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How education, stimulation, and incubation encourage student entrepreneurship: Observations from MIT, IIT, and Utrecht University



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ABSTRACT

Universities across the world are increasingly trying to become more entrepreneurial, in order to stay competitive, generate new sources of income through licensing or contract research, and follow policy guidelines from governments. The most powerful resource universities have to stimulate entrepreneurship is their students. However, there is no evaluated theory on how to encourage students to become entrepreneurs. Through three case studies the entrepreneurial encouragement offerings applied at MIT in the United States, IIT in India, and Utrecht University in the Netherlands are investigated. The offerings provided by these institutes have been surveyed, interviews about these offerings with university staff have been performed, and reflected upon through interviews with entrepreneurs that graduated from these institutes. The three case studies provide insight in how student entrepreneurship encouragement offerings contributed to students choosing a career as an entrepreneur. Several successful examples of student entrepreneurship encouragement offerings are presented, and a model is proposed on how to effectively encourage entrepreneurship among students. The model supports academic institutes in constructing an environment that encourages student entrepreneurship and aims to help universities convince students to continue their careers as entrepreneurs.

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1. Introduction

Universities play an important role in the regional entrepreneurial climate. As institutes focus on creating new inventions and knowledge, they serve as an important output of knowledge and innovation, which can be exploited by new ventures (Edmondson & McManus, 2007; Shane, 2004). Etzkowitz (2001) calls it the second academic revolution: the first academic revolution added research as a mandate next to the education of students, now entrepreneurship has become a third mandate of universities. Academic entrepreneurship has therefore become a priority for policymakers from inside the universities as well as local governments everywhere (Potter & Storey, 2007). Universities and governments try to create highly innovative science parks where young entrepreneurs lead innovation and, ultimately, economic growth. For example, Stanford and MIT

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and their close links to industry and entrepreneurship were once seen as anomalies within the academic system, whereas currently they have become the model for other universities to emulate (Etzkowitz, Webster, Gebhardt, & Terra, 2000).

There is a significant body of evidence linking the level of entrepreneurial activity to desirable effects such as the competitiveness of an economy, job creation, unemployment reduction, innovation, and economic and social mobility (Rotger, Gørtz, & Storey, 2012; Van Praag & Versloot, 2007). Therefore, governments of virtually all developed countries have put the stimulation of entrepreneurship high on their agenda (Potter & Storey, 2007), all hoping and striving to become entrepreneurial economies that pick the fruits of dynamic capitalism (Thurik, Stam, & Audretsch, 2013). Universities are encouraged to observe and analyze their own entrepreneurial ecosystems: the organizations and climate that support starting students in building a successful enterprise. In a study assessing the effectiveness of a Danish entrepreneurship-stimulating program Henrekson and Rosenberg (2001) find that initiatives aimed at stimulating entrepreneurship contribute to the survival and growth of new ventures. Entrepreneurs that participated in the Danish program have a 3–12% higher survival rate (measured over two years) than entrepreneurs that did not participate in such a program.

Several studies concerning the fostering of student entrepreneurship have been conducted (Franke & Lüthje, 2004; Huffman & Quigley, 2002; Liñán, Urbano, & Guerrero, 2011; Lüthje & Franke, 2003; Nab, Pilot, Brinkkemper, & Ten Berge, 2010). Universities worldwide employ a combination of these initiatives in order to create an attractive entrepreneurial climate. However, the initiatives are not always successful, and not every science park becomes the next Silicon Valley. We identify the problem that universities do not have an overview of what instruments there are to stimulate students to choose a career as an entrepreneur. In this article we define Entrepreneurship Education and Support Offerings (EESO) as being instruments that universities can employ to stimulate students in an academic environment to follow a career as an entrepreneur. A university can employ several EESOs in order to stimulate and facilitate innovative entrepreneurship. Among such offerings are: education in entrepreneurship, hosting business plan competitions, setting up technology incubators, technology transfer offices, and appointing chairs for entrepreneurship (Lüthje & Franke, 2002). In this article we list fifteen EESOs and evaluate them in three international case studies.

