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Bridging the gap from research to high-technology ventures with experienced entrepreneurs

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Bridging the gap from research to high-technology ventures with experienced entrepreneurs

Abstract: The paper explores an alternative approach to the traditional transfer of university research output. This approach proposes a systematic search and matching of external experienced entrepreneurs with university researchers to stimulate spinning out university-developed technology. 'Bridging the gap' (BtG) is a model for combining the experiences, market insight and network connections of experienced entrepreneurs and the technical knowledge and capabilities of university researchers to create a stronger basis for spin-outs. Inserting market knowledge and competences in the research domain of scientists optimizes the selection of technology applications, which accelerates the spin-out process and generally strengthens the prospects for the emerging firm to achieve and sustain growth. Application of the model to two departments at the Technical University of Denmark provides empirical evidence for the model's usefulness.

Keywords: technology transfer; university spin-out; researchers' skills gap; experienced entrepreneurs; bridging the gap.

Introduction

The emergence of successful new technology companies based on university research has caused research universities to be recognized as breeding grounds for entrepreneurship. Universities contribute to entrepreneurship development through different mechanisms that help exploit technological opportunities created by research (Van Burg et al. 2008). This recognition has created an explosion in the general interest in and research regarding the broad topic of university entrepreneurship (Rothaermel et al. 2007) and specifically technology transfer from universities. This research has shown that some universities are much better at spinning out new companies than others (Di Gregorio and Shane 2003; Nerkar and Shane 2007) and that European universities generally lag behind their American counterparts (Rothaermel et al. 2007).

The recognition that university spin-outs are important contributors to economic development (Roberts and Eesley 2011) has spurred a quest to find a ‘magic bullet’ to increase the number of spin-outs based on university research. The questions of what makes some universities good at spinning out companies and how others can achieve better outcomes from their efforts have no straightforward answers. Nerkar and Shane (2007) demonstrated that the ‘scope and pioneering nature’ of different technologies influence commercial outcomes, whereas Van Burg et al. (2008) and Jain and George (2007) explored how technology transfer units, by providing access to resources and support services, can impact the process. Müller (2010), Shane and Stuart (2002) and others have outlined the importance of complementary knowledge.

One method to acquire knowledge that complements that of scientists is through surrogate or experienced entrepreneurs (EEs). EEs are accepted as key contributors to the wider university entrepreneurship, especially through their involvement as mentors or advisers to entrepreneurship students in education programs. Their involvement in the commercialization process as an integral part of potential start-up teams—through working closely with researchers and investing time and other resources into realizing commercial outcomes from university research—has not been widely studied. Experienced (or surrogate) entrepreneurs can bring accumulated experiences, knowledge of specific business environments and professional networks to the commercialization process (Franklin et al. 2001; Lundqvist 2014; Vohora et al. 2004). These competences aid the recognition and evaluation of opportunities that emerge from research for new spin-outs (Davidsson 2013). Individuals with start-up experience and knowledge of operating in specific technology markets can help improve the start-up situation, thereby contributing to better resources and capabilities for new

technology firms to navigate the many challenges that they must overcome to be successful (Shane and Stuart 2002).

Key contributions (Franklin et al. 2001; Lundqvist 2014; Vohora et al. 2004) concerning the role of surrogate entrepreneurs have focused mainly on their impact on performance. The process of identifying suitable external EEs and matching them with researchers to create a productive interaction that leads to the successful spinning-out of university technology remains mostly unexplored. It is in this gap that this paper makes a contribution. It does so by exploring how to combine the competences of external EEs with those of university research teams to create optimal conditions for university spin-outs. It addresses two key questions: How can a university combine the know-how of external EEs with that of its research staff to influence the spin-out process? At which stage of the research process should the interaction between these two categories be encouraged?

The paper outlines the implementation of the ‘bridging the gap’ (BtG) model in two research departments at the Technical University of Denmark to stimulate research-based spin-outs. The model embeds EEs into research teams at the department level. It complements the activities of the university-wide technology transfer office (TTO) and operates through the voluntary participation of researchers. The core of the model is the identification of junctures in the commercialization process where the introduction of EEs is most productive and the development of mechanisms to govern the interactions between researchers and EEs, which encourage participation on both sides.

The paper is structured as follows. This introduction is followed by a conceptual background, framed by the existing literature. The subsequent section presents the methodology, including the model design and implementation. The research context and information about the cases are then presented, followed by key observations. The paper ends with concluding remarks and implications for research and practice.

Conceptual Background

Universities engage in technology transfer for many reasons, including accomplishing sustainable innovation with economic and societal impacts and diversifying income streams through commercialization of knowledge with licensing technology and establishment of new companies (Lundqvist 2014; Mosey et al. 2007). Spinning-out new companies (university spin-outs) may create advantages over licensing both for the university and the academic inventor as equity holders (Lockett and Wright 2005).

Some researchers, however, are not interested in the commercial aspects of their inventions, whereas others with commercial interests are reluctant to leave their university positions to concentrate solely on forming spin-outs. Maintaining a full academic position with research, teaching and administration responsibilities while spinning-out a university technology is almost impossible. This creates important challenges for university spin-outs, with investors looking more favorably at start-ups when the inventors are involved with the company and their overall prospect is improved (Jensen and Thursby 2001; Radosevich 1995;). Universities therefore walk a delicate line between encouraging research staff to participate in the commercialization of knowledge and increasing their academic reputation, which is traditionally based on teaching and research publications in high-impact journals. Balancing these two objectives suggests the need for a model that allows researchers to optimize their core competences in a specific scientific area and creates supportive conditions for university spin-outs.

European research universities (following the trend in the USA) have created TTOs to facilitate and support the commercialization of research outcomes (Muscio 2009). As their US counterparts do, European TTOs face many challenges, with questions about their effectiveness in transferring university-generated technologies (Bradley et al. 2013). Bozeman et al. (2015) reviewed the literature on the effectiveness of TTOs, highlighting the many indicators of effectiveness. University spin-outs, or the creation of new firms solely to commercialize a technology emanating from university research, are recognized as legitimate. However, researchers without commercial backgrounds/experience tend to do worse in spinning-out research results (Druilhe and Garnsey 2004; Wright et al. 2011), and TTOs simply cannot replace the participation of the researcher.

Researchers who lack a business background, prior business ownership, networks within industry and strong financial resources have strong liabilities that work against successfully spinning out technologies. These shortcomings/liabilities must be mitigated, and the literature suggests that EEs

can meet these needs in an emerging university spin-out (Mosey et al. 2007). Radosevich (1995) used the term surrogate entrepreneurs to describe EEs who, in the absence of inventors (with no desire to become entrepreneurs), take ‘ownership’ of technologies developed in public research institutions and use them to launch new ventures. Surrogate entrepreneurs can add credibility, financial resources, and thick social and business networks gained from prior experience (Lundqvist 2014) to reduce the challenges that a knowledge-intensive university spin-out faces. Several studies regarding entrepreneurial opportunity confirm that prior knowledge is beneficial for the process of opportunity recognition (Grégoire et al. 2010; Shane 2000; Vaghely and Julien 2010). Others have shown positive relations between ‘years of industry experience’ and venture emergence (Dimov 2010; Mayer-Hauga et al. 2013). One’s networks and the associated externalities, including access to know-how or easier access to financial resources, have also been shown to have a significant impact on university spin-out outcomes (Müller 2010; Shane and Stuart 2002).

External EEs, on the other hand, lack the technical and domain-specific knowledge that the researchers/scientists possess, which may also limit the development of a spin-out. The goal is to create a model that combines the skills and expertise of EEs and researchers in a manner that allows researchers to continue with their research and other university obligations while contributing their knowledge to the resource base of the university spin-out. Vohora et al. (2004) suggested that university spin-outs pass through several critical junctures, each of which feature resource requirements critical for passage to the escalating stage. Failure to apportion the required resource set may prevent escalation to the next stage, resulting in stagnation and failure.

These observations have led to the creation of a model to connect EEs who have complementary industry experience with researchers at universities to help create university spin-outs. The addition of EEs at earlier critical junctures facilitates the emerging spin-outs through better interactions with important parts of the product and market systems to improve both technology and product development aspects of the new firm. This stronger resource base contributes to spin-outs that can sustain development and achieve growth.

Model Description - BtG

BtG was initiated in 2013 by the Departments of Chemistry and Photonics Engineering at the Technical University of Denmark, with financial support from The Danish Industry Foundation, as a

program to increase commercial activities based on their research. The program began with visits and discussions with colleagues at Aalto University in Finland, Technion in Israel, and UC Berkeley in the US, interviews with EEs, and several rounds of interviews and discussions with researchers.

Following a design anthropology approach, which combines observations, iterative actions in the development process and reflections, the co-authors created a design workbook based on examples and evidence of practice from research groups in Denmark, Finland, Sweden and elsewhere. Characterized as quasi-participatory, the design workbook provides participants with the possibility to interpret and elaborate upon ideas as they emerge over time (Gaver 2011). Through the design workbook, the program leaders document major activities in different iterations as the process moves from the original concept of the model through the various iterations and implementations. This approach allows us to both study and produce a theoretical framework by observing the existing practice regarding the development of university spin-outs while being able to transform this practice and to design a new model based on the active involvement and engagement of the participants. Design anthropology allows us to follow dynamic situations and social relations throughout the project and to iterate the overall framework for the bridging the gap model (Gunn et al. 2013).

BtG is divided into five phases: screening and patenting, matching EEs to research teams, connecting to potential lead customers and developing prototypes, spinning out, and following up, as depicted in Figure 1, with some overlap of the activities.

Insert Figure 1 here

In the first phase, researchers who generate a potential invention notify the university management in much the same manner as they would in the traditional technology-transfer process (Bradley et al. 2013). A disclosure in the department triggers an initial screening for potential business opportunities through an evaluation of the market potential (customer segments and size of the potential market, for example), the maturity of the technology and estimated efforts for bringing it to the market, the business model, and the required team. This juncture benefits significantly from the input of industry and market knowledge and marks a significant departure from traditional TTO activities. Although

not all cases can incorporate EEs at this early phase, those that do benefit from a clearer technology-market fit and a faster time to spin-out.

In the second phase, an external EE is introduced in an in spe CEO position as an integral part of the university team. The EE dedicates significant resources in terms of his/her own time to understand the details of the technology, and the only incentive is the prospect of becoming a future co-founder and/or CEO. A press release at the launch of the BtG program generated a considerable expression of interest. Criteria for selection include being able to spend at least 500 hours on each case, willingness to invest at least €7k of one's own funding, and the potential to attract customers and generate early sales. Additional screening is based on experience with entrepreneurship, sales and marketing, in addition insight and networks within the specific technology area. The initial screening is performed by the project managers. When the EEs first meet with the researchers, personal chemistry between them serves as a first step in building mutual trust and is critical. At this stage, the EEs and the researchers typically align their expectations, clarify mutual goals and determine whether their personal chemistry matches a joint commitment.

The matching of EEs with research teams is an important component of the BtG. The matching is performed either through an advisory board or by individual matching. Advisory boards usually comprise 3-5 EEs with different profiles and backgrounds. The starting point is always to find the right market fit for the technology, which makes it beneficial to have more EEs representing a broader set of expertise. A technical proof-of-concept is performed in this phase to clarify major issues before contacting potential business partners.

The advisory board and the research teams usually meet every month, and each meeting generates deliverables for each party for the next meeting. In addition, frequent individual contact is initiated between the researcher team and EEs. In this manner, the advisory boards become an important forum for discussion and progress—and, from the EEs' point of view, a way to become familiar with the technology and its potential and to establish team spirit with the researcher. Typically, within six months, one or two EEs from the advisory board become strongly involved in the case due to either personal interest and/or shared goals with the research team. They take the lead and become co-founders of the company together with the researchers. The rest of the EEs in the advisory board typically transition into a formal board-member role of the new company (often as seed investors).

Individual matching is used when the market fit is more obvious or if the research team needs a specific profile, such as sales and marketing experience within a certain technology area. The research team usually meets with 2-3 potential EEs. At the first meeting, the researchers present the technology and their visions in a very informal setting. At the second meeting, the tables turn, and the EEs present a potential business case based on the knowledge gained about the technology at the first meeting. Based on this presentation, the researchers decide to work with the EE whose vision, knowledge, profile and personality fit best with the technology and their personal vision.

In the third phase, the EEs typically use their business networks to establish contact with potential early adopters of the new technology. Feasibility studies or technology demonstrations are performed, often with re-iteration regarding technology and revisions of initial business plans. At this phase, many cases begin to explore funding opportunities while still operating within the university arena. In the fourth phase, the team forms the new venture as a legal entity, negotiates license agreements with the university, finalizes their shareholder agreement, and typically also raises capital. In the fifth phase, the spin-out cases are evaluated in terms of their ability to generate first sales and to secure financing and their number of employees. The goal of BtG is to create more sustainable spin-outs, but this goal has a long time horizon for verification (5 to 15 years). However, the above parameters are used as key indicators of early business traction and of potential future success.

Insert Table 1 here

Research Context and Cases

DTU

Technical University of Denmark (DTU) is a publicly funded technical university located in Lyngby, a town north of Copenhagen. The university is organized into departments and centers across a range of technical and engineering disciplines. At the end of 2014, DTU employed 5813 full-time staff, of which 3281 were research and teaching staff, including approximately 1200 PhD students. The university owns all technologies and inventions created by research staff. A key piece of the university innovation policy is a scheme where surplus revenues from intellectual property (IP), after the university's expenses have been covered, are distributed equally among the university, the department, and the inventor/researcher (including PhD students). The university has operated a TTO

and a commercial incubator since approximately 2002, following a change in the Danish legislation regarding researchers' right to ownership of intellectual property in 2000.

The Cases - BtG in Action

Table 2 summarizes the activities of 6 spin-out cases that were facilitated through BtG.

Insert Table 2 here

Observations

With relevant industry and market knowledge and business competences, EEs contribute to a more efficient opportunity framing through targeting the most promising application and customer focus, which accelerates the spinning out from research to company. Because the technology in many instances is at a Technology Readiness Level (TRL) of 1-2, the possibility to influence its development is high (Mankins 1995). The focus on creating value for customers while developing the technology allows most cases to generate early sales, which is a critical threshold for new technology firms.

One difference in the BtG model compared to other models of technology transfer, including that of Vohora et al., is the early participation of EEs. In addition to the critical juncture with entrepreneurial commitment proposed by Vohora et al., involving EEs in ongoing research activities provides distinct advantages. The quality of the opportunity framing improves because of the EEs' industry experience, even for cases already within the university tech-transfer system. The number of opportunities recognized (application and market potential) and articulated increases substantially. This is a direct result of EEs' understanding of industry needs, which is mostly missing among university staff.

With few exceptions, EEs' involvement increases the motivation of researchers to help them identify the most necessary tasks to create a strong foundation for a future business. A cornerstone of BtG is the creation of trust between EEs and academics and mutual acceptance of the EEs as venture champions. The initial mutual chemistry, together with required and facilitated regular meetings and mutually agreed-upon specific deliverables, helps build acceptance and eventual trust.

All spin-out companies attract resources through traditional investments, customer financing and soft funding grants. The EEs help create a strong focus on customers and co-development with potential

customers, which helps with the financing of the companies and with bringing in unusual early sales. The close collaboration between researchers and EEs, in addition to achieving a better technology-to-market fit, also contributes to the launching of companies with more innovative business models.

The presence of EEs on the research team creates what we consider to be a more ‘entrepreneurial mindset’ among researchers early in the technology development process. This mindset helps accelerate the progression from patent to spin-off by setting more targeted goals based on a specific product-market fit. The EEs use their knowledge and experiences to connect the research environment with key stakeholders in specific markets, contributing to more customer-focused development activities. Thus, successful co-existence helps create a dynamic interaction between the research laboratory and the market structures, which helps eliminate much of the information asymmetry typically associated with new technologies.

The business models and go-to market strategies should give them a better feel of the market and the flexibility to adapt to changing conditions, as is necessary for some of the cases. The relatively short time to market depicted in the 6 cases is due importantly to a more effective evaluation of the technologies and to dedicated efforts by the EEs in connecting with potential lead customers prior to launching the spin-out company. The relatively short time between the evaluation and exploitation of the identified opportunities through spin-out ventures is directly related and influenced by the overall characteristics of the EEs, which we collectively refer to as their experience.

An unexpected outcome of the BtG model and program is the growth of a more entrepreneurial culture in the respective departments and at the university in general as news of the model has spread across campus. The facilitation of the results/technology analysis and co-creation of applications between researchers and EEs maybe considered transformative for innovation and entrepreneurship practice in the university. As the researchers learn that they can receive committed and competent advice and have EEs take the lead in the commercialization process, they are becoming increasingly interested in the commercial prospects of their research results. Some are more open to pursuing a life as an entrepreneur, whereas others are happy to work along with EEs to bring technologies to market. Since the launch of the BtG program, the number of researchers who have expressed interest in forming an advisory board or meeting with potential EEs has increased significantly.

Concluding Remarks and Implications

In contrast to the centralized TTO (traditionally helping established companies access university research output), the BtG model outlines an alternative decentralized approach in which new technologies are positioned for the market through external individuals and their expertise in starting companies, customer and product development, financing and sales. The model, applied to 6 technology cases, shows that EEs and researchers can co-exist to improve the commercialization process by creating common commercial goals and allowing those goals to direct the later research-development process. BtG provides access to research results and inventors at an early stage in order for them to create commercial opportunities. This open-door practice stimulates active engagement in the commercialization process and encourages opportunity-seeking entrepreneurs to become future co-founders.

This co-existence, however, requires concerted effort on the part of the university due to challenges aligning the goals of key parts of a research team and the entrepreneur and handling major divergences that can derail the corporations. A major challenge is for researchers who wish to maintain the traditional university responsibilities of teaching and publications and normal family activities. While these challenges may seem insurmountable, researchers who see the potential beyond monetary gains, such as wider network connections with industry and an improved ability to attract external financing for research, may be encouraged to participate in spin-out activities following a model such as BtG.

Although the spinning out of technology and other research results continues to attract attention and importance, universities are still to a large extent rated and ranked based on publications and other traditional academic output. University leaders must therefore create a balance between these two types of activities and create an environment in which both can co-exist; this remains a key challenge for many research universities. The BtG model can assist those charged with helping universities create more spin-outs based on research create more open structures for successful technology commercialization without threatening their integrity and fundamental goals. The BtG may be adapted by other universities that are struggling to realize commercial gains from their research investments and to fulfill the mandate to contribute more directly to the economic conditions of their locale.

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Figure 1: The BtG model

Table 1: The five phases in the BtG Model

	Screening and Patenting	Matching	Connect and Develop	Spinning Out	Follow-up
Description of the different phases of the BtG model	Researchers and business developers within the university secure IPR and perform initial opportunity search. Typically TRL level 1-2.	Experienced entrepreneurs (EEs) from outside the university are matched to potential spin-out cases. The EEs dedicate significant resources in terms of their own time to understand the details of the technology. Typically TRL level 1-4.	The EEs seek to connect the technology to potential first customers. Development of prototypes and project-based feasibilities studies to clarify market demands. Typically TRL level 3 to 5.	EE and university researchers form founding team and establish a new venture. License agreements with the university for IPR. Securing of seed funding and/or customer financing for spin-out. Typically TRL level 4 or higher.	Following the new spin-out via individual meetings and advisory board roles. Collecting data on time from spin-out to receiving first commercial order and on team dynamics between EE and university co-founders. Typically TRL level 5 or higher.
Legal activity	Draft Term Sheet developed by the university	NDA between EE and university. LoI between uni and founder group. Uni states intention of spinning out a company.	MoU among future founding team (uni not part). Consultancy agreement between EE and university.	Term Sheet. Shareholder agreement for new company. License agreement between new company and university	
Patent activity	Patent filed		Patent developed with a business perspective		
EE actions	No EE	Overview of business potential	Business plan and patent	Responsible for legal process and possible investments	
EE level of commitment	(0 EE)	EE participates via advisory boards or individual meetings (1-4 EEs)	EE is part of the team working at the university (1-2 EEs)	Part of the team away from university (1-2 EEs)	
Researcher actions	Filing of patent	Dialogue with EEs about technology and business potential	Working on the development of the technology for market	Part of the team away from university	

Table 2: BtG - the case firms

Spin-out company	Screening and Patenting	Matching	Connect and Develop	Spinning Out	Follow-up	EE characteristics
<i>Technology</i>						Stage of entry (wrt. Vohora)
Case 1: <i>Photonics</i> Lasers for medical applications, sensors and lighting	A team of 4 researchers, from professor to post-doc levels, had worked on a technology for around 5 years and filed 3 patents. The team had industrial contacts via a European research grant representing potential future customers.	<p>The team had a desire to see their invention be commercialized and had participated in various events to promote academic entrepreneurship (including winning a Danish venture competition). However, none of the researchers had an interest in leaving their academic jobs.</p> <p>An advisory board was established that comprised three experienced entrepreneurs. The team also engaged two business school students to serve as personal assistants to the CEO.</p>	A member of the BTG advisory board led negotiations with a European company (partner in a EU-funded research project) to enter a feasibility study for a potential future product. The feasibility study was to be initiated once a company had been spun out of the university. The feasibility study would be fully funded by the European company.	Six months after initiating the matching phase, the EEs and the researchers reached a mutual understanding about the future venture and the sharing of equity among them. Furthermore, one of the EEs had committed to serve as CEO. Seed funding from the group of 11 individuals (on average €5k each) funded the hiring of the CEO for one year. The team secured a license agreement with the university (royalty agreement with exclusivity). The total period from first meeting the EEs to spinning out the company was 12 months.	Within the first 3 months, the company made its first sales (negotiated during the Connect and Develop phase), and within 11 months, the team had secured a further investment of about €500k from business angels and a venture capital firm. The founding group holds around 75% of the company. The company has successfully secured more than 1 MEUR in EU and Danish government funding (with the university benefitting with roughly equal amounts). The company has 7 employees today, including a sales representative in the US.	<i>Research background similar to academics</i> <i>15 years of industry experience (R&D engineer, product manager, technical sales support)</i> <i>Working in two early ventures (not founder)</i> <i>Technical and market insight</i>
Case 2: <i>Imaging</i> Infrared cameras with high sensitivity. Based on nonlinear optics.	The research team for this case comprised three individuals, two with previous experience from a spin-out, albeit with hesitation to join the start-up full time. The last researcher had an interest in joining the start-up but lacked business or management experience. The team had filed a total of 7 patent applications.	The team was approached by an EE who was looking for a new venture that he could engage in fully. He committed 1 year of dedicated work with the research team to understand the technology, to develop the business foundation and to build mutual confidence.	The EE and a member of the research team negotiated a feasibility study with a Danish company. The feasibility study was divided into two phases: a first phase that was to be conducted prior to spin-out and a second (large) phase after the spin-out that would be triggered by successfully meeting milestones in the first phase.	After approx. 1½ years, the EE and the research team decided to form a company with shares split equally between them and to pursue a customer-financed start-up. The company further secured IPR from the university. The total period from the engagement of the EE to spinning out the company was 18 months.	The company today has three employees, the EE as CEO, one researcher as lead engineer, and an industrial Ph.D. The company has secured several EU and Danish government grants (about 0.7 MEUR) to finance its operation without taking in venture capital.	<i>Engineer (non R&D)</i> <i>Entrepreneur in IT business (in the 1990s)</i> <i>Venture capital</i> <i>Technical and market insight</i>
Case 3: <i>Sensors</i> Laser-based structural sensor. Bend measurements of microscopic	The academic team spotted a potential application for the technology in sports equipment but had no interest in joining a spin-out. They were happy to see the technology sold off, either as a license agreement to	A BTG advisory board was set up with three individuals: a sales and marketing person with specific market insight, an experienced entrepreneur with technical background, and a business angel with a focus on	A series of customer meetings was held during the first 6 months. This included travels to individual companies, exhibitions and trade shows. The meetings	After 12 months, the team decided to form a new company financed by the two EEs. Ownership of the new company was split with 80% to the EEs (40% each), 10% to the researchers and 10% to the	After 6 months, the new technology exhibited unforeseen disadvantages, prompting the EEs to move to alternative technologies (maintaining business opportunity focus). One of the	<i>Engineer from cell phone industry</i> <i>Business angel with strong general management skills</i>

mechanical deformations.	an existing company or as a spin-out headed by someone else.	the management of start-up teams and executive sales. After 4 months of involvement, two of the EEs decided to engage full time to spin out the technology. The third EE had a different perception of the right business strategy and left the team after a mutual agreement.	confirmed the EEs of a credible business opportunity.	university 10%. The company secured IPR from the university (equity agreement).	EEs continues to be in the business, whereas the other has left. Today, the EE who continued the course has demonstrated a prototype based on existing technology and secured a partnership with a leading player in the market. The new company has 4 employees and is funded via the EE's private money and customer financing (no venture capital).	<i>General technical skills, but no market insight</i>
Case 4: <i>Spectroscopy</i> Measuring devices developed to conduct new in situ IR spectroscopy	The research team consisted of one PhD student and two master's students with no previous expertise in start-ups or product development. The researchers had desired to be part of a spin-out. The plan was to set up a web shop and sell their technology worldwide, primarily focusing on the R&D segment. They expected turnover of €1m after three years selling devices at €4k per unit. The research team had already met with a potential investor, who wanted to provide them with the first early investment for 25% of the shares in the company.	The team met with two potential EEs, and it was clear that they had very different visions. EE1 wanted to move forward with the existing business model. EE2 did not see any potential in the current business model but instead suggested that the team focus on a specific B2B segment and develop a large-scale installation where test results did not have to be analyzed by other researchers but were presented as finished results. The team decided to go with EE2, who was also responsible for applying for a government grant.	The EE engaged his personal network and led a number of business meetings to his proposed strategy. This confirmed the team's new plan to develop a large scale installation where test results did not have to be analyzed by other researchers but were presented as finished results. Instead of €4k per unit, this would represent a value of approx. €70k pr. unit.	The team was successful in securing a government grant that allowed the bootstrapping of their early activities. The ambition was to keep the company shares for a potential future investment round, when the company had increased its value. From the point when the EE became part of the team, it took the joint team six months to spin out.	The company currently employs two full-time researchers, one part-time researcher, the EE and a part-time programmer. The company has installed pilot systems for in-line spectroscopic analysis at large industrial companies, and the systems are undergoing extensive testing for design lock.	<i>Engineer with a long history in the management and development of new business areas in larger companies in Denmark and internationally</i> Opportunity framing
Case 5: <i>Chemistry</i> High-throughput solution for enzyme screening	The company is based on knowhow developed at the University of Copenhagen (KU) and the Technical University of Denmark (DTU). The founders have over 30 years combined experience in the field and a history of extensive collaboration with academic and industrial partners. A joint patent had been filed, and initial commercialization efforts (led by the researchers) had been conducted over a two-year period.	The researchers wanted the technology to be spun out, but they were not interested and did not believe they had the skills to lead the process. An advisory board with five EEs with networks and expertise within this area was set up. After the first meeting, one EE became the lead, and the rest of the board was unwilling to spend time on the case. The remaining EE set up biweekly meetings with the researchers.	The EE engaged a business graduate to conduct sales and to set up a website for the product. During the process, it became evident that the current patent would not provide the necessary protection for the company, and the EE co-wrote a new patent with the researchers and a patent attorney.	The new patent provided a crucial foundation for both the company and investments from business angels and venture capital secured by the EE. The EE spent approx. one year with the team before spinning out.	The company has employed the business graduate full time to act as interim CEO and has employed a technician. The EE has a role as Chairman of the Board with active participation in the operation on a weekly basis.	<i>Business training and very experienced in starting up companies within the overall research area</i> Pre-organization

Case 6: <i>Chemistry</i>	Case initiated by EE contacting the University	An EE approached the university with an idea for a potential business. He was matched with a research team that had specific knowledge within the area. They worked together intensively for six months, during which the EE brought in potential investors and board members. This focused the development of the technology, and within the first month, a common goal was set, paving the way for developing the technology specifically for this goal. This made the research team very focused and driven.	Over the six-month period, the EE set up a production line and sales channels and contacted future customers. The collaboration during the six months proved highly successful technically and team-wise.	Nine months after the initial contact, the EE had led the team to develop products available in stores.	This case shows an alternative to the research-initiated start-up cases, where the university is open to an EE with a business opportunity requiring the research expertise of a university team. The case underlines how researchers and expertise in the hands of an EE who commit early enable approaching future customers in a credible way and creating sales channels for a fast track from research to market.	<i>Business training and experience with starting up companies</i>
New formulation for a greener cleaning product						Research