaemmerer, W. F. 1978. Measuring the Perceived Support for Innovation in Organizations. *Journal of Applied Psychology,* 63(5): 553–562. http://psycnet.apa.org/doi/10.1037/0021-9010.63.5.553

Soriano Alencar, E. M. L. de, & Bruno-Faria, M. D. F. 1997. Characteristics of an Organizational Environment Which Stimulates and Inhibits Creativity. *Journal of Creative Behavior,* 31(4): 271–281. http://dx.doi.org/10.1002/j.2162-6057.1997.tb00799.x

Sternberg, R. J. 1996. *Successful Intelligence: How Practical and Creative Intelligence Determine Success in Life.* New York: Simon and Schuster.

Tushman, M. L., & O'Reilly III, C. A. 1996. Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change. *California Management Review*, 38(4): 8–30. http://www.jstor.org/stable/41165852

Unsworth, K. L., & Clegg, C. W. 2010. Why Do Employees Undertake Creative Action? *Journal of Occupational and Organizational Psychology,* 83(1): 77–99. http://dx.doi.org/10.1348/096317908X398377

Van Gundy, A. Organizational Creativity and Innovation. 1987. In S. G. Isaksen (Ed.), *Frontiers of Creativity Research: Beyond the Basics:* 358–379. Buffalo, NY: Bearly Ltd.

von Stamm, B. 2005. *Managing Innovation, Design and Creativity.* Hoboken, NJ: John Wiley and Sons.

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

Zhou, J., & Shalley, C. E. 2008. *Handbook of Organizational Creativity.* New York: Lawrence Erlbaum Associates.

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Does Social Innovation Require Social Entrepreneurship?

Asceline Groot and Ben Dankbaar

> *Nobody talks of entrepreneurship as survival, but that's exactly what it is.*
>
> Anita Roddick (1942–2007)
> Founder of The Body Shop

Social innovation is now considered an important element in the search for solutions to pressing social problems. Inspired by Schumpeter's conceptualization of innovation, "social" entrepreneurship is thought to contribute to "social" innovation in more or less the same way that "normal" entrepreneurship consists of the introduction of "normal" innovations. In the literature as well as in practice, the definition of concepts such as social innovation and social entrepreneurship has led to considerable confusion. We aim to bring clarity to the debate, arguing that every entrepreneurial action results in some measure of intended or unintended social innovation, regardless of whether the entrepreneurs in question are considered or consider themselves "social" or not. We test our insights in an investigation of 20 social enterprises that have a commercial business model.

Introduction

In the European Union, social innovation is currently widely debated and considered an important element in all efforts to meet the "grand challenges" advanced societies are facing today: environmental degradation, climate change, declining birth rates, high levels of immigration, the rising costs of healthcare, the increasing number of elderly people, rising costs of healthcare, poverty and social exclusion, security of the citizenry, protection of critical infrastructures against terrorist attacks, etc. Given the complexity of these problems, no simple and politically uncontroversial solutions are available. Efforts to introduce major changes in the social welfare system, in healthcare and pensions, and in energy and mobility systems become bogged down in political conflict or end up in compromises that satisfy no one.

In contrast to such efforts toward reform undertaken by the public sector, social innovation is seen as a matter of private initiative. All over Europe, private initiatives that aim to tackle social problems and contribute to a more inclusive, more secure, and more sustainable society are flourishing. Social innovation is seen as complementary and sometimes as corrective to changes in public arrangements, but also as a source of inspiration, experimentation, and a catalyst for change, forcing the public as well as private actors to change their behaviour. Against this background, there is also a growing interest in what is called "social entrepreneurship" (Dees, 2001; Peredo & McLean, 2006; Seelos & Mair, 2005; Short et al., 2009). As we demonstrate later, there are many different definitions of social entrepreneurship, but they all concentrate on entrepreneurial action with social intentions.

In this article, we focus on the connection between social entrepreneurship and social innovation. In the first two sections, we discuss the concepts of social innovation and social entrepreneurship in more detail. In the third section, we argue that the distinction between social entrepreneurship and "normal" entrepreneurship is far from clear, especially if the focus lies on actual social impact instead of intentions. In the fourth section, we test our insights by looking at the characteristics of 20 enterprises in The Netherlands that are generally considered to be "social". In a final section, we offer our conclusions and suggestions for further research.

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Social Innovation

Considerable literature on social innovation has come into existence over the past two decades, recently culminating in *The International Handbook on Social Innovation* (Moulaert et al., 2013). In North America, social innovation is usually associated with initiatives in and by the public sector, sometimes also in the form of public-private partnerships. In the European context, the concept of social innovation usually refers to private initiatives to solve specific problems and fulfil specific needs, originally mainly in the field of social care and security (Leadbeater, 1998). Some of these problems and needs had come to the surface as a consequence of the retreat of the welfare state starting in the 1980s. Others had never been adequately covered or solved by the institutions of the welfare state: loneliness among the elderly, petty crime and violence among high school dropouts, or diminishing social cohesion in multi-cultural neighbourhoods. Social innovation took the form of local initiatives to tackle these problems, often at the level of a single neighbourhood.

The International Handbook on Social Innovation argues that social innovation "means fostering inclusion and wellbeing though improving social relations and empowerment processes: imagining and pursuing a world, a nation, a region, a locality, a community that would grant universal rights and be more socially inclusive" (Moulaert et al., 2013). The European Union, which has recently supported various activities in the area of social innovation, defines social innovations as "new ideas (products, services, and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations" (Dro et al., 2011). This definition is very similar to textbook definitions of innovation with the addition of the adjective "social". The reference to "new social relationships" brings it close to the definition from the handbook. However, in the handbook approach, social innovation tends to be located in the so-called "third sector", which consists of non-governmental and non-profit organizations. Texts published by the European Commission, however, show that the meaning of social innovation is expanding in two directions (European Commission, 2010; Dro et al., 2011). On the one hand, it is argued that social innovation can be initiated everywhere in the economy, not just in the non-profit sector, but also in the public and private sectors. On the other hand, social innovation is, in these texts, not limited to issues of welfare and social inclusion, but may also be concerned with issues of environmental protection and sustainable development. Thus, a program matching students looking for accommodation with older people living on their own in Oporto, Portugal, is considered just as much a social innovation as a cooperative enterprise set up to revive beekeeping in Copenhagen, Denmark (European Commission, 2010). Social innovation is seen to be concerned with "the development of what are currently viewed as assets for sustainable development: environmental, human and social capital" (Dro et al., 2011).

What are measures of success for social innovation? Obviously, an innovation needs to survive for some period of time in order to be recognized as successful and indeed to be recognized as a social innovation in the first place. But is survival enough? Shouldn't there be some kind of diffusion of the innovation, a spreading to other locations and maybe even other countries? And what about funding? What if the social innovation only has survived because it has attracted public funding? Social innovation has attracted interest because it was based on private initiative and promised to supplement and even replace public arrangements. It would become less interesting if it were to depend on public funding. On the other hand, one can argue that an important measure of success for privately initiated social innovation is that it becomes institutionalized. Institutionalization can involve public funding of similar initiatives in other places and communities, outside its original place of invention. But, institutionalization can also take the form of a change in behaviour by a substantial number of people (e.g., refusing plastic bags in supermarkets) or a new code of conduct for multinational corporations (e.g., purchasing textiles in developing economies). Successful social innovation will indeed be characterized by some form of formalization, institutionalization, or by changes in behaviour by a substantial number of people or companies. Differences may arise with regard to questions of scale. How many people should be involved in a local initiative before it can be called social innovation? What share of the population must change their behaviour before we speak of successful social innovation?

Social Entrepreneurship

As noted, social innovation is usually a result of private initiative. The initiative can also come from people working in the public sector, but new social legislation initiated by politicians is usually not seen as social innovation – however innovative it may be. The people engaged in social innovation have an idea – a product, service, or model (Dro et al., 2011) – to meet an unfulfilled need. In line with Schumpeter (1934), who argued

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that innovation is the essence of entrepreneurship, social innovation is therefore associated with "social entrepreneurship".

There is a considerable literature on social entrepreneurship, which partly overlaps with the literature on social innovation. However, although definitions of social innovation have been relatively uncontroversial, there is considerable debate on the definition of social entrepreneurship (Mair & Marti 2006; Dacin et al., 2010). For some authors, social entrepreneurship is by definition not for profit (Dees et al., 2002; Weerawardena & Mort, 2006), whereas others argue that there is no such thing as entrepreneurship without profit (Acs et al., 2011; Marshall, 2010; Wilson & Post, 2011). Some authors emphasize that the concept should not be constrained by the profit/not-for-profit discussion (Dees & Battle Anderson, 2006; Kramer, 2005; Santos, 2009). Moreover, on closer inspection, the meaning of "non-profit" appears far from clear. Does it imply living off charity and subsidies? Does it include making no profits, but generating income to cover costs? Or making profits, but sharing profits with stakeholders?

Circular definitions abound in the literature, with "social" appearing on both sides of the equation. Social entrepreneurs are, for instance, defined as producers of social value – where social value remains largely undefined. Sometimes, social value is considered purely separate from economic value, but in other cases, economic value is seen as a type of social value, and then there are various options in between (Auerswald, 2009; Lumpkin et al., 2013). Obviously, there is no metric scale for happiness, active aging, social cohesion, or security. Some authors therefore underline that "social entrepreneurs" and "business entrepreneurs" have different ways of measuring performance. Contrary to business entrepreneurs, social entrepreneurs have a "double bottom line" in which social value appears next to financial value (Acs et al., 2013; Lumpkin et al., 2013). Other authors emphasize that social entrepreneurship is also a question of governance: both in the business process and in performance measurement, all stakeholders should play a role. Social entrepreneurship is then closely related to economic democracy.

Because of the lack of clear definitions, the literature is full of examples and case studies that are used to illustrate the authors' understanding of social entrepreneurship (Dees, 2001; Mort et al., 2003). Others criticize this approach (Mair & Marti, 2006; Peredo & McLean, 2007; Seelos & Mair, 2005) because it tends to focus on successful "heroes" and therefore fails to include the countless initiatives that falter or fail. Central to the discussion is the use of the adjective "social". In practice, people have different ideas of what is social and what is not. The term social appears to be inherently subjective. The meaning can differ between countries, but even between different regions of one country. It is negotiable and stakeholders can agree on what it is and what it is not (Lumpkin et al., 2013; Santos, 2009).

Social Entrepreneurs and "Normal" Entrepreneurship

Here, we focus on social entrepreneurs, who aim to be independent of public funding, charity, or gifts. They may receive some initial public funding or soft loans from a supportive patron, but they have a business model that aims at long-term survival without such support. In fact, we agree with other authors that, only in such cases, it is justifiable and interesting to speak of entrepreneurship. These social entrepreneurs aim to bring about change in society and support movement towards sustainable development by means of activities that raise so much income that all costs are covered and the enterprise remains financially independent. Looking at these social entrepreneurs, two important observations can be made.

First, these entrepreneurs need to be profitable in order to survive. Social entrepreneurs want to meet social needs, stimulate social change, or induce responsible behaviour. Therefore, making a profit may seem less relevant to them (Dees & Battle Anderson, 2006; Kramer, 2005; Santos, 2009). However, just like other entrepreneurs, they must find resources for their business: human capital, money, knowledge, etc. (Austin et al., 2006). Acquiring these resources involves costs. Social entrepreneurs will need to make some sort of profit in order to run a sustainable business, cover their costs, and manage their own risks and the risks of their investors, even while they are constantly led by their social mission. They have indeed a "double bottom line" with social and commercial purposes. Social entrepreneurs may need investors who step in for the long run and support them until they are able to pay the money back – but they do have to pay it back. From this perspective, social entrepreneurs do not differ very much from normal business entrepreneurs. Making profit is not their main aim, but they need to be profitable, or at least cover all relevant costs, in order to survive. In fact, there is a category of "social" enterprises that have been explicitly set up to make maximum profits for the benefit of some specific charity, for example, the commercial activities undertaken by the United Nations Children's Fund (UNICEF).

A second observation is that quite a few business entrepreneurs may not see themselves as social entrepreneurs, but are similarly less interested in profits and are more interested in, for instance, selling their invention or maintaining jobs in the business they have built up or inherited from their parents. The adjective "social" suggests that normal "business" entrepreneurs are not social or are even anti-social – something most of them would emphatically deny. And, what to do with "normal" entrepreneurs, who realize innovations with positive social impact? Take the Internet service Skype. A large number of elderly people have been able to be in regular contact with their children and grandchildren and even see them on screen without having to pay expensive telephone bills. For eliminating the isolation of elderly people, Skype could be called a social innovation. However, it is seldom classified as such, because its creators did not have "social" intentions. Unless we want to define social entrepreneurship purely in terms of declared intentions, it turns out to be far from easy to distinguish the social entrepreneur from the normal business entrepreneur.

These two observations lead us to the conclusion that distinguishing social entrepreneurs from business entrepreneurs is not very useful if not impossible, because the two categories show considerable overlap. We also reject the idea that social businesses have a double bottom line, whereas normal businesses do not. Instead, we think it is far more useful to acknowledge that every business has a financial as well as a social bottom line. Every company has some social and environmental impact (positive or negative), regardless of whether it is intended or not. Moreover, many "ordinary" enterprises today want to behave in a "socially responsible" way or, for example, have set themselves targets to reduce their CO2 footprint or mitigate other negative environmental impacts. If we move away from intentions and towards actual impact, some "normal" enterprises may turn out to be more social than some "social" enterprises. Arguing along similar lines, Pol and Ville (2009) have argued that social innovations and what they call business innovations show considerable overlap. However, they insist on maintaining the distinction. Our point is that it is more useful to consider "social" and "business" as dimensions of all innovations. Some innovations may score low on social and high on business or the other way around and many may score high on both, but any effort to draw a line between the two is arbitrary.

Two important implications can be drawn from this line of reasoning. First, there is no a priori reason why social entrepreneurs should be less profitable than normal entrepreneurs. Second, if social entrepreneurs want to receive special treatment because of their social goals, it is useful and indeed necessary to judge them on their impact, not their intentions, and to compare their impact with that of normal business entrepreneurs.

Examining Twenty "Social" Enterprises

With these implications in mind, we have taken a closer look at 20 Dutch social enterprises with a business model based on generating revenue through sales to customers. All of them are widely considered as "social" enterprises. The cases were selected from the network of the online community of ASN Bank (asnbank.nl), a medium-sized Dutch bank that focuses on sustainable investments, and the website of the Dutch organisation Social Enterprise NL (social-enterprise.nl). The mission of the consumer bank ASN is to promote sustainability in society. The economic conduct of the bank (i.e., investing the savings entrusted to it by its clients) is guided by that principle and is based on three criteria: i) promoting and defending human rights (people); ii) preventing climate change; and iii) maintaining biodiversity on the planet. The bank does not lend money to enterprises, it only invests in various securities, but it provides social entrepreneurs with network linkages, knowledge, training, and some start-up money through its online community of over 50,000 members and 1,000 projects and startups. We selected enterprises with paying customers and a business-to-consumer strategy from four different areas, which relate to the themes of the online community: i) fashion and design; ii) food; iii) social cohesion; and iv) energy and technology. The enterprises vary in scope and scale from local to national and international.

We are interested in three questions:

1. What is the social impact of these enterprises?

2. Is their social impact considerably higher than that of similar "ordinary" enterprises active in the same market?

3. Are these enterprises financially viable? An enterprise that is financially viable, but has no extraordinary social impact, cannot be called a "social" enterprise; an enterprise that aims to achieve an extraordinary social impact, but fails to survive without permanent financial support, stops being an enterprise.

In this article, we focus mainly on questions 1 and 3; question 2 is an area of ongoing research.

We base our analysis primarily on information available on the websites of these enterprises, but we contacted the companies if their website did not include some of the information needed (e.g., figures on turnover and number of sales transactions). Table 1 provides a brief overview of the cases.

All of these enterprises have paying customers. Although some of the companies also engage in business-to-business activities, they all operate in the consumer market. The number of customers varies greatly, as measured by the number of consumers buying the company's product in shops or through other sales channels. Because some of the enterprises did not want precise figures to become public, we distinguish three different ranges: small (up to 5,000 customers); medium (between 5,000 and 25,000); and large (more than 25,000 customers per year). These ranges allow rough, relative comparisons; but of course, it is easier to reach a large number of customers selling chocolate bars than solar lights.

Looking at the aims of the enterprises, we distinguish between "people" (e.g., social cohesion, human rights) and "planet" (e.g., saving energy, recycling, improving biodiversity) on the one hand and between enterprises aiming to change the behaviour of individual consumers and enterprises promoting institutional change (e.g., influencing large corporations or policy makers). Based on these two dimensions, we have placed the 20 enterprises in a 2x2 matrix (Figure 1) based on their primary focus. Obviously, some of these enterprises aim to help people as well as the planet, and it is not always easy to say where their primary focus lies. However, we use this matrix only as a heuristic device, to see if grouping enterprises along these lines leads to additional insights. The enterprises with a large number of customers (i.e., more than 25,000) or that are operating on an international level are printed in bold and italics.

Fourteen of the enterprises studied aim to influence consumer behaviour as their primary focus and they include several large enterprises with over 25,000 customers a year. Six enterprises focus primarily on influencing institutions, three of which have an international scope. First, note that there are large enterprises in each section of the matrix. Size (i.e., turnover, number of customers, international presence) is obviously a measure of social impact. Apparently, it is possible to be successful regardless of whether the primary focus of the enterprise is on people, the planet, influencing behaviour, or effecting institutional change. A second observation is that there are many more enterprises combining a focus on the planet and influencing behaviour. Of course, this bias may be a result of our selection, and we cannot claim to present a representative sample. Nevertheless, we do not think this finding is a coincidence. It seems to be far easier to convince con-

	People	**Planet**
Behavioural Change	• ***Waka Waka*** • ***Tony Chocolonely*** • ***Fair Phone*** • ***O My Bag***	• ***Dopper*** • ***OAT shoes*** • Snappcar • ***Thuisafgehaald*** • ***Prof Grunschnabel*** • ***De Buurtboer*** • ***Taxi Electric*** • ***Peerby*** • ***RESCUED!*** • ***Roetz Bikes***
Institutional Change	• Zorg voor elkaar • ***A Beautiful Story*** • De Mantelaar • Granny's Finest	• ***Studio Jux*** • ***Chocolatemakers***

Figure 1. Primary focus of the 20 enterprises in this study.
(The names of large or international enterprises are printed in bold and italics.)

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Table 1. Details of the 20 enterprises in this investigation *(continued on next page...)*

Theme	Enterprise	Mission Statement	Type	Customer Base*	Scale
Food	**Tony Chocolonely** www.tonychocolonely.nl	Crazy about chocolate, serious about people	For profit	Large	National
	Chocolatemakers chocolatemakers.nl	(Not mentioned on the website)	For profit	Large	International
	De Buurtboer debuurtboer.nl	To stimulate the use of biological, local, and seasonal products in company canteens.	For profit	Large	National
	Professor Grunschnabel grunschnabel.nl	Natural vegetable ice cream	For profit	Large	International
Fashion & Design	**Studio Jux** studiojux.nl	Studio JUX = design + eco + fair (people, planet, profit). Sustainability is in our DNA.	For profit	Large	International
	A Beautiful Story abeautifulstory.nl	A beautiful story improves fair trade by creating opportunities for producers in a difficult economic environment.	For profit	Large	International
	O My Bag omybag.nl	We, at O My Bag make great bags that will not only make you happy, but also the world around you. We aim to harness the power of business to create social change.	For profit	Large	International
	Granny's Finest grannysfinest.nl	Kickstart young designer talent and improve the well being of elderly people.	Non-profit /hybrid	Small	National
	RESCUED! rescued.nl	RESCUED! Stands for the indoor and outdoor products that are made of used materials, with respect for their original beauty.	For profit	Medium	International
	OAT Shoes oatshoes.com	Our future lies in a reconciliation between industry and nature, between mankind and nature. We have to close the loop, come full circle and realize we’re an integral part of the whole thing.	For profit	–	International
	Roetz Bikes roetz-bikes.com	Roetz-Bikes makes stylish city bikes with hands and heart, bikes with a history that are ready for a second life.	For profit	Small	International
	Dopper dopper.nl	Dopper stops plastic waste.	For profit	Large	International

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Table 1. Details of the 20 enterprises in this investigation *(...continued from previous page)*

Theme	Enterprise	Mission Statement	Type	Customer Base*	Scale
Social Cohesion	**Mantelaar** demantelaar.nl	Mantelaar is the second-best solution for elderly people in need.	For profit	Small	National
	Zorg voor Elkaar zorgvoorelkaar.com	Zorg voor Elkaar is an online marketplace for volunteers and professionals who want to help others.	Co-operative	Medium	National
	Taxi Electric taxielectric.nl	Our mission is to be the most client oriented and cleanest taxi service in the Netherlands.	For profit	Large	National
	Thuisafgehaald thuisafgehaald.nl	Thuisafgehaald improves the social cohesion in neighbourhoods by making it possible to share food and reduces waste.	Founda-tion	Large	International
	Peerby peerby.nl	80% of the products we own are used only once a month. Why buy if you can borrow for free?	Profit	Large	International
	Snappcar snappcar.nl	Snapp car tries to reduce the number of cars by making it possible to share your car with others and as a by-product meet new people too.	For profit	N/A	National
Energy & Technology	**Waka Waka** waka-waka.com	Waka Waka makes the world's most efficient lights and chargers on solar energy. High tech, cheap and a solution for people without electricity all over the world.	For profit	Large	International
	Fair Phone fairphone.com	Fairphone is a social enterprise working to create a fairer economy and change how things are made. We open up supply chains, solve problems and use transparency to start debate about what's truly fair.	For profit	Large	International

* Small = up to 5,000; Medium = 5,000 – 25,000; Large = > 25,000 customers

sumers to buy products with a positive environmental story than products with a story that focuses on people. For the latter purpose, consumers are more inclined to think in terms of either donations and charity or in terms of state responsibilities. Similarly, there are fewer enterprises having a primary focus on institutional change than on influencing individual behaviour, but it is interesting to note that promoting institutional change can be the focus of profitable entrepreneurial activities and not just of non-governmental organizations and non-profit organizations.

The 20 enterprises clearly differ in their social impact. Apart from the number of customers they reach, they differ in geographical scope and in the breadth of their impact on people, the environment, or both. Waka Waka, for instance, scores high on all of these points. It has distributed 97,209 solar lights and chargers in 25 countries. Its product is environmentally friendly and allows people to (learn to) read in the evening hours in places where no electricity is available. An enterprise such as Granny's Finest has a far more limited scale and scope, but we do not argue here that Waka Waka is more social than Granny's Finest. It would be easy to develop a scale on which Waka Waka could be shown to be more social, but it would probably be as controversial as earlier efforts in that direction. The point we would like to make here, is that such scales should and can be applied to ordinary enterprises just as well as to so-called social enterprises. It should be possible to measure the social impact of normal enterprises with, for instance, an ambitious corporate social responsibility strategy just as easily as measuring the impact of social enterprises.

Conclusions

The main contribution of this article is a clarification of the concept of social entrepreneurship. We propose that "social" should not be used as an adjective to entrepreneurship, which suggests that some entrepreneurs are social and others are not, but as a dimension of the results of entrepreneurial action. Entrepreneurship can have social results, intended (by what are often called social entrepreneurs), but also unintended (when a business idea leads to social change) or maybe half-intended. New ideas, new products, or new services, may turn out to be social innovations regardless of any social impact intended by the inventor. It may well be far easier to define, distinguish, and compare the social impact of enterprises than to come up with a solid criterion to distinguish "social" enterprises from "regular" enterprises. At the same time, focusing on impact instead of on intentions makes it far easier to treat "social" entrepreneurs as "normal" entrepreneurs, who have to meet certain standards to stay in business.

Our investigation of 20 social enterprises shows that these companies with a variety of social intentions can be successful in terms of their customer base, their turnover, and indeed their profitability. Conversely, we argue that "normal" enterprises can also be successful in terms of their actual impact on human rights, climate, biodiversity, etc. Therefore, social enterprises should allow themselves to be compared with normal businesses with regard to their impact. If they are truly "social", they should perform much higher on various indicators of social impact than ordinary businesses, while at the same time showing a financial performance that guarantees survival. The aim of this article is therefore to put an end to considerable confusion in the literature concerning the definition of social entrepreneurship. At least for the category of social entrepreneurs that do not want to depend on charity or government subsidies, we have shown that it is more fruitful for all stakeholders to consider "social" as a "normal" dimension of all entrepreneurship, regardless of the intentions or self-image of the entrepreneur.

We see several important practical implications arising from our research. First of all, it is important to encourage would-be social entrepreneurs to learn from "normal" entrepreneurs. Instead of thinking of themselves as incomparable, the social entrepreneurs should learn to see themselves as not that much different from ordinary entrepreneurs. This perspective will in all likelihood lead to more attention for the financial aspects of the business and therefore contribute to the viability and success of the social enterprise.

Second, "normal" entrepreneurs should be encouraged to think about possibilities to engage in social innovation instead of thinking that social innovation is something for government, foundations, charity, or non-profit organizations. By uncovering the social dimension of their activities, companies may find ways to increase their impact and at the same time improve their competitive performance.

Third, political actors have been encouraged to think of social change as the result not just of legislative action, but also of social entrepreneurship. It is important for them to realize that social innovation can also be a product of normal business entrepreneurship.

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Finally, further research is needed to compare avowed social enterprises with normal enterprises. For this purpose, efforts to create valid indicators for the social impact of enterprises need to be intensified. Such efforts can build on the work done in the fields of corporate social responsibility, quality of work, fair trade, and sustainability.

Social innovation is apparently happening in many places: in the public sector, in the non-profit sector, and also in the private sector. It can result from actions undertaken by public authorities and political actors as well as from private initiatives, both profit and nonprofit. Thus, the answer to the question raised in the title of this paper should be "no". Social innovation does not require social entrepreneurship, because there are other sources of social innovation. And, if we limit ourselves to the private sector, we have seen that social innovation can also be a product of normal business entrepreneurship. Social innovations should not be considered hugely different and separate from other innovations that are constantly being introduced by businesses. Thus, also in the private sector, social innovation does not require social entrepreneurship, but like any other innovation it does require entrepreneurship.

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References

Acs, Z. J., Boardman, M. C., & McNeely, C. L. 2013. The Social Value of Productive Entrepreneurship. *Small Business Economics,* 40(3): 785–796.
http://dx.doi.org/10.1007/s11187-011-9396-6

Auerswald, P. 2009. Creating Social Value. *Stanford Social Innovation Review,* Spring 2009: 50–55.

Austin, J., Stevenson, H., & Wei-Skillern, J. 2006. Social and Commercial Entrepreneurship: Same, Different or Both? *Entrepreneurship Theory and Proactive,* 30(1): 1–22.
http://dx.doi.org/10.1111/j.1540-6520.2006.00107.x

Dacin, P. A., Dacin, M. T., & Matear, M. 2010. Social Entrepreneurship: Why We Don’t Need a New Theory and How We Move Forward from Here. *Academy of Management Perspectives,* 24(3): 37–57.

Dees, J. G. 2001. *The Meaning of "Social Entrepreneurship".* Stanford, CA: Stanford Graduate Business School.

Dees, J. G., Emerson, J., & Economy, P. (Eds). 2002. *Strategic Tools for Social Entrepreneurs: Enhancing the Performance of Your Enterprising Nonprofit.* New York: John Wiley & Sons, Inc.

Does Social Innovation Require Social Entrepreneurship?

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Dees, J. G., Battle Anderson, B. 2006. Framing a Theory on Social Entrepreneurship: Building on Two Schools of Practice and Thought. *ARNOVA Occasional Paper Series,* 1(3). Aspen, CO: Aspen Institute.

Dro, I., Therace, A., & Hubert, A. 2011. *Empowering People, Driving Change: Social Innovation in the European Union.* Brussels: European Commission.
http://dx.doi.org/10.2796/13155

European Commission. 2010. *This is European Social Innovation.* Brussels: European Commission.
http://dx.doi.org/10.2769/825

Kramer, M. 2005. *Measuring Innovation: Evaluation in the Field of Social Entrepreneurship.* Boston, MA: Foundation Strategy Group.

Leadbeater, C. 1999. *Living on Thin Air.* London: Penguin Books.

Lumpkin, G. T., Moss, T. W., Gras, D. M., Kato, S., & Amezcua, A. S. 2013. Entrepreneurial Processes in Social Contexts: How Are They Different, If at All? *Journal of Small Business Economics,* 40(3): 761–783.
http://dx.doi.org/10.1007/s11187-011-9399-3

Mair, J., & Marti, I. 2006. Social Entrepreneurship Research: A Source of Explanation, Prediction, and Delight. *Journal of World Business,* 41(1): 36–44.
http://dx.doi.org/10.1016/j.jwb.2005.09.002

Marshall, R. S. 2010. Conceptualizing the International For-Profit Social Entrepreneur. *Journal of Business Ethics,* 98(2): 183–198.
http://dx.doi.org/10.1007/s10551-010-0545-7

Mort, G. S., Weerawardena, J., & Carnegie, K. 2003. Social Entrepreneurship: Towards Conceptualisation. *International Journal of Entrepreneurial Behaviour & Research,* 8(1): 76–88.
http://dx.doi.org/10.1002/nvsm.202

Moulaert, F., MacCallum, D., Mehmood, A., & Hamdouch, A. (Eds.). 2013. *The International Handbook on Social Innovation.* Cheltenham: Edward Elgar

Peredo, A. M., & McLean, M. 2006. Social Entrepreneurship: A Critical Review of the Concept. *Journal of World Business,* 41(1): 56–65.
http://dx.doi.org/10.1016/j.jwb.2005.10.007

Pol, E. & Ville, S. 2009. Social Innovation: Buzz Word or Enduring Term? *The Journal of Socio-Economics,* 38(6): 878–885.
http://dx.doi.org/10.1016/j.socec.2009.02.011

Santos, F. M. 2012. A Positive Theory on Social Entrepreneurship. *Journal of Business Ethics,* 111(3): 335–351.
http://dx.doi.org/10.1007/s10551-012-1413-4

Schumpeter, J. A. 1934. (Reprinted in 1980.) *The Theory of Economic Development.* London: Oxford University Press.

Short, J. C., Moss, T. W., & Lumpkin, G. T. 2009. Research in Social Entrepreneurship: Past Contributions and Future Opportunities. *Strategic Entrepreneurship Journal,* 3(2): 161–194.
http://dx.doi.org/10.1002/sej.69

Seelos, C., & Mair, J. 2005. Social Entrepreneurship: Creating New Business Models to Serve the Poor. *Business Horizons,* 48(3): 241–246.
http://dx.doi.org/10.1016/j.bushor.2004.11.006

Thompson, J. 2002. The World of the Social Entrepreneur. *International Journal of Public Sector Management,* 15(5): 412–431.
http://dx.doi.org/10.1108/09513550210435746

Weerawardena, J., & Mort, G. S. 2006. Investigating Social Entrepreneurship: A Multidimensional Model. *Journal of World Business,* 41(1): 21–35.
http://dx.doi.org/10.1016/j.jwb.2005.09.001

Wilson, F., & Post, J. E. 2013. Business Models for People, Planet (& Profits): Exploring the Phenomena of Social Business, a Market-Based Approach to Social Value Creation. *Journal of Small Business Economics,* 40(3): 715–737.
http://dx.doi.org/10.1007/s11187-011-9401-0

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Disruptive Innovation vs Disruptive Technology: The Disruptive Potential of the Value Propositions of 3D Printing Technology Startups

Finn Hahn, Søren Jensen, and Stoyan Tanev

> *"The distinctions we use to build a language and discuss strategy are as commonsense as left/right and up/down, but they rise from the specifics of the business context rather than everyday life."*
>
> J.-C. Spender
> Engineer, professor, and author

This article describes an empirical study focusing on the classification of existing business opportunities in the 3D printing technology sector. The authors address three research questions. First, how do technology startups integrate new 3D printing technologies into specific market offers? Second, which value propositions are most attractive in terms of interest from the public and investors? Third, how does the degree of disruptiveness of value propositions relate to the degree of interest from the public and investors? The most notable finding is the link between the business traction of 3D printing technology startups and the degree of disruptiveness of their value propositions. Thus, the article provides empirical support for the conceptualization of the degree of disruptiveness of the value proposition as a metric for the evaluation of the business potential of new technology startups.

Introduction

3D printing is a term used to describe the production of tangible products by means of digitally controlled machine tools. The novelty of this manufacturing approach consists of the selective addition of materials layer-upon-layer, rather than through machining from solid material objects, moulding, or casting. There is clearly articulated perception by both scholars and practitioners that 3D printing technologies have the potential to change the traditional manufacturing paradigm as well as to enable the emergence of new innovation practices based on mass customization, user design, and distributed product innovation. As a result, 3D printing is considered to be a truly disruptive technology. At the same time, however, it is an emerging technology that is exploited today by only a small number of early global adopters (McKinsey & Company, 2013). It appears to be significantly over-hyped, which could potentially demotivate the variety of potential adopters who could influence the dynamics of its technology adoption life cycle.

The existing literature focusing on 3D printing is very scarce and appears to suffer from a "double disease". First, it appears dominated by consultancy reports and reviews by practitioners, which lack the methodological depth and the predictive power of serious research studies. Such publications contribute to the hype without offering much analytical substance. Second, it is dominated by technical publications, which, although highly valuable, focus on the engineering aspects of the technologies and much less on the specific ways they are expected to disrupt the existing manufacturing and innovation practices. In addition, there seems to be confusion in the use of the terms "disruptive technology" and "disruptive innovation" (Christensen, 2006; Schmidt et al., 2008; Hang et al., 2011), which does not really help in examining the market opportunities associated with specific 3D printing technologies. All this suggests the need for more systematic studies focusing on the potential business and investment opportunities associated with the emergence of 3D printing technologies.

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The present article addresses the lack of literature on 3D printing innovation by offering the results of an empirical study focusing on the classification of emerging business opportunities in the 3D printing technology sector. It starts with a brief description of the technology sector and continues with the description of the methodology. One of the key research steps includes the evaluation of the disruptiveness of the different types of value propositions with respect to existing ways of user involvement in design, manufacturing, and product customization. The evaluation focuses on how the market offers address the needs of new market segments in a convenient and affordable way as well as on the way they address overshot customers in existing markets that are currently overlooked by incumbent firms. The summary of results helps in comparing the degree of disruptiveness of the value propositions to the degree of public and investor interest. The article ends with a brief conclusion which emphasizes some the key findings and helps in conceptualizing the degree of disruptiveness of the value propositions as a metric for the evaluation of the business potential of new technology startups.

The 3D Printing Technology Sector

The 3D printing sector has enjoyed sustained double-digit growth in recent years, and it is realistic to forecast the sector to be worth more than $7.5 billion USD by 2020 (McKinsey & Company, 2013). There are clearly opportunities for the adoption of this technology in key sectors such as aerospace, medical devices and implants, power generation, automotive manufacturing, and the creative industries. Many companies have already assessed the technology or have begun using it on a small scale. In addition, 3D printing technologies could reduce the use of materials, energy, and water by eliminating waste together with all additional harmful process enablers, thus having a positive impact on sustainability (Cozmei & Caloian, 2012). Due to their digital nature, 3D printing technologies are progressively being integrated with the Internet, which enables consumers to engage directly in the design process, and allows for true customer co-creation and personalization. The adoption of 3D printing is expected to stimulate the emergence of alternative business models and supply-chain management approaches by mitigating the need for expensive tooling, freeing up working capital within the supply chain, and reducing business risk in new product development and innovation. There is a growing perception among both innovation scholars and business experts that 3D printing technologies will generate a new wave of technology adoption that could be associated with the emergence of multiple business opportunities for both technology entrepreneurs and existing firms. There is, however, little research on the specific ways 3D printing technologies are integrated into specific market offers as well as the potential business models that could help in delivering the corresponding value propositions.

Cozmei and Caloian (2012) have summarized the benefits of 3D printing technologies by pointing out that they are particularly relevant where:

- the production volumes are low, which is typical of companies engaging in small batch production
- the geometries of the parts and their assembly are complex
- the design complexity and capability should be maximized with no cost penalty
- there is a need for shorter lead times
- there is a need to personalize products and there is an opportunity to differentiate by offering unique personalized products
- the fixed-cost tooling cannot easily be amortised into the price of the individual parts
- the customer base is widely distributed and target customers or suppliers have ethical or environmental concerns
- the materials that are used are expensive and difficult to process by conventional means

Despite all the benefits, the adoption of 3D printing technologies is associated with several technological issues, including the lack of a supportive framework, comprehensive underfunding, and the absence of proper industry standards (Royal Academy of Engineering, 2013). A recent roundtable forum hosted by the Royal Academy of Engineering in the United Kingdom enumerated several key problems:

1. *Materials:* There is a great demand for better materials to be used in 3D printing processes. Although new metal alloys are already addressing some key manufacturing needs, polymers require greater research and development. In addition, whereas metals are often recyclable, polymers have a much lower degree of recyclability.

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2. *Software:* Existing computer-aided design (CAD) systems are not at all suited for exploring the design freedom of 3D printing processes. The organic shapes required for biomimetics, for example, cannot easily be replicated using existing CAD systems, which are better suited to designs with many straight lines or circles. More importantly, CAD interfaces do not tend to be user friendly. Thus, the software problem is major issue for the adoption of 3D printing technologies, because the true potential of the new manufacturing paradigm can be actualized only if it reaches the non-expert designer.

3. *Data management:* Issues associated with data management are related to the need for substantial memory storage capacity, and not the manufacturing technology itself. In this sense, "rather than advancements in the machines themselves, software developments are what will 'drive the industry forward'" (Royal Academy of Engineering, 2013). It might be worth looking for insights from the development of the electronic design automation (EDA) industry, which could be quite useful in predicting some of the future trends in the evolution of 3D printing software design tools (MacMillen et al., 2000).

4. *Sustainability:* Although low-volume production offers opportunities for customization and reduction of materials, its benefits for sustainability are not always obvious. Although manufacturers are driven by efficiency goals that lower their carbon emission rates and energy consumption, homemakers can hardly be expected to care that much about wasted materials and energy. In this sense, the democratization of 3D printing design and innovation may introduce uncontrollable sustainability issues.

5. *Affordability:* There are significant financial overheads for running machines and buying feedstock for the 3D printing manufacturing process. Materials for 3D printing are significantly more expensive than traditional injection moulding materials.

6. *Production speed:* Although low-volume production using 3D printing technologies is faster than conventional manufacturing, higher-volume production is considerably slower. British experts believe that there will be a need for a new generation of machines in order for 3D printing to be able to compete and eventually replace injection moulding and casting machines (Royal Academy of Engineering, 2013).

7. *Reliability and reproducibility:* It is difficult for 3D printing technologies to compete with traditional techniques in terms of reliability and reproducibility. Traditional manufacturing methods aim for a rejection rate of just a few parts per million, which cannot be achieved with current 3D printing technology (Royal Academy of Engineering, 2013).

8. *Intellectual property rights*: Compared to traditional manufacturing, there is a much greater potential for users to infringe copyrights using 3D printing technologies, especially in combination with 3D scanning technology. Insights into this key issue may be gleaned from the experiences and business practices within the open source software domain, which contributed to the rethinking of earlier ways of managing intellectual property rights (Cohendet & Pénin, 2011).

9. *Industry standards:* There is a need for a set of standards that would provide the necessary assurance to businesses and manufacturers that 3D printing processes, materials, and technologies are safe and reliable. The challenge here would be to quickly introduce key formal standards to the sector, while leaving room for open innovation.

10. *Funding:* Government programs to encourage companies to enter the sector and university research focusing on increasing the awareness of potential benefits and business opportunities associated with the adoption of 3D printing technologies could help drive the adoption of the new technology.

Research Methodology

The objective of this research is to empirically examine emerging 3D printing business opportunities by studying technology startups in this sector. To meet this objective, we have addressed three research questions:

1. How do technology startups integrate new 3D printing technologies into specific market offers?

2. Which value propositions are most attractive in terms of interest from the public and investors?

3. How does the degree of disruptiveness of value propositions relate to the degree of interest from the public and investors?

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For the sake of this research, we conceptualize a value proposition by means of three components: i) the specific market offer; ii) the target customer; and iii) the job that the target customer is trying to do by using the market offer (Johnson et al., 2008).

Information about the value propositions was complemented by the specific profit formula and the key human and technology resources used by the startups to develop their market offers. The focus on technology startups (i.e., technology companies incorporated within 3 years from the start of the study) allows the development of insights about emerging business opportunities that are currently explored by entrepreneurs across the world. Finally, the research aims to conceptualize the degree of disruptiveness as part of the evaluation criteria of emerging business opportunities by both entrepreneurs and investors.

Research design

The research study adopts a combination of qualitative and quantitative approaches. It is based on a research sample of 79 3D printing startups (up to three years old) that were labelled as such on the AngelList startup platform (https://angel.co/3d-printing). The AngelList platform was chosen as a source for data collection because it provides publicly available online information about:

1. The classification of the startups in terms of their main technology orientation.

2. The composition of their executive management team.

3. The websites of the firms with all the additional information about their mission, products, hiring priorities (job announcements), etc.

4. Their investors, and the type and amount of the investments.

5. The number of people interested in following their progress (i.e., their online "followers").

6. The ranking of the firms on the basis of a proprietary composite metric corresponding to their business traction (signal).

We examined the information about each of the 79 startups included in the sample by focusing on: the description of the firm, including its location, year of incorporation, mission statement, etc.; the market offer; the target customer; whether the startup offers a product or a service; the number of investors and the total amount of investments attracted by the firm; the public interest in the firm expressed as the number of followers on the AngelList platform; the signal value as a measure of the business traction of the firm, as estimated by the AngelList experts. The market offer of each of the value propositions was analyzed along several constitutive dimensions by examining: whether the offer is hardware or software; whether it integrates the 3D printing technology (and how); whether there are any online tools available to support its use; and whether there are any open source hardware or software products that could complement its value in use. The examination of the market offer, the target customers, and the "job to be done" by the target customers resulted in a classification of the value propositions of all the firms included in the sample and a comparative analysis of the different types of value propositions in terms of their business traction (signal), investments, number of followers and degree of disruptiveness.

In addition to analyzing the startups using the metrics from the AngelList platform, we evaluated the disruptiveness of the value propositions by using the Disrupt-o-Meter tool suggested by Anthony and colleagues (2008). The tool was designed to evaluate the degree of disruptiveness of company offers to particular customer target segments with respect to existing solutions (including the lack of solutions associated with non-consumption). We used the tool to evaluate the seven value propositions by considering their specific market offers against nine different criteria (Table 1). Each of the nine criteria is evaluated by choosing between one of three options corresponding to 0, 5, or 10 points. At the end, all points are summed to provide the value of the Disrupt-O-Meter up to a maximum of 90 points: the higher the value, the more disruptive the value proposition.

Classification of the Value Propositions

This section provides an overview of the results from the analysis of the data collected from the AngelList startup platform. The value propositions of the 79 startups were categorized in seven types with respect to their specific market offers (Table 2).

Type A: Access to online printing networks offered by firms that do not own the printers

The customer value of the access to such networks is two-fold. First, it offers a relatively easy and affordable option for people or organizations interested in print-

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Table 1. Evaluation criteria included in the Disrupt-O-Meter (Anthony et al., 2008)

	Evaluation Criteria	0 points	5 points	10 points
1	**First-year target**	Mass market	Large market segment	Niche market
2	**Customers' opinion about the job to be done**	Needs to be done better	Needs to be done less expensively	Needs to be more easily
3	**Customers' view on offer**	Perfect	Good	Good enough
4	**Customers' view on price**	High	Medium	Low
5	**Business model**	What has been always done	What has been always done but with a few tweaks	Radically different
6	**Channel to market**	Existing	At least 50% new	Entirely new channel
7	**Competitors' urgency to do something**	Willing to act as soon as possible	Willing to watch for any new developments very carefully	Do not care
8	**Expected first-year revenue**	Large	Average	Small
9	**Required investment over next 12 months**	Above average	Average	Below average

Table 2. Classification of the value propositions of the startups with respect to their market offers

Type	Market Offer Description	Number of firms
A	Access to online printing networks allowing both printing services and offering the use of privately owned printers at a cost as part of the network resources (i.e., the firms managing the networks do not own the printers).	14
B	Online printing services offered through a platform enabling the access to a network of 3D printers. The firms managing the networks own the printers.	12
C	Design tools and software applications for 3D modelling.	4
D	3D model-generation products such as scanners or special cameras.	4
E	Commercial 3D printers that anyone can afford to purchase.	15
F	Online 3D printing services with a focus on a particular application such for printing action figures or toys.	5
G	Specialized applications of 3D printing (usually business-to-business).	4
Other	Individual market offers that are different from the ones given above.	21

ing services. The online network platform takes care of everything around the job. Second, it offers an option for people or organizations owning 3D printers to integrate their printers as part of the network resources and make revenue through the printing services by sharing that revenue with the network administrators. The access to such networks can be an affordable entrance point for local "maker movements" or just an opportunity to meet other people sharing the same professional interests. The customer has the option of using print service anonymously. Once printed, the object is shipped by mail and the payment can be handled through the company's website.

Type B: Online printing services through a platform enabling the access to a network of 3D printers
Besides getting the desired object printed, the platform makes it easier for customers to either become designers themselves or to access the innovative designs of others. Some of the companies managing such platforms offer tools for collaborative work around the design of the objects, thereby ensuring a growing library of models for the customers and the possibility to be part of the design process.

Type C: Tools and software applications for 3D modelling used in the 3D printing process
The software tools allow customers to easily create and modify 3D objects and models. In this way, users with no prior CAD knowledge are able to model 3D objects in a convenient and simple way. These tools can be seen as complementary products to the 3D printing machines, because they enable home users to create their own input models for their 3D printers.

Type D: 3D model-generation products such as scanners or special cameras
These companies enable customers to convert their own existing 2D pictures into working 3D scans. In this way, customers can create content for their own 3D printers or share models on the Internet. Further, this technology converts an existing printer into a 3D "copy machine" because it easily allows people to digitize real-world models. These tools can be also seen as complementary products to the 3D printing machines, because they enable home users to capture their own input models for their 3D printers.

Type E: Commercial 3D printers that anyone can afford to purchase
The direct value for the customers is to be able to print 3D models at home. Some of the companies are further engaged in delivering less expensive materials for the printing process. One company (Honeycomb Technologies) enables doctors to print customized exoskeletons to support the healing of fractured bones, as an alternative to plaster or fibreglass casts. Further, these printers can significantly lower the barriers to manufacturing. For a few hundred dollars, customers can assemble a small factory that can make fully customized plastic parts for products or they can use printing networks or services.

Type F: Online 3D printing services with a focus on a particular application such as for printing action figures or toys
The value for the customers is grounded in the opportunities for customization. The high degree of potential customization makes the offer highly valuable for every single customer.

Type G: Special applications of 3D printing (usually business-to-business)
Customers benefit from access to state-of-the-art advances in 3D printing technologies and processes, which enable them to do things they were not able to do before (e.g., mass customization). They are also able to enhance existing processes to work faster or better, for example, through enhanced processes for medical doctors or the use of new resins or other materials.

Comparative Analysis of the Different Types of Value Propositions

The value propositions associated with the seven market offers A to G (Table 2) correspond to 73% of the firms. The value propositions of the rest of the (or other) firms were based on unique specialized market offers that did not fall into the seven categories given above and were not included in the analysis. Figure 1 shows that the three highest ranking value propositions in terms of business traction are not the ones focusing on the production of 3D printers, but are those offering design tools and software applications for 3D modelling (market offer type C), 3D model-generation products such as scanners or special cameras (market offer type D), and online 3D printing services with a focus on a particular application such as action figures or toys (market offer type F).

A report by McKinsey & Company (2013) suggests a similar conclusion: "The success of 3D printing also depends on improvements in products such as design software, 3D scanners, and supporting software applications and tools. Commercial 3D scanners are an important enabling technology." Companies selling

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affordable 3D printers (market offer type E) are fourth in the list in terms of their business traction (Figure 1). At the same time, these companies rank highest in terms of the amount of investments and the number of followers interested in knowing about their future progress (Figures 2 and 3).

The three value propositions that rank highest in terms of number of investors in the corresponding companies are selling commercial 3D printers that anyone can afford to purchase (Figure 2, market offer type E), online 3D printing services with a focus on a particular application such as action figures or toys (market offer type F), and companies developing and offering design tools and software applications for 3D modelling (market offer type C). These findings suggest that investors tend to prefer more tangible products that are in the very core of the technology sector.

The three highest ranking value propositions in terms of number of followers of the corresponding companies are selling commercial 3D printers that anyone can afford to purchase (market offer type E), online 3D printing services with a focus on a particular application such as action figures or toys (market offer type F), and companies with 3D model-generation products such as scanners or special cameras (market offer type D). The comparison between Figures 2 and 3 suggests that followers are attracted to the companies with the highest degree of external investments.

Table 3 provides a quantitative representation of the comparison of the different value propositions in terms of their degree of disruptiveness. It is based on the criteria described in Table 1.

Figure 4 provides a visual representation of the results from the application of the Disrupt-O-Meter tool. The ranking is based on the data presented in Table 3. The Disrupt-o-Meter analysis shows that the offers associ-

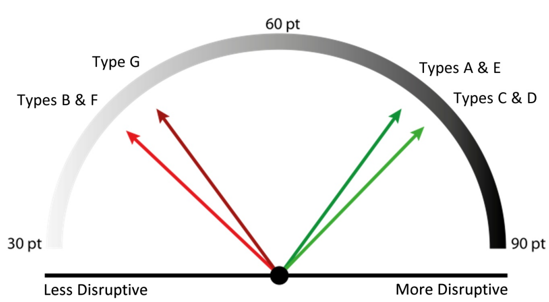

Figure 4. A visual representation of the ranking of the value propositions in terms of degree of disruptiveness

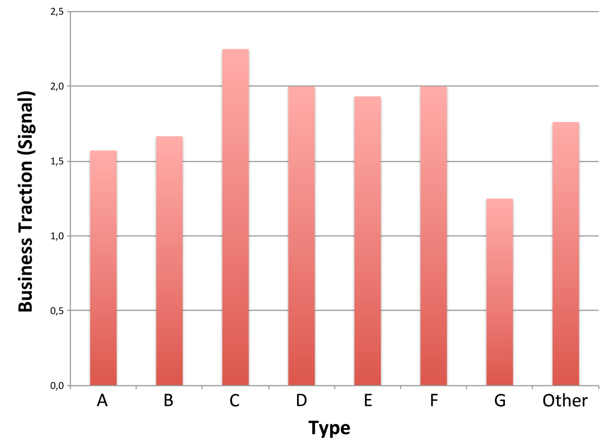

Figure 1. Ranking of the 3D printing value propositions in terms of their business traction

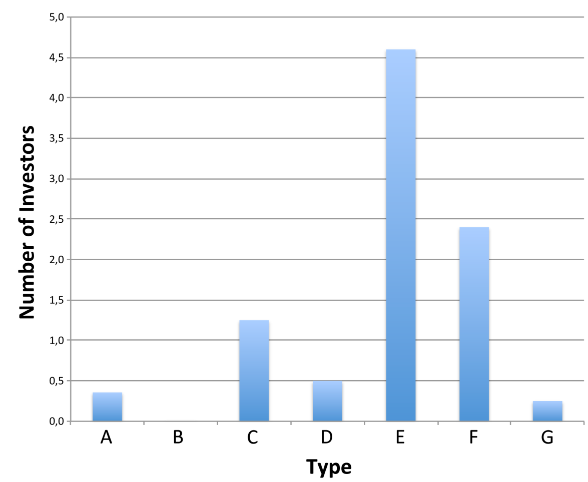

Figure 2. Ranking of the 3D printing value propositions in terms of number of investors

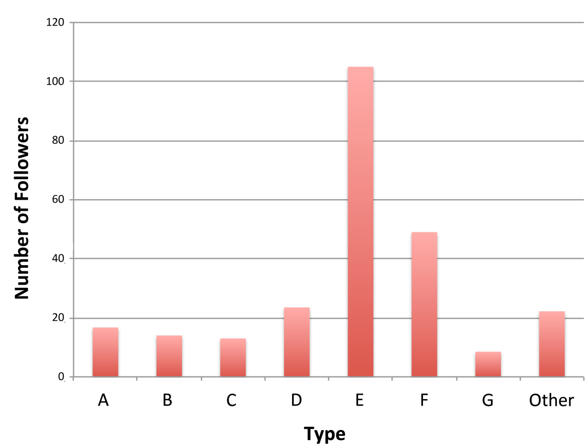

Figure 3. Ranking of the 3D printing value propositions in terms of number of followers

Table 3. Evaluation of the disruptiveness of the different types of market offers on the basis of the Disrupt-O-Meter tool (Anthony et al., 2008)

	Disruption Criteria	Type A	Type B	Type C	Type D	Type E	Type F	Type G
1	**First-year target**	10	5	10	10	10	10	10
2	**Customers' opinion about job to be done**	10	10	10	10	10	0	10
3	**Customers' opinion about the offer**	5	5	10	10	5	0	5
4	**Customers' opinion about the price**	5	0	10	10	10	0	0
5	**Business model**	10	5	5	5	5	5	5
6	**Channel to market**	10	5	5	10	10	5	5
7	**Competitors' urgency to act**	5	5	10	5	5	10	5
8	**First-year revenue**	10	5	10	10	10	10	5
9	**Investment over next 12 months**	10	5	10	10	10	5	5
	Total points	**75**	**45**	**80**	**80**	**75**	**45**	**50**

ated with model generation (market offer type C) and scanning software applications (market offer type D) are the most disruptive. The next two groups in terms of disruptiveness are the offers associated with online printing networks (market offer type A) and the 3D printers themselves (market offer type E). These results provide an opportunity to compare the disruptiveness of the value propositions to their business traction and the number of external investors.

The comparisons in Figures 5 and 6 show that the ranking of the value propositions in terms of business traction (signal quality) corresponds to the ranking in terms of the degree of disruptiveness but does not correspond to the one based on the number of external investors. This finding has two implications: i) the degree of disruptiveness could be used as a valuable metric in the evaluation of business traction and ii) investors do not seem to consider the degree of disruptiveness when rationalizing their investment decisions.

Conclusion

This article summarized the results of an empirical study focusing on identifying some of the emerging business opportunities in the 3D printing technology sector. The business opportunities was examined by studying the value propositions of startups operating in

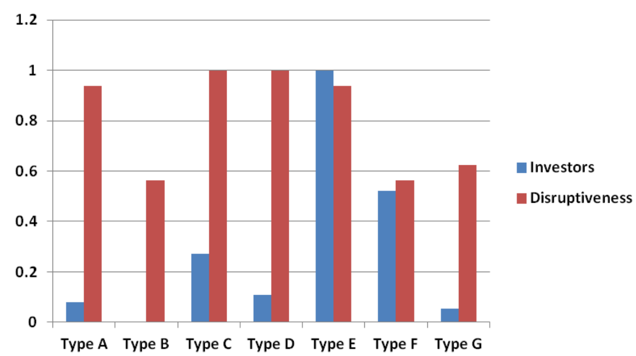

Figure 5. Comparing the disruptiveness of the value propositions to number of investors (normalized units)

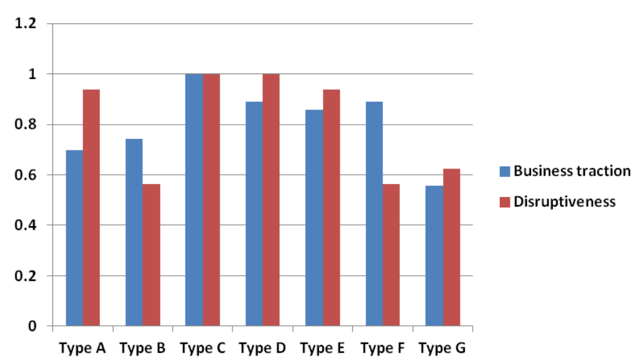

Figure 6. Comparing the disruptiveness of the value propositions to their business traction (normalized units)

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this technology sector. The assumption is that the value propositions of most recent startups are an indicator of the type of emerging opportunities in a specific sector. The most notable finding is the link between the business traction of 3D printing technology startups and the degree of disruptiveness of their value propositions. Therefore, the main contribution of this study is the empirical support for the conceptualization of the degree of disruptiveness of the value proposition as a metric for the evaluation of the business potential of new technology startups.

The article also contributes to the research stream focusing on 3D printing by discussing emerging business opportunities and suggesting a method for their evaluation. The methodology could be successfully applied to other emerging technologies. The results of the study will be relevant for both academic researchers and stakeholders in the public and private sectors; it may help them evaluate the competitive position of specific value propositions based on 3D printing technologies. It may also be relevant to potential investors who could use the research insights in rationalizing their investment decisions.

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References

Anthony, S., Johnson, M., Sinfield, J., & Altman, E. 2008. *The Innovator's Guide to Growth: Outting Disruptive Innovation at Work.* Boston, MA: Harvard Business Press.

Christensen, C. 2006. The Ongoing Process of Building a Theory of Disruption. *Journal of Product Innovation Management,* 23(1): 39–55. http://dx.doi.org/10.1111/j.1540-5885.2005.00180.x

Cohendet, P., & Pénin, J. 2011. Patents to Exclude vs. Include: Rethinking the Management of Intellectual Property Rights in a Knowledge-Based Economy. *Technology Innovation Management Review,* 1(3): 12–17.

Cozmei, C., & Caloian, F. 2012. Additive Manufacturing Flickering at the Beginning of Existence. *Procedia Economics and Finance,* 3: 457–462. http://dx.doi.org/10.1016/S2212-5671(12)00180-3

Hang, C. C., Chen, J., & Yu, D. 2011. An Assessment Framework for Disruptive Innovation. *Foresight,* 13(5): 4–13. http://dx.doi.org/10.1108/14636681111170185

Johnson, M., Christensen, C., & Kagermann, H. 2008. Reinventing Your Business Model. *Harvard Business Review,* 86(12): 50–59.

MacMillen, D., Butts, M., Camposano, R., Hill, D., & Williams, T. 2000. An Industrial View of Electronic Design Automation. *IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems,* 19(12): 1428–1448. http://dx.doi.org/10.1109/43.898825

McKinsey & Company. 2013. *Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy.* McKinsey Global Institute. Accessed December 1, 2014: http://www.mckinsey.com/insights/business_technology/disruptive_technologies

Royal Academy of Engineering. 2013. *Additive Manufacturing: Opportunities and Constraints.* London: Royal Academy of Engineering.

Schmidt, G., & Druehl, C. 2008. When Is a Disruptive Innovation Disruptive? *Journal of Product Innovation Management,* 25: 347–369. http://dx.doi.org/10.1111/j.1540-5885.2008.00306.x

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Keywords: 3D printing technology, additive manufacturing, disruptive innovation, value proposition

Turning Technology into Business Using University Patents

Dap Hartmann

> *I hear, I know.*
> *I see, I remember.*
> *I do, I understand.*
>
> Confucius (551–479 BC)
> Philosopher

We present an education paradigm that stimulates innovation and entrepreneurship through a master's-level university course: "Turning Technology into Business". The course was specifically designed to connect technological research with education using patented technologies developed at the research faculties of a technical university in the Netherlands. We outline the structure and the main content of the course and explain the selection process of both the patents used in the course and the students admitted to the course. This program was initiated at Delft University of Technology in 2003 and has resulted in 10 startups that have commercialized new technologies and at least two additional dozen startups that are indirect spinoffs. To illustrate the potential of this approach, we describe the case of Holland Container Innovations, a company founded by students who developed a foldable sea container during the course.

Introduction

New technologies that might provide solutions to practical problems are constantly being developed at technical universities worldwide. In most cases, the researchers involved report their findings in international scientific journals to share them with their colleagues in the field. Occasionally, these technologies are patented, thereby protecting the intellectual property rights. The question is: what happens next? Generally, the researchers move on to new projects and the university's technology transfer office is then responsible for finding interested parties to whom the university can license these patented technologies. Over the years, this approach has proven to be very difficult to execute because there is a large gap between the laboratory proof of principle that gave rise to the patent and a marketable application that utilizes the patented technology. For this reason most patents merely remain "solutions looking for a problem".

To bridge this gap and to overcome the deadlock, we designed the course "Turning Technology into Business". This elective course is aimed at Master's-level students, PhD students, and employees (researchers) of a technical university. For the sake of brevity, we will refer to all participants as *students*, even though about 10% of them are PhD students and employees. The course brings together diverse students; they come from different faculties and have different cultural and family backgrounds. The students work in interdisciplinary teams of four or five people so that their individual skills and competencies may complement each other. The synergy between, for example, Aerospace Engineering students, Industrial Design Engineering students, and students from the Business School is often very fertile because it combines the specific insights and tools from each discipline. Moreover, such diverse teams create opportunities for cross-over: solutions developed in one domain may solve problems experienced in another domain. Each multidisciplinary team investigates the commercial potential of a patented new technology developed at the Delft University of Technology (TU Delft; tudelft.nl/en/). The aim is to understand what the new technology enables users to do, why this is useful, which problem it solves, who is in needs of this solution, what they are willing to pay for that solution, and what alternative solutions already exists in the market today.

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Patents and Technologies

The core of the "Turning Technology into Business" course consists of new technologies developed at TU Delft. In most cases, these technologies are patented, but not necessarily so. For the sake of clarity, conciseness, and consistency, we will refer to all technologies used in the course as *patents*, even though some of the technologies are not (yet) patented.

In the early editions of this course, we mined the TU Delft patent portfolio in search of useful patents. But, after a few years, researchers became familiar with the concept of the course and started contacting us directly, offering new technologies they had developed or even technologies that were still in the process of being developed. It was clear to these researchers that a thorough investigation of the commercial potential of their new technology could provide useful guidance to the direction of further research and development. Rather than perfecting the technology before looking for marketable applications, it became clear that the technological capabilities should be matched with the societal needs in a cyclical feedback loop. Market needs should guide the technological development in the right direction. A "perfect solution" is not so much perfect in the technology as it is perfect in filling a need in the market.

The patents used in the course are selected on the basis of three criteria:

1. *Creative potential:* the technology offers sufficient creative possibilities for innovative applications

2. *Inventor involvement:* the inventor agrees to be involved in the early stages of the project

3. *Business potential:* the patent is available for commercialization.

Criterion 1: Creative potential
We prefer patents that have a broad applicability in a wide range of fields. For example, a patent for a mechanical balancing mechanism or patent for a device that actively compensates for unwanted motion is sufficiently versatile to enable finding innovative applications in different industries. In contrast, a patent for a highly specialized process for manufacturing one particular substance (ammonia, for example) leaves no room for creativity. Although there might be business opportunities related to this new process (when it is safer, or cheaper, or uses different raw materials) there is little creative challenge in what the patent will be used for (producing ammonia).

Criterion 2: Inventor involvement
The involvement of the inventor (i.e., the university researcher) is of paramount importance in the early stages of the project. The inventor knows much more about the technology than what is codified in the patent. Many patents do not contain specific parameters that may be crucial to the proper implementation of the technology. For example, a TU Delft patent for a sludge drier consists of two large transport screws in which hot steel balls are mixed with the sludge to evaporate the moisture and hence dry the sludge. But, the patent contains no information on the dimensions of the screws, the size of the compartments, or the rotational velocity (i.e., the transport speed) of the screw, nor on the size, the amount, or the temperature of the steel balls. In some cases, the ideal parameters are unknown to the inventor; in other cases, they may have been determined but are kept secret.

The inventor can answer questions regarding the technology and its applications. Is there a prototype? Which alternative similar technologies exist? Why was this technology developed? Which likely markets may benefit from this solution? What additional information is available that is not part of the patent? After providing the students with all relevant information, the inventor is kindly requested not to be involved anymore until the final presentations. Asking the inventor to step back from the process at this stage avoids the risk of "tunnel vision". In many cases, the technology was developed with a specific application in mind. We do not want the students to focus too much on that particular application. For example, students working on a patent describing a fibre-braiding technology developed at the faculty of Aerospace Engineering came up with a business idea to produce risers for the offshore oil industry. Originally, this technology was developed for braiding airplane fuselages. The students who developed the risers had no aerospace background and started a company called Straw Rising Technologies, which was later renamed Taniq (taniq.com).

Criterion 3: Business potential
It is rather pointless to name a course "Turning Technology into Business" if there is no possibility of the students starting a company to commercialize the technology they study in the course. Although the chances that this actually happens are modest, over the

past 12 years 10 companies have been founded as a direct result of the course. Therefore, it is important that the patents studied in the course are available for commercial use. It would demotivate the students who put a lot of effort into their project and want to start a company to discover that the patent cannot be licensed. There are a few TU Delft patents that have been licensed exclusively to third parties, and these patents obviously are not suitable for use in the course.

Team Selection and Patent Assignment

The course participants are master's-level students and PhD students from all eight faculties of TU Delft. Occasionally, researchers (employees) enrol in the course and bring their own technology to explore its potential business opportunities. The choice to focus on graduate students is motivated by two considerations. First, experience shows that these students possess the necessary scientific backgrounds and skills pertaining to their fields of expertise. For example, we consider a fifth-year mechanical engineering student to be a mechanical engineer, whereas a third-year student is merely a high school student who took courses in mathematics, physics, and mechanical engineering for two years but still needs to develop sophisticated mechanical engineering skills. Second, these students are close to graduation and are contemplating what to do next. One career option is to become an entrepreneur. Even though there is no guarantee that a viable business opportunity will emerge from the course, there is always a chance that this option will present itself. Third-year students would then be faced with the dilemma whether to continue their education (which would take another three years on average) or quit their studies to pursue this business opportunity as entrepreneurs. We strongly encourage students to finish their MSc degrees first, because obtaining a university degree is generally a one-shot deal. In our experience, very few students have successfully completed their degrees after interrupting their education to pursue business ideas that later failed. However, we generally find that technology entrepreneurship requires much more than casual attention, and admittance to the Yes!Delft incubator requires a full-time commitment. This entrepreneurship dilemma is less prevalent for advanced master's-level students who are close to graduation.

Every year, more than 100 students register for the "Turning Technology into Business" course. We limit admittance to a maximum of 75 students (which breaks down into 15 groups of five students) for two reasons. First, this number just about fills the auditorium at the Yes!Delft incubator (yesdelft.nl) where we teach the course. Second, and more important, we consider teaching entrepreneurship as a hands-on practice that requires a lot of personal attention and coaching. It is not a mass-market enterprise that can be managed from a distance. In our approach, we adhere to the famous saying by Confucius (551–479 BC): *"I hear, I know. I see, I remember. I do, I understand."*, which is appropriately rephrased in the Chinese proverb *"Tell me and I'll forget; show me and I may remember; involve me and I'll understand"*.

The course involves students and staff in a three-month-long intensive exploration of potential business opportunities offered by new technologies developed at TU Delft. Every student who registers for the course is required to complete a number of pre-course assignments, the most important of which is a letter of motivation in which the student explains why they want to take this course and what they hope to get out of it. Only the most motivated, fully committed students are admitted to the course. Apart from the obvious reason that it is very rewarding to work with highly motivated students, there is another important reason: we ask researchers from the technical faculties to make available their latest inventions and to invest their valuable time by helping students in the early stage of their projects. The least we can do in return is to try and prevent dropouts and mediocre work. Without new technologies and the support of the inventors, there would be no course.

In the course, work is done in teams of four or five students – no more, no less. We have not studied the literature on the ideal group size; we are merely guided by our experience that four or five students to a group works best. During the first lecture, the students must form groups, and every group must select a patent. It is entirely up to the students how they achieve these requirements. There are two general approaches to this problem. The first approach is for a student to form a group with fellow students who feel comfortable working together, and then find consensus over which patent the group wants to work on. The second approach is to form a group with students who are interested in the same patent, and hope that this group will prove to be a good team to work with. There is only one rule that all groups must adhere to: the composition of the team must be as diverse as possible. Ideally, that means five students from five different faculties, but because that is not always feasible, we allow a maximum of two students from the same faculty per team. This diversity requirement is crucial because different disciplines equip the students with different tools and skill sets, which we encourage the students to apply (when appropriate, of course) in their analyses. Furthermore, students from one faculty may be aware of specific problems and related solutions that are not familiar to students from other faculties. One of the main goals of the course is to benefit from this collective intelligence.

The patents are assigned to the groups using a tiebreaker methodology that involves commitment and intelligent gambling. During the first lecture, all patents are presented and a tentative inventory is made of the popularity of each patent using an informal poll (i.e., a show of hands). Using this information, together with the particular preferences of the team members, each group must hand in its top-three choices of the available patents. Each group is given ten points to distribute over their three choices, with the restriction that each choice must be assigned at least one point. This approach provides a psychological challenge: should a group put all its eggs in one basket or take a more conservative approach? If a group gives the maximum eight points to its favourite patent, it will certainly be assigned that patent if none of the other groups did the same. However, if other groups waged eight points on that patent, the second and third choices are indistinguishable (one point each). Despite all these challenges, risks, and pitfalls, this way of assigning the patents works quite well: most groups obtain their number one choice and virtually no group "gets stuck" with its third choice. Generally, two different groups are allowed to work on the same patent. Only in special cases (such as when the inventor is a participant in the course) is a patent limited to one group. Usually, all the patents entered into the course are assigned to at least one group, which motivates the inventors to put forward their patents and assist during the early stages of the project. The message, "unfortunately, your patent was not chosen this year" rather stifles the enthusiasm of an inventor and may discourage other inventors from coming forward for future editions of the course.

Course Structure and Content

The course includes seven four-hour sessions that combine lectures, participant-centred case studies, classroom exercises, real-life case studies, and trial presentations. Attendance is mandatory but we expect full commitment and active participation rather than merely presence. Moreover, because this course is a highly interactive elective that is heavily oversubscribed – so only the best-motivated 70% of the applicants can be admitted – we observe that students actually feel bad when they have to miss a lecture. The advantage of working in groups is that the other team members can later bring the absent student up to date on what they missed. They are also strongly encouraged to do the classroom assignments and exercises because, as stated earlier while referring to Confucius, only by actively doing the work (i.e., involvement) will they obtain the understanding.

Because we are dealing with technology, it is relevant to ask the question "what is technology?" However, instead of elaborate definitions such as “The collection of tools, including machinery, modifications, arrangements and procedures used by humans” (Wikipedia, 2014), “The purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities” (Business Dictionary, 2014), or “The application of scientific knowledge for practical purposes, especially in industry” (Oxford Dictionaries, 2014), we use a more practical and useful definition. During the course, we express, or define, any particular technology by completing the phrase “We know how to…”. Specifically, the technology described in the patent should be rephrased in this way. For example, “We know how reduce the volume of a rectangular box by 75% using a mechanical folding mechanism”, or “We know how create axisymmetric tubes that are very strong and lightweight, using fibre braiding that positions the fibres along the minimal path”.

The lectures consist of concepts, tools, theories, and methods culled from the literature and augmented with case studies, anecdotes, and lessons learned from experience. The only requirement for any of these notions to be part of the lectures is an affirmative answer to the question, "Is this practically useful to the art of commercializing a new technology?" Conceptual frameworks, abstract theories, psychological speculations, philosophical musings, and most quantitative social studies are not practically useful and, for that reason, have no place in this course. Among of the notions that we do use are technology unbundling and the technology tree (Floyd, 1997), the lead user concept (Urban & von Hippel, 1988; von Hippel, 1995), the theory of inventive problem solving (Altshuller, 1996), diffusion of innovations (Rogers, 2003), crossing the chasm (Moore, 2014), and a framework identifying the central drivers of start-up commercialization strategy (Gans & Stern, 2000). Each of these concepts is first presented in a general way together with practical applications. Next, the

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teams must apply it to their own cases. For example, technology unbundling and the technology tree are discussed and applied to the Philips Living Colors luminaire (livingcolors.philips.com), a consumer LED lamp for creating coloured "mood lighting". We start with the top-level description of the (combined) technologies that make up this product: “We know how to create 16 million colours of light that can be modified in hue and intensity using a remote control”. That meta-technology is the root of the technology tree, which is created by disassembling the product into specific technology blocks for the basic functionalities of the device. This process is called technology unbundling and it is of prime importance because, no matter which technology your patent describes, it is virtually useless without complementary technologies that together make up an application. Given that it is unlikely that the business also owns these other technologies, it must decide how to acquire them and combine them with its own (patented) technology. In the case of the Living Colors luminaire, four main branches emerge from the root of the technology tree: “We know how to i) supply power to the light source; ii) select colour and intensity; iii) emit coloured light; iv) design a light to suit a home interior”. These four main branches can be further refined until the leaf nodes represent very specific technologies. Each of these technologies is assessed in two dimensions: technology maturity (e.g., embryonic, growing, mature, aging) and competitive position (e.g., base, key, pacing, emerging). Positioning each technology in a two-dimensional matrix shows the strategic technology landscape that can be used to determine the best strategy to build the application.

Results

The first edition of "Turning Technology into Business" took place in 2003. We used seven patents distributed between nine teams. One team developed a marketable application for a boundary-layer suction technology and pursued this idea in the follow-up course "Writing a Business Plan" (in 2010 renamed "Ready to Startup!"). In 2005, two of the students founded Actiflow (actiflow.nl), a company that developed an active flow control system for vehicles. Later, Actiflow also offered engineering and design services for other industries. Actiflow specializes in combining aerodynamics and product design for a wide range of markets, and the company conducts aerodynamic studies on a consultancy basis.

Since 2003, there have been 11 successive editions of "Turning Technology into Business", hosting a total of 95 patents analyzed by 138 teams. Ten companies were founded as a direct spinoff from this course, meaning that the idea developed in the course was actually turned into a business (as the name of the course suggests). All these companies are still in business today, and the most successful spinoff to date, Ampelmann (ampelmann.nl) has well over 250 employees. In addition to these 10 first-line startups, at least another two dozen technology-based companies were started by students who participated in the course but did not manage to find an application to commercialize the patent they were analyzing. Instead, they later applied the course tools and methods to another technology for which they did develop a marketable application.

All of the companies that came out of the pipeline of the two courses ("Turning Technology into Business" and the follow-up course "Ready to Startup!") were incubated in the Yes!Delft high-tech entrepreneurs centre, which is partnership between TU Delft, the City of Delft and the Netherlands Organisation for Applied Scientific Research (TNO). Yes!Delft focuses on companies with a technological, innovative, and scalable product or process, and has a clear mission: "Building Tomorrow’s Leading Firms". Since its foundation in 2005, Yes!Delft has accommodated 142 startups, the majority of which have outgrown (and moved out of) the incubator to make room for new startups.

Case Study: Holland Container Innovations

In the 2005 edition of the "Turning Technology into Business" course, we used a Dutch patent (NL1017159) for a foldable sea container that had been dormant at the university's technology transfer office for some time. Although the patent specifically describes a foldable cargo container, the assignment was broadened to look for commercially interesting applications of any type of foldable rectangular box. The box could be as large as a 40-foot maritime container and made of steel, or as small as a shoebox and made of wood. The main questions were: Who needs foldable rectangular boxes? What problem does it solve? and What is that solution worth to them? After analyzing many possible applications (including a foldable raised workspace, a foldable cupboard, a foldable bar, and foldable temporary housing), the most promising market remained that of foldable sea containers. As a next step, the students entered this idea in the follow-up course, which was then named "Writing a Business Plan", where they transformed this concept into a viable business plan. In 2008, they founded the company Holland Container Innovations (HCI; hcinnovations.nl), which has since developed the first 40-foot foldable cargo container that meets all industry requirements, including certification from the International Organization for Standardization (ISO) and compliance with the International Convention for Safe Containers (CSC). HCI is convinced that this innovation will revolutionize the strained logistics of the world transport system by reducing the excessive costs of storage and repositioning of empty containers.

One particularly interesting aspect of this case is that HCI does not use the original patent. The way in which the container was folded in that patent was not reliable enough and it took too much time to make it practically useful. This dilemma is frequently encountered when trying to implement a new technology in the real world; we refer to as the "university–market gap". A technology that works perfectly well in the laboratory at the university does not automatically fill the real needs in the market. Exploring various applications of this technology had led the students to the market of cargo containers and the potential benefits of foldable containers. Although the market expressed a need for foldable containers, it also had requirements that could not be fulfilled by the folding technology described in the original Dutch patent. At such a moment, there are two options: i) quit the business because, apparently, you cannot deliver what the market wants, or ii) come up with a better solution that solves the problem the way the market dictates. HCI decided to do the latter and, together with the faculty of Mechanical, Maritime and Materials Engineering (3mE), they redesigned the foldable container in such a way that it complied with the market demands. This new technology was subsequently patented by TU Delft. The new patent (WO2009034142) lists both the mechanical engineer from the faculty of 3mE and the CEO of HCI as inventors. This example also illustrates how technology-based startups provide interesting engineering challenges for researchers at the host university. The new foldable-container technology contains a spring system that stores the potential energy from the long side walls (which each weigh approximately 600 kg) when they are folded inward. This energy is reused when the container is unfolded again, thus minimizing the effort. This spring system is protected by the same patent.

The 4FOLD foldable container is currently being tested in a pilot project in collaboration with CARU Containers (carucontainers.com), one of the largest traders of new and used shipping containers in the world. HCI is one of CARU's preferred suppliers, and CARU owns 5% of its stock. In May 2014, HCI won the prestigious Promising Innovation in Transport Award at the 2014 International Transport Forum for its 4FOLD ISO-certified foldable container (youtube.com/watch?v=UYOMhjbpuil).

Lessons Learned

The "Turning Technology into Business" course has proven to be a successful methodology to overcome the university–market gap. What works well in the laboratory is usually not quite ready for the market. The reason may be technological immaturity, for example, when a new process is successfully demonstrated in batch mode on a laboratory scale but the market requires a continuous process on a much larger scale. More often, there is simply no good match between the real market needs (i.e., what the customers want) and early applications of the new technology. What is still needed is the repeating process that Blank (2013) and Ries (2011) call "pivoting": the iterative improvement of the product–customer fit. Researchers at TU Delft do not have the time or the incentives to pursue that process. And, on the opposite side of the gap, incumbent companies are generally unwilling to acquire new technologies that are barely out of the experimental phase. Startup companies are a great way to break the gridlock and bridge that gap. When successful, the startup – which according to Blank (2013) is merely a temporary organization in search of a profitable, repeatable, and scalable business model – has matured into a real company. Not surprisingly, these young companies are sometimes acquired by incumbents, as was the case for Yes!Delft alumni Epyon and Ephicas.

Students have discovered that the course is an excellent hands-on way to learn how to commercialize a new technology. Even when the patent they worked with during the course did not lend itself to commercially interesting applications, they still acquired the tools and the skills that could be applied to another technology. And, researchers have discovered that the course offers a unique opportunity to analyze the commercial potential of a new technology that they have developed. Increasingly, the policy of the university is requiring researchers to "valorize" the results of their research, meaning that it should somehow generate money to fund future research. Although some researchers at TU Delft have a good track record in this endeavour, many of their colleagues are less successful, not in the least because they do not like to be distracted from what they love doing best: scientific and technological research. For these researchers, the "Turning Technology into Business" methodology offers a welcome alternative.

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Conclusion

The "Turning Technology into Business" course concept has been implemented at TU Delft, where it is organized once a year for a maximum of 75 master's-level students, PhD students, and university researchers. Given the rate of success as witnessed by the innovative technology-based companies that were started as a direct result of this course, we believe this method is the ideal way to bridge the gap between a proof of principle for a new technology and a marketable application. It stimulates students to start technology-based companies that generate valuable spinoff effects. First and foremost, it shows students that there is a third career opportunity for engineering graduates: entrepreneurship. Starting your own company and being your own boss is a serious alternative to the "traditional" career choices: academia (researcher) or industry (employee). Second, it provides an important way for new technology to find its way to the market. This benefit is particularly relevant for technologies that have not generated immediate interest from industry. Although the "Turning Technology into Business" approach is a clear example of technology push, its successes prove that finding the right balance between technological competencies and societal needs does pay off. Third, the companies started as spinoffs from TU Delft motivate the next generation of students to do the same thing. Bringing back alumni who started their own companies following the course methodology gives current students first-hand proof that "it can be done". Moreover, it preys on the Dutch sentiment that "if *they* can do it, then *I* can do it too!" And, fourth, it generates good publicity for the university. Technology-based startups are considered to be "cool" and, more importantly, they are regarded as important drivers of innovation and economic growth.

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References

Altshuller, G. 1996. *And Suddenly the Inventor Appeared: TRIZ, The Theory of Inventive Problem Solving* (2nd ed.). Worcester, MA: Technical Innovation Center, Inc.

Blank, S. 2013. *The Four Steps to the Epiphany* (2nd ed.). K&S Ranch.

Business Dictionary. 2014. Technology. *BusinessDictionary.com.* Accessed December 1, 2014: http://businessdictionary.com/definition/technology.html

Floyd, C. 1997. *Managing Technology for Corporate Success.* Aldershot, England: Gower Publishing Ltd.

Gans, J. S., & Stern, S. 2003. The Product Market and the Market for "Ideas": Commercialization Strategies for Technology Entrepreneurs. *Research Policy,* 32(2): 333–350. http://dx.doi.org/10.1016/S0048-7333(02)00103-8

Moore, G. A. 2014. Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers (3rd ed.). New York: HarperBusiness.

Oxford Dictionaries. 2014. Technology. *OxfordDictionaries.com.* Accessed December 1, 2014: http://oxforddictionaries.com/definition/english/technology

Ries, E. 2011. *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses.* New York: Crown Business.

Rogers, E. M. 2003. *Diffusion of Innovations* (5th ed.). New York: Simon & Schuster.

Urban, G. L., & von Hippel, E. 1988. Lead User Analyses for the Development of New Industrial Products. *Management Science,* 34(5): 569–582. http://dx.doi.org/10.1287/mnsc.34.5.569

von Hippel, E. 1995. *The Sources of Innovation.* Oxford: Oxford University Press.

Wikipedia. 2014. Technology. *Wikipedia.org.* Accessed December 1, 2014: http://en.wikipedia.org/wiki/Technology

University Spinoffs: What, Why, and How?

Pinaki Nandan Pattnaik and Satyendra C. Pandey

> *" The medieval university looked backwards; it professed to be a storehouse of old knowledge. The modern university looks forward, and is a factory of new knowledge. "*
>
> Thomas Henry Huxley (1825–1895)
> Comparative anatomist; known as "Darwin's Bulldog"

University spinoffs have remarkably strengthened the linkage between universities and industry. The number of technology patents and spinoffs coming out of university research has a significant impact on regional economic and social development. To further highlight the importance of university spinoffs, the aim of this article is to review available literature on university spinoffs and present a comprehensive overview of what university spinoffs are, why they are important, what makes them significant, and how they are or can be created. In addition to reviewing existing models of university spinoff creation, we also propose a new, multi-stage, holistic model.

Introduction

Over past two decades, the field of academic entrepreneurship has found greater visibility, and universities are being increasingly considered as a source for creation of high-technology firms. With greater attention focused on the linkage between science, technology, and university spinoffs, universities are moving from their traditional roles of research, teaching, and knowledge dissemination to a more advanced role of creating spinoffs and promoting academic entrepreneurship (Lerner, 2004).

Cohen and colleagues (1998) highlighted the need to emphasize the transfer and commercialization of knowledge generated within universities. Other scholars also point towards the growing need for universities to disseminate their generated knowledge beyond the narrow confines of the academic community (Branscomb et al., 1999; Hague & Oakley, 2000). Universities and governments, both in technologically advanced and developing nations, have shown greater interest in academic entrepreneurship and university spinoffs as a means of building links between universities and industry.

To help guide stakeholders from government, industry, and academia itself in the promotion of university spinoffs, this article examines three questions that are often asked in the advancement of any phenomenon: what, why, and how. We first answer the question "What is a university spinoff?" and examine definitions from the literature. Next, we address the question "Why is there a need for university spinoffs?" Finally, we examine various models that address the question "How are university spinoffs created?", and we then propose our own multi-stage model. There is a need for a new model that can highlight various stages that lead to the creation of a university spinoff – from the identification of capabilities to the disclosure of invention to the final decision of creating a spinoff. Our model addresses this need by bringing clarity to the existing body of literature on university spinoffs. Finally, we conclude by pointing towards some of the potential research avenues that can be taken up by scholars in the area of academic entrepreneurship.

What is a University Spinoff?

According to Pirnay and colleagues (2003), "spinoff" is a fuzzy and general concept that covers a wide variety of phenomenon among which a university spinoff represents only one specific type. This assertion may also lead to a confused understanding of spinoffs, which may impede definitional understanding of the concept. There have been several attempts in the academic literature to define university spinoffs, and although they are not all consistent, common threads may be identified. They represent different perspectives that many not be compatible. Table 1 presents four definitions of university spinoffs, from which we can distil the following salient characteristics of a university spinoff:

1. the parent organization from which the innovation emerges has to be a university or academic institution

2. the output that is a university spinoff has to be a separate legal entity and not an extension or controlled body of the university

3. the new entity has to exploit knowledge produced from academic activities or academic pursuits

4. the spinoff should be aimed at profit generation and commercialization of technology

Table 1. Common definitions of "university spinoff"

Author	Definition
Smilor et al. (1990)	"a company that is founded (1) by a faculty member, staff member, or student who left the university to start a company or who started the company while still affiliated with the university; and/or (2) around a technology or technology-based idea developed within the university" (p. 63)
Weatherston (1995)	" a business venture which is initiated, or becomes commercially active, with the academic entrepreneur playing a key role in any or all of the planning, initial establishment, or subsequent management phases" (p. 1)
Bellini et al. (1999)	"companies founded by university teachers, researchers, or students and graduates in order to commercially exploit the results of the research in which they might have been involved at the university. ... the commercial exploitation of scientific and technological knowledge is realized by university scientists (teachers or researchers), students and graduates." (p. 2)
Klofsten & Jones-Evans (2000)	"[a] new firm or organization to exploit the results of the university research."(p. 300)

Why Is There a Need for University Spinoffs?

University spinoffs are not very common, but they are important for economic development (Lowe, 2002), for commercializing university technologies (Etzkowitz, 2003), and for helping universities with their major missions of research and teaching (Jones & Gold, 2001). Below, each of these potential benefits of university spinoffs is examined in greater detail.

Enablers of economic development
University spinoffs contribute to the economic development of the locality to which they belong. Firstly, they create business opportunities by translating research results into workable technologies leading to market solutions. Secondly, they typically conduct most of their basic activities locally (e.g., hiring, sourcing supplies, production) and thus have significant multiplier effects on local economic activity. Spinoffs frequently serve as catalysts for the formation of geographic clusters of new firms in particular technologies (Lowe, 2002).

Commercialization of university technologies
University spinoffs make use of university technologies that might otherwise would go undeveloped. Researchers have identified two ways that spinoffs enhance the development of technology:

1. Spinoffs provide a mechanism for firms to commercialize inventions that have very high uncertainty, which reduces interest from other larger establishments (Etzkowitz, 2003)

2. Spinoffs provide a way to ensure inventor involvement in the subsequent development of university technologies, which is crucial when technologies are based on tacit knowledge (Shane, 2004).

University spinoffs also provide effective mechanisms for involving the inventor of the technology in the process of commercialization, which is a necessary condition for the development of products or services from university technology (Hindle & Yencken, 2004; Jensen & Thursby, 1998). University spinoffs achieve inventor involvement because many scientists perceive that spinoffs are better places to work than established firms, where the projects may be less interesting or challenging (Kenney, 1986). As a result, inventors are more inclined to work with new companies seeking to commercialize their university inventions than they are to work with established companies seeking to commercialize their own inventions.

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Also, startups firms focus more on technology development as opposed to other aspects of business, and university researchers tend to be more interested in technology development than in other aspects of business. Also, equity is a more effective tool to ensure inventor involvement in spinoffs than other forms of compensation (Geuna & Nesta, 2006). Spinoffs can provide inventors with equity holdings more easily than established firms because the distribution of equity at the time of firm founding does not involve the transfer of equity from someone who has it to another individual, as is the case when equity is distributed after founding.

University spinoffs and the mission of research and teaching

Attracting and retaining productive science and engineering faculty can be a substantial challenge otherwise, and the potential for university spinoffs can help on both counts. By allowing faculty to supplement their salaries with equity in their own companies, universities provide a financial mechanism to retain and recruit faculty, particularly in the biomedical areas, where this approach is similar to the use of practice plans common with clinical faculty in medical schools (Jones & Gold, 2001). In the discipline of biological sciences, researchers have observed that allowing faculty to found spinoffs reduces the number of faculty leaving the university to take higher paying industry jobs (Powell & Owen-Smith, 1998).

How Are University Spinoffs Created?

The creation of the technology used by a university spinoff is a multi-stage process. Funding from the governments, industry, and foundations are used to support scholarly research in science and engineering. In a typical process, some of this research results in the creation of new technology that is then brought to the attention of the university. The university technology-licensing office may then decide whether or not to seek intellectual property protection for the invention, after which efforts may be made towards licensing the technology. Policies regarding the retention and protection of intellectual property will vary from university to university, but in most cases, established companies are the licensees of university inventions, and in some cases, newly formed companies are the licensees. Beginning with the initial research phase, the process of university technology development involves significant amounts of hard work, with only some efforts leading to outcomes that mark progression to the next stage.

This section discusses some of the three most widely accepted models for the creation of university spinoffs. After systematically reviewing these three models, we then propose a new operational model

A review of existing models

After reviewing the extant literature on university spinoffs, we identified three such models for a detailed discussion. In the first model, Ndonzuau, Pirnay, and Surlemont (2002) identified four important stages in the development of university spinoffs: i) generating a viable business idea, ii) translating the idea into a business process, iii) creating a firm, and iv) contributing value to customers, employees, investors, and all other stakeholders (both internal and external). The four stages of the model are dependent on each-other as decisions made in earlier stages can severally impact the later stages.

The second model, by Shane (2004), includes five stages in describing a typical process to create a university spinoff. The first state is purely academic but the model also allows for tangential technologies that have the potential to facilitate new products and services. In cases where the researcher believes that their new technology is an invention that can be commercialized, they then disclose it to the university's technology-licensing office. Then, in the third stage, the potential for intellectual property protection is evaluated and a patent application may be made. Based on the limited monopoly via the patent, the technology transfer office can either license the technology to an established company or the researcher may establish a spin-off firm.

Building on the models by Ndonzuau and colleagues (2002) and Shane (2004), Vohora, Wright, and Lockett (2004) offered a new perspective on the development of university spinoffs. Their model also has five stages, but it emphasizes four critical junctures, or hurdles, that must be crossed before transitioning to the next stage:

1. Research
    - *Opportunity recognition*
2. Opportunity framing
    - *Entrepreneurial commitment*
3. Pre-organization
    - *Threshold of credibility*
4. Re-orientation
    - *Threshold of sustainability*
5. Sustainable returns

Similar to the model proposed by Shane (2004), the first stage of this third model involves research and is primarily aimed at producing academic knowledge. This stage starts with research into new technology and ends when intellectual property is created, although not all technologies will be commercially viable.

Thus, the first critical juncture is opportunity recognition. In the next phase, if an opportunity has been identified, it has to be framed or, in other words, structured and tested for viability. The next critical junction is entrepreneurial commitment, which represents the hurdle that must be overcome to move from the opportunity framing stage to the pre-organization stage. Vohra and colleagues propose that, once intention of the entrepreneur is set, a re-orientation of the organization in terms of resources available occurs. Access to resources requires credibility and thus this represents the next critical juncture. Finally, similar to any venture, university spinoffs require sustainable returns for survival and when this viability threshold is passed, the university spinoff creation process is completed.

On a comparative note, the model proposed by Vohora and colleagues provides a rather systematic approach for the development of university spinoffs. The model recognizes that opportunity analysis and identification is critical to successful commercialization. However, connecting academic research to a market opportunity is not an easy task and requires more than scientific knowledge; it also requires sound business knowledge. In a broad sense, the opportunity is an end result of the research, but it does not mean that ultimate endpoint has been reached. The opportunity must be scrutinized for value in relation to the potential market.

These three models are valuable, but they leave some questions unanswered, such as: How does a researcher identify and decide on specific opportunities? What kind of funding is available for conducting research? Do similar opportunities exist for both pure and applied research and the results thereof? What modes for commercializing research results are available to the researcher or the university? These gaps must be explored for a better understanding of how university spinoffs take shape. In the following section, we propose a conceptual model that encompasses the nuances that the existing models fail to address.

A multistage, holistic university spinoff creation model

The previous section condensed the most prevalent models concerning university spinoffs and identified certain gaps in those models in terms of identifying specific opportunities based on research, funding research, related processes for pure versus applied research, and modes of commercialization. In this section, we propose a more holistic multistage conceptual model (Figure 1) to help fill the gaps we identified.

Newbert (2007) indicated that capabilities act as preconditions to research in any setting. From capabilities, competencies can be identified; an understanding of competencies is required to understand the availability of resources (Hodgetts et al., 1999). Most important of all resources at this stage would be finance. The research can be self funded or university funded, or it can be funded by corporate or public entities. Capabilities and competencies are fundamental determinants of creating market viable technology spinoffs. Thus, capabilities dominate the first stage in our model.

The existing models are silent regarding the nature of research and which type – pure or applied – may be better suited for spinoffs. Pure or fundamental research is intended to advance the knowledge in the field, which may further provide a foundation for applied research. In our model, based on the nature of research conducted, whether pure or applied, the results are tested and confirmed for reliability, validity, and viability. A formative understanding of the commercial potential of a proposed spinoff should originate at this second stage, where the opportunity should also be analyzed and framed.

Research results as outcomes of either public, corporate, or self/university funding should be treated differently. In cases of corporate-funded research, disclosure leading to patents is not possible unless explicitly mentioned in the general terms and conditions of engagement, as is the case with public/state-funded research. It is essential to understand the nature of funding because that would be the deciding factor in whether a certain invention can lead to spinoff creation. In Stage 3, terms and conditions of funding permitting, the university or innovator discloses an innovation and a decision is made on whether or not to file a patent.

Mikhail (1999) commented that patents do not necessarily reflect commercial viability. If that is so, the previous models again miss out on who conducts the analysis of commercial viability. A gap develops when there is a lack of clarity as to which kind of technology is most suitable or ends as university spinoffs. There arises the role of a technology licensing office. The technology licensing office seeks out possible buyers or lessees for the technologies that have the potential to create commercially viable business opportunities. Leasing or buying depends on how businesses view the

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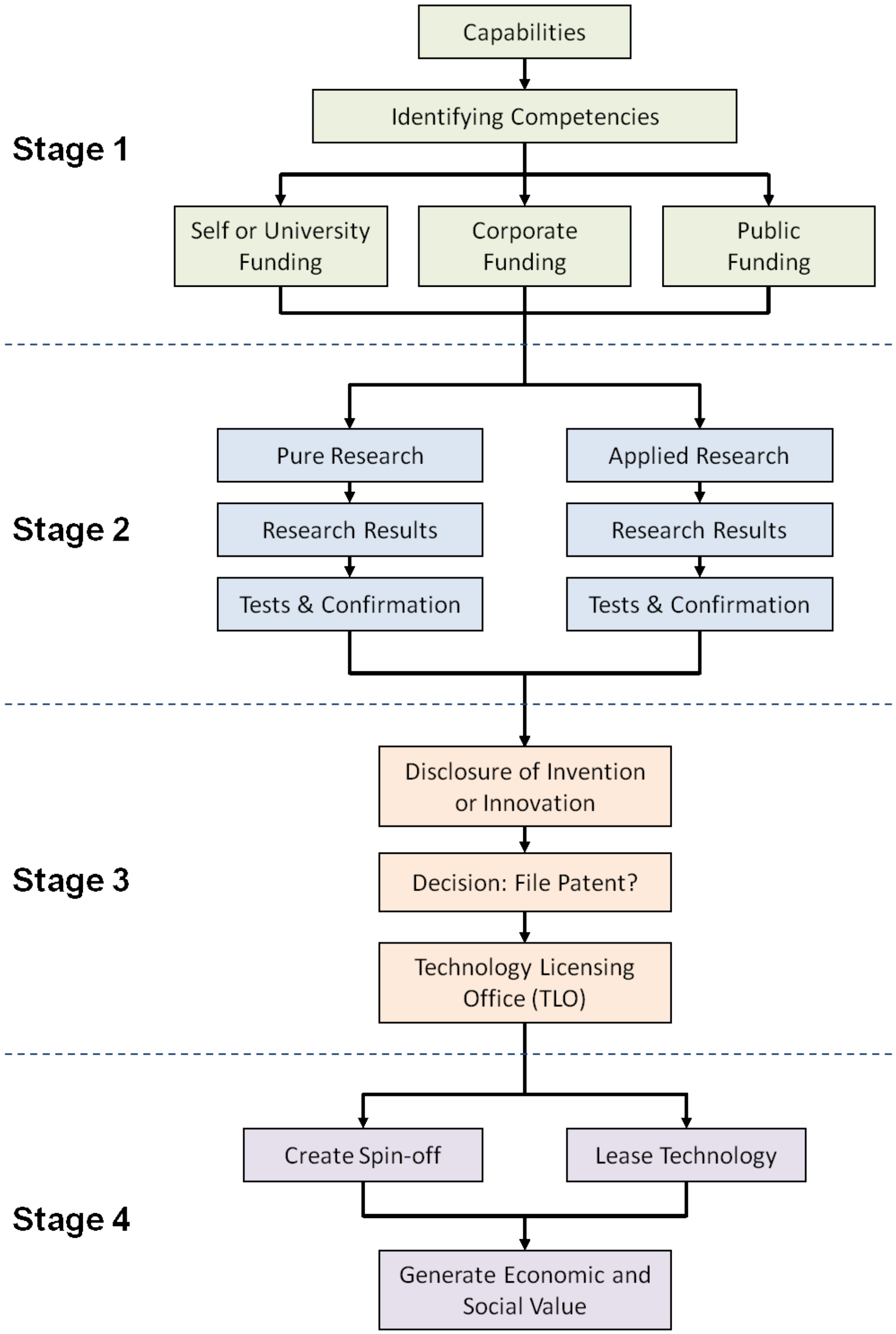

Figure 1. A multistage holistic model for creating university spinoffs

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commercial potential of the technology. It has been observed that mostly incremental or adaptive technologies are the ones that businesses seek out. Zahra and Van de Velde (2007) reported that technologies that are radical in nature resulting from pure research primarily lead to inventor-led enterprises or university spinoffs. Thus, we reach Stage 4, the final stage of our multi-stage model. If all goes well, economic and social value is created through university spinoffs via financial returns to the inventor and university (if the university holds equity), job creation, and economic development.

Conclusion

Spinoffs are one of the rare yet significant engines of direct commercialization of university intellectual property. They are a valuable entity because of the various benefits they bring to universities and society at large; they are a source of local and national economic growth with the capability of providing significantly higher revenue to the universities than licensing (Bray and Lee 2000) as a result of equity partnerships between universities and spinoffs.

In this article, we first presented what university spinoff are by examining and synthesizing existing definitions. Second, we discussed why university spinoffs are needed in light of past scholarly work stating their economic and social benefits. Finally, we examined how university spinoffs are created by reviewing three existing models of university spinoff creation and then proposing a more comprehensive multistage model based on the gaps we identified in the existing models.

The focus of this study was to develop a wider understanding of university spinoffs for those who are interested in knowing about and researching academic entrepreneurship. The multistage model of university spinoffs proposed in this study can be used by scholars in the area of academic entrepreneurship to build case studies and do phenomenological studies. These studies can be undertaken in universities that promote spinoffs to identify variations in the capabilities, funding, and licensing of spinoffs. Statistical generalizations can be possible in future studies that take into account causal relationships between identified competencies, attempts to patent the invention or innovation, spinoffs created, and economic value generated in large-scale survey-based studies. However, care should be taken by researchers doing such studies because bi-causality can be an inherent characteristic of this kind of data, where more than one variable can influence or cause change in another variable.

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References

Bellini, E., Capalldo, G., Edström, A., Kaulio, M., Raffa, M., Ricciardi, M., & Zollo, G. 1999. Strategic Paths of Academic Spin-Offs: A Comparative Analysis of Italian and Swedish Cases. *Proceedings from the 44th ICSB Conference, Naples, June 20-23, 1999.*

Branscomb, L. M., Kodama, F., & Florida, R. L. (Eds.). 1999. *Industrializing Knowledge: University-Industry Linkages in Japan and the United States.* Cambridge, MA: MIT Press.

Bray, M. J., & Lee, J. N. 2000. University Revenues from Technology Transfer: Licensing Fees vs. Equity Positions. *Journal of Business Venturing*, 15(5): 385–392. http://dx.doi.org/10.1016/S0883-9026(98)00034-2

Cohen, W. M., Florida, R., Randazzese, L., & Walsh, J. 1998. Industry and the Academy: Uneasy Partners in the Cause of Technological Advance. In R. G. Noll (Ed.), *Challenges to Research Universities:* 171-199. Washington, DC: The Brookings Institution.

University Spinoffs: What, Why, and How?

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Etzkowitz, H. 2003. Research Groups As 'Quasi-Firms': The Invention of the Entrepreneurial University. *Research Policy,* 32(1): 109–121. http://dx.doi.org/10.1016/S0048-7333(02)00009-4

Geuna, A., & Nesta, L. J. 2006. University Patenting and Its Effects on Academic Research: The Emerging European Evidence. *Research Policy,* 35(6): 790–807. http://dx.doi.org/10.1016/j.respol.2006.04.005

Hague, D., & Oakley, K. 2000. *Spin-Offs and Start-Ups in UK Universities.* London: Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom.

Hindle, K., & Yencken, J. 2004. Public Research Commercialisation, Entrepreneurship and New Technology Based Firms: An Integrated Model. *Technovation,* 24(10): 793–803. http://dx.doi.org/10.1016/S0166-4972(03)00023-3

Hodgetts, R. M., Luthans, F., & Slocum Jr, J. W. 1999. Redefining Roles and Boundaries, Linking Competencies and Resources. *Organizational Dynamics,* 28(2): 7–21. http://dx.doi.org/10.1016/S0090-2616(00)80013-3

Jensen, R., & Thursby, M. 1998. *Proofs and Prototypes for Sale: The Tale of University Licensing* (No. w6698). Cambridge, MA: National Bureau of Economic Research.

Jones, R. F., & Gold, J. S. 2001. The Present and Future of Appointment, Tenure, and Compensation Policies for Medical School Clinical Faculty. *Academic Medicine,* 76(10): 993–1004. http://www.ncbi.nlm.nih.gov/pubmed/11597838

Kenney, M. 1988. *Biotechnology: The University Industrial Complex.* New Haven, CT: Yale University Press.

Klofsten, M., Lindell, P. Olofsson, C., & Wahlbin, C. 1988. Internal and External Resources in Technology-Based Spin-Offs: A Survey. In B. A. Kirchhoff, W. A. Long, W. McMullan, K. H. Vesper, & W. E. Wetzel William Jr (Eds.), *Frontiers of Entrepreneurship Research:* 430-443. Babson Park, MA: Babson College.

Lerner, J. 2004. The University and the Start-Up: Lessons from the Past Two Decades. *The Journal of Technology Transfer,* 30(1-2): 49–56. http://dx.doi.org/10.1007/s10961-004-4357-8

Lowe, R. A. 2002. *Invention, Innovation, and Entrepreneurship: The Commercialization of University Research by Inventor-Founded Firms.* Doctoral dissertation, University of California, Berkeley.

Mikhail, P. 1999. Hopkins v. CellPro: An Illustration That Patenting and Exclusive Licensing of Fundamental Science Is Not Always in the Public Interest. *Harvard Journal of Law & Technology,* 13(2): 375–394.

Ndonzuau, F. N., Pirnay, F., & Surlemont, B. 2002. A Stage Model of Academic Spin-Off Creation. *Technovation,* 22(5): 281–289. http://dx.doi.org/10.1016/S0166-4972(01)00019-0

Newbert, S. L. 2007. Empirical Research on the Resource-Based View of the Firm: An Assessment and Suggestions for Future Research. *Strategic Management Journal,* 28(2): 121–146. http://dx.doi.org/10.1002/smj.573

Pirnay, F., Surlemont, B., & Nlemvo, F. 2003. Toward a Typology of University Spin-Offs. *Small Business Economics,* 21(4): 355–369. http://dx.doi.org/10.1023/A:1026167105153

Powell, W. W., & Owen-Smith, J. 1998. Universities and the Market for Intellectual Property in the Life Sciences. *Journal of Policy Analysis and Management,* 17(2): 253–277. http://dx.doi.org/10.1002/(SICI)1520-6688(199821)17:2<253::AID-PAM8>3.0.CO;2-G

Shane, S. A. 2004. *Academic Entrepreneurship: University Spinoffs and Wealth Creation.* Cheltenham. UK: Edward Elgar Publishing.

Smilor, R. W., Gibson, D. V., & Dietrich, G. B. 1990. University Spin-Out Companies: Technology Start-Ups from UT-Austin. *Journal of Business Venturing,* 5(1): 63–76. http://dx.doi.org/10.1016/0883-9026(90)90027-Q

Vohora, A., Wright, M., & Lockett, A. 2004. Critical Junctures in the Development of University High-Tech Spinout Companies. *Research Policy,* 33(1): 147–175. http://dx.doi.org/10.1016/S0048-7333(03)00107-0

Weatherston, J. 1995. Academic Entrepreneurs: Is a Spin-Off Company Too Risky? *Proceedings of the 40th International Council on Small Business, Sydney, June 18-21, 1995.*

Zahra, S. A., Van de Velde, E., & Larrañeta, B. 2007. Knowledge Conversion Capability and the Performance of Corporate and University Spin-Offs. *Industrial and Corporate Change,* 16(4): 569–608. http://dx.doi.org/10.1093/icc/dtm018

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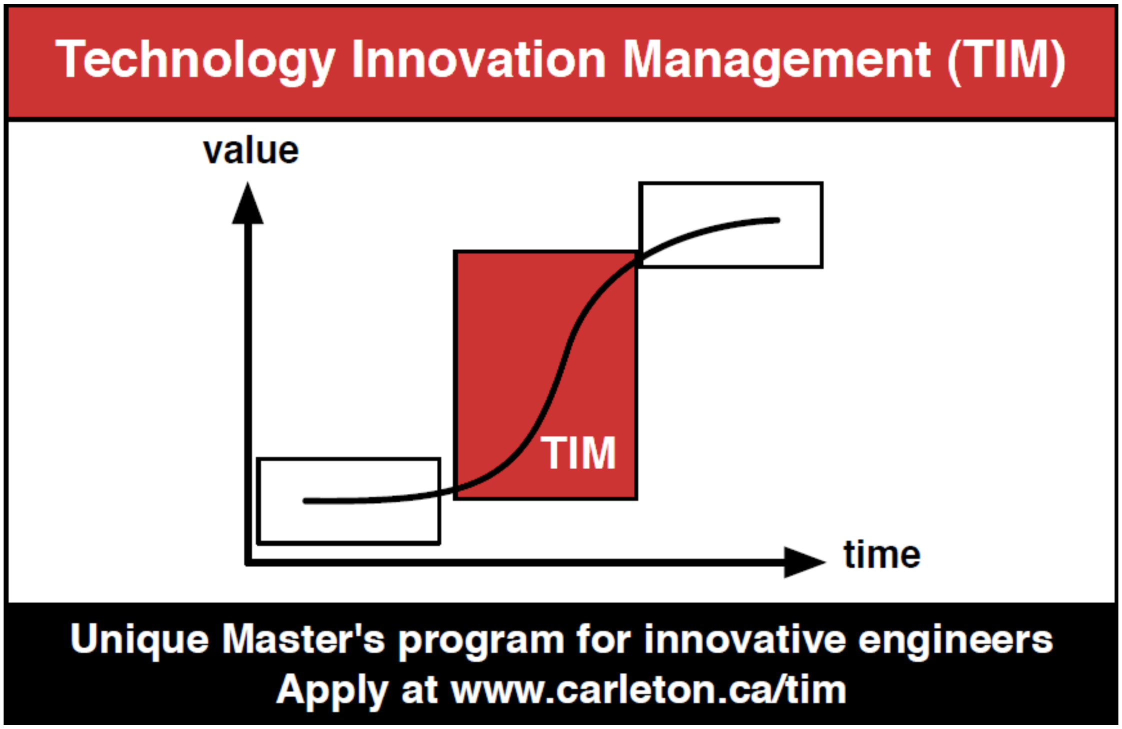
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