There are excellent examples of universities that have had significant influence on start-up success, such as Stanford and MIT. However, it is unclear why one university succeeds in creating a fertile entrepreneurial climate while others, with similar initiatives, fail. Which initiatives have proven successful during new venture formation? Moreover, to what extent did they contribute to startup success? In Section 2 the literature is discussed and we find that this is a domain that is rapidly growing to a mature field of research. We continue to present our own Student Entrepreneurship Encouragement Model in Section 3. The model provides fifteen EESOs grouped into three categories: education (for awakening dormant entrepreneurs), stimulation (to support students in starting a business), and incubation (to support young companies to independence). We present the case study method and the three cases at MIT, IIT, and Utrecht University in Section 4 and in Section 5 we discuss how the model is evaluated in the case studies. We compare entrepreneurship education offerings at three exemplary entrepreneurial universities in different regions of the world, and evaluate these offerings by interviewing business founders that graduated from these institutes. We end with a discussion on the consequences of our research in Section 6: we provide a complete list of offerings that universities can implement and we call for a further discussion on the responsibility of the university in entrepreneurship after students have graduated.

2. Background

Just like the prevalence of entrepreneurship education has increased enormously, the literature on entrepreneurship education has also expanded considerably over the last decade. Two main foci are the nature of entrepreneurship education and the entrepreneurial outcomes. This literature ranges from describing the nature of the programs to the various effects of these programs on entrepreneurial intentions, skills, technology commercialization, new business creation and success (Rideout & Gray, 2013).

The standard theoretical model to explain students' entrepreneurial intentions and ultimately entrepreneurial behavior is theory of planned behavior (TPB) (Ajzen, 1991). Entrepreneurial intentions are seen as the product of an individual's self-efficacy, attitude and the subjective norms toward entrepreneurial behavior (Krueger, Reilly, & Carsrud, 2000; Schlaegel & Koenig, 2014). Entrepreneurship education is seen to be instrumental especially in raising entrepreneurial self-efficacy, i.e. the belief in having adequate skills and competencies for setting up a business. Subsequently, entrepreneurial intentions are seen as one of the strongest predictors of entrepreneurial behavior.

Studies based on the TPB show positive relations between entrepreneurship education and entrepreneurial intention (Zhang, Wang, & Owen, 2015). However, given that most of these studies are cross-sectional, one should be careful to infer causality from entrepreneurship education to entrepreneurial intentions. Research has shown that students enrolling for entrepreneurship education have higher self-efficacy and entrepreneurial intentions than other students. This suggests a sorting mechanism (Von Graevenitz, Harhoff, & Weber, 2010). A longitudinal study based on the experimental methodology by Oosterbeek, van Praag, and Ijsselstein (2010) even found a negative effect of (obligatory) entrepreneurship education on entrepreneurial intentions, and no significant effect on students' self-assessed entrepreneurial skills. In a similar study Von Graevenitz et al. (2010) found no statistically significant effect of entrepreneurship education on entrepreneurial intention, but a positive effect on perceived entrepreneurial skills. Bae, Qian, Miao, and Fiet (2014) concluded from their meta-analytic study on the effect of entrepreneurship education on entrepreneurial intention, that the two are positively related, but that, after controlling for pre-education entrepreneurial intentions, the relationship between entrepreneurship education and

post-education entrepreneurial intentions was not significant. Studies on the effect of entrepreneurship education on entrepreneurial behavior (starting own business) generally show positive effects, however these studies mostly lack a proper experimental research design (Rideout & Gray, 2013). Despite of the large number of studies on entrepreneurship education, Rideout and Gray (2013) conclude their review study that we still do not really know whether entrepreneurship education really works.

Even if we would assume that entrepreneurship education can work, Nelson and Monsen (2014) conclude that classroom teaching is not sufficient for successful university entrepreneurship and technology commercialization. The studies they reviewed emphasize the importance of understanding and leveraging the broader university commercialization ecosystem. In particular, they stress the need for close partnerships between the technology commercialization office and the educational process, as well as close linkages between science, engineering, business, law and other groups, i.e. the whole university entrepreneurial ecosystem. In this article, we build upon the fact that the complete university entrepreneurial ecosystem needs to be mobilized by creating a set of offerings that will be supplied by different parties in the ecosystem.

3. The Three Stage Student Entrepreneurship Encouragement Model

In this article we address the following research question: *Which entrepreneurship encouragement offerings contribute to the decision of a student to pursue a career as an entrepreneur?* An answer is provided to this question by developing and presenting the Three Stage Student Entrepreneurship Encouragement Model (SEEM). It has been created in two steps: first a (snowballing) literature study was conducted to identify EESOs. Secondly, the SEEM and separate EESOs were evaluated by performing three case studies at large universities. The research methods are further elaborated in Section 4.

The SEEM is presented in Fig. 1. The identified EESOs were divided in three separate stages that students go through in their entrepreneurial endeavors. The SEEM divides the university offerings over three separate stages: a stimulation stage, an education stage, and an incubation stage. Each stage has a specific goal, and contains specific activities, in order of importance, that could be provided and/or supported in order to reach that goal, and effectively foster entrepreneurship at a university.

Educate. Donckels (1991) conducted a large-scale survey amongst Belgian students, graduates, and faculty in the field of economics, regarding entrepreneurship education in Belgian higher education. He found that the most important goal for entrepreneurship education is to create awareness for entrepreneurship as a career option, as this would lead to a change in attitude towards entrepreneurship. The goal of the education stage is to wake up dormant entrepreneurs. It entails creating an environment at the university in which students are made aware of the possibility of becoming an entrepreneur. There are several things that have proven effective during the education phase. Primarily, having university staff and faculty that are supportive towards entrepreneurship and entrepreneurial students (E1). Additionally, students react positively to role models and success stories (E2) (Franke & Lüthje, 2004), for instance by providing a stage for university alumni that became

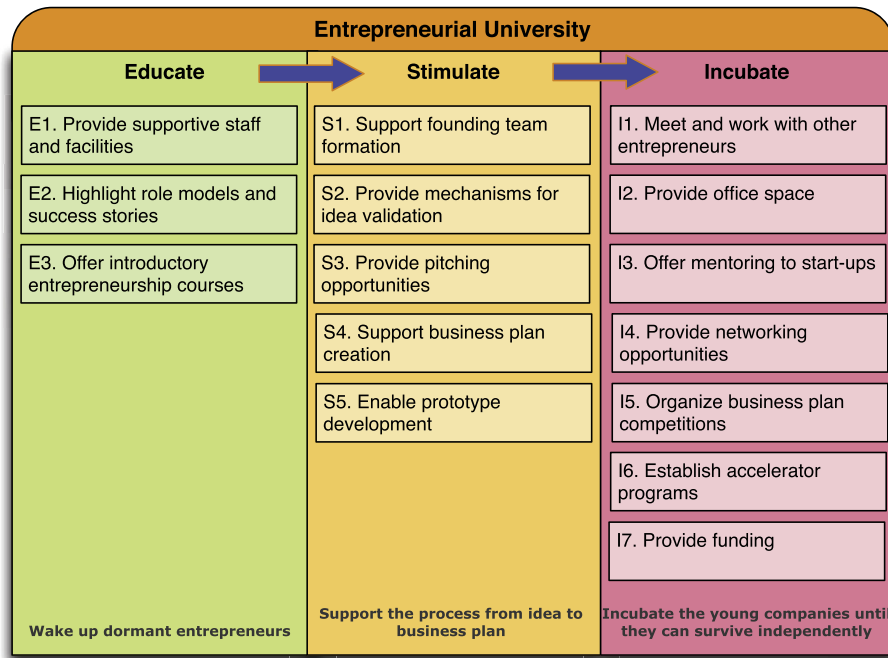


Fig. 1. Three-stage Student Entrepreneurship Encouragement Model (SEEM) to contribute to becoming an entrepreneurial university.

Table 1
Properties of the three universities where case studies were conducted.

Name	Location	Founded in	Students	Faculty	Ranking (AWRU 2012)	Interviews ^a
Massachusetts Institute of Technology (MIT)	Cambridge, MA, USA	1886	10.894	1.018	3	2/6
International Institute of Information Technology (IIIT)	Hyderabad, AP, India	1998	1.220	47	<500	2/8
Utrecht University (UU)	Utrecht, the Netherlands	1636	29.082	8.614 ^b	53	4/6

^a Staff versus founders.

^b Including supporting staff.

successful entrepreneurs or by hosting activities that celebrate entrepreneurship, such as contests and career days. Another activity to support entrepreneurship is to provide introductory courses (at the bachelor/undergraduate level) (**E3**). This introduces students to the concepts of entrepreneurship, and is also an ideal way to introduce students who become interested to the other offerings at the institute. Education has as the main goal to awaken dormant entrepreneurs, primarily by raising awareness of entrepreneurship as a career option, and (**E3**) does that precisely. [Martin, McNally, and Kay \(2013\)](#) performed an extensive meta-analysis of entrepreneurship education outcomes and they find a positive correlation between entrepreneurship education and entrepreneurship outcomes.

Stimulate. The goal of the stimulation stage is to support students with a business idea in the transformation from an idea towards a complete business plan. There are several activities where the university can provide support. Primarily, the university should support founding team formation (**S1**). Furthermore, the university should promote the formation of multidisciplinary founding teams by bringing together students that are interested in entrepreneurship and support founder teams in the process of validation of their idea (**S2**). Does the idea have potential? Is it feasible? The remaining activities that should be supported in this phase are the pitching of the idea (**S3**). The entrepreneur should be able to convince others why his idea is worth investing in or paying for. To further prepare the student (or founding team) the stimulation stage should also focus on the development of a business plan (**S4**) and the realization of a prototype (**S5**).

Incubate. Incubators have a positive impact on their tenant firms survival and growth ([Mian, 1994](#)). The incubation stage focuses on supporting the launch of an actual company. The offerings in this stage should focus on bringing young entrepreneurs together in a common working space (**I1**) and providing access to (free or subsidized) professional office space (**I2**) ([Lewis & Edward, 2001](#)). Additionally, mentoring and networking services should be provided for the young entrepreneurs (**I3** and **I4**). Hosting business plan competitions are an effective way to provide entrepreneurs with mentoring, networking, and publicity (**I5**). An accelerator program (**I6**) helps the entrepreneurs to progress faster, by providing a rigid structure with strict deadlines where the entrepreneurs have to show progress. According to the three case studies, which focused exclusively on software entrepreneurship, (seed) funding (**I7**) is the least important offering during the incubation stage for software companies. It can be helpful for some startups, but it is not as crucial as the other offerings.

4. Case study design

This research employs an exploratory qualitative research approach, consisting of three case studies and inductive and iterative data analysis, to discover and develop nascent theory related to the fostering of student entrepreneurship at universities. The multiple-case study research method is a suitable research method, as it provides a way to gain in-depth insight in an unstructured and unfamiliar environment ([Eisenhardt, 1989](#); [Yin, 2009](#)). The goal of the case studies is to clarify whether EESOs are present at each university, how these offerings work, and how successful (ex-)student entrepreneurs valued these EESOs for their own success. These results are then used to compare entrepreneurship stimulation at the three institutes of interest, and finally to provide general success-patterns in stimulating entrepreneurship.

The object of study thus is the university's entrepreneurship ecosystem, i.e., any part of the university organization that is involved in encouraging student entrepreneurship and any part of the student and alumni body that actively participates in start-ups as an entrepreneur. As the object of study is broad (by design), the researchers uncovered many different parts of the university that are involved: professors that teach entrepreneurship courses, incubators that are not connected to any specific faculty, business plan contests organized by the university board, etc. The case studies have been conducted at MIT in the United States, Utrecht University in the Netherlands, and IIIT Hyderabad in India. These particular universities have been selected as they are considered key cases in relation to the concept of university entrepreneurship. Furthermore, we limited our scope to software entrepreneurship, for several reasons. The universities that were selected are all research universities, and as software start-ups tend to require relatively little investment in the beginning, we believe that software entrepreneurship is at the forefront of the entrepreneurship encouragement trend. Finally, the selection process was a matter of convenience sampling, as two of the authors were working at Utrecht University and MIT at the time of the research. IIIT was selected as a relevant reflective case. No other institutes were contacted ([Table 1](#)).

The case studies followed the data collection methods described by [Yin \(2009\)](#). We used document study and two rounds of interviews: a round of university staff interviews to collect data about the offerings of each university and a second round of founder interviews with ex-students from the academic institutes to assess effectiveness of the EESO. All founder interviews were with alumni or current students in the master program at the university under study, with the exception of two students from IIIT, who did not continue after obtaining their bachelor degrees.

The types of documents that were studied include course descriptions/outlines, university websites, and publications on the student entrepreneurship encouragement activities of that university. The faculty and staff interviews further elaborated on the identified EESOs and corroborated the findings. Successful start-ups were identified and the interviewees were asked, during their interviews, whether they could supply us with contact data of the students that were involved in those startups. In the founder interviews we also used the snowballing method, where we asked founders whether they could identify other successful founders with whom they had studied. The interviews took around 95 min on average, with two exceptional cases of 1 h and one around 3 h. The interviews at founders tended to take longer, as they typically toured the grounds of their companies with the interviewer before actually starting the interview. The interview recordings were transcribed within 24 h of the interview. Using simple marking techniques, the EESO were identified from the university staff interviews.

We assume that, because the student or alumnus is now pursuing a career as an entrepreneur, the offerings were successful in pushing the founder towards becoming an entrepreneur. The approach is not water-tight: culture and hereditary factors play a large role in whether a person becomes an entrepreneur or not. In the interviews it was explicitly stated that our aim is to evaluate the success of university offerings. Founders were asked to state whether they thought that the offering had a positive or negative effect on becoming an entrepreneur. Our success definition (*“the student/alumnus is pursuing a career as an entrepreneur”*) is somewhat eccentric: it predicts nothing about the successful outcome of the start-up. There is an implicit factor in the definition, however, as we only interviewed founders of companies that were well known around campus and had a successful track record. We cannot eliminate the factor of self-selection here: perhaps these alumni came to university brimming with entrepreneurial ideas? We console in a quote from one of the founders: *“I always wanted to become a consultant before following the ICT Entrepreneurship course at Utrecht University. My current career (as an entrepreneur, red.) was somewhat unexpected.”*

Analysis. The case study database, which consists of documents from the document study and transcribed interviews from the interviews with university staff and faculty and founders of startups, were analyzed using qualitative data analysis and based on grounded theory principles (Charmaz, 2006). The software tool Nvivo was used for the qualitative data analysis. Grounded Theory Analysis describes multiple rounds of coding and data gathering. In this research, the data coding process associates statements by the founders to these offerings and therefore one round of coding proved sufficient.

Interview candidate selection: Even though the number of interviewees per case is seen as sufficient, as the interviews continued until no significant new information was introduced, the selection of these interviewees was not ideal. One or two faculty members of each institute suggested and introduced the interview candidates. Especially at big institutes, such as MIT and UU, this presents a risk that only a subset of potential interviewees has been included. Additionally, only successful entrepreneurs were included. None of the interviewees had started a business that failed. Finally, as a research design consequence we omitted ‘indirect’ entrepreneurs: the ones that did not start right after graduation, but later. Interestingly, a significant number of students expect to found a company five years after graduation, as is shown by the surveys held at MIT Roberts and Eesley (2009).

4.1. The Massachusetts Institute of Technology

Ever since its creation in 1886, it has a reputation of an institute that stimulates entrepreneurship. Together with Stanford University in California, MIT is seen as one of the exemplars of an entrepreneurial university. It sits at the center of Route 128, an area with an unusual high concentration of high-tech firms. Route 128 is referred to as the east-coast equivalent of Californias Silicon Valley. In an attempt to define and quantify this entrepreneurial spirit at MIT, Roberts and Eesley (2009) published several reports since 2003 on the role of MIT in relation to entrepreneurial impact. These reports are mainly based on large surveys sent to MIT alumni in 2001, 2003, and 2006. Roberts and Eesley estimated that if all active companies founded by currently living MIT alumni would form an independent nation, their revenues would make that nation at least the 17th largest economy in the world. A large survey among MIT alumni found that, as of 2006, there are 25,800 active companies founded by MIT alumni that employ 3.3 million people and generate nearly \$2 trillion in revenues.

MIT offers a broad array of offerings related to entrepreneurship. Most offerings are coordinated from the Martin Trust Center for MIT entrepreneurship. Among the offerings are courses in entrepreneurship, such as New Ventures, and a business plan course where students work on a real business idea. Other offerings are office facilities, and mentoring and networking services for student entrepreneurs. At MIT six founders were interviewed. The founders graduated from the Sloan school of management, and started at least one business during or after graduation. Even though MIT has many centers, courses, clubs and places related to MIT, these founders only identified a select set of offerings that significantly contributed towards their startup success.

Example Offering: Staff Support – At MIT staff are supportive when starting a business, frequently forging long-lasting relationships between professors and students. The staff support, which seems to be ingrained in the MIT culture, is essential for alumni entrepreneurs and can provide fertile grounds for new ideas, high quality employees, and domain knowledge. *“I stayed in touch with many of my former professors, and talked to them about investment structure, company structure etc. My personal coach at Sloan was a professor, I still meet with her every week, and I did since leaving in 2007. My coaches introduced me to so many people that helped me, and in return they sometimes ask me to come and speak in their classes.”*

4.2. The International Institute of Information Technology Hyderabad

The International Institute of Information Technology Hyderabad (IIIT) was founded in 1998. IIIT is a university that focuses on research and education in fields related to Computer Science and Information Technology. Its mission is to *“achieve*

excellence in research and introduce relevant programs that maximize the impact on industry and society". It focuses on research with practical applications. It offers Bachelor, Master and PhD degrees in several areas of information technology. During its relatively short existence, IIIT became one of the highest ranked engineering colleges in India. Next to high-class research and education, IIIT also has a goal to actively prepare students for a career as an entrepreneur. IIIT is not organized around departments or schools. Instead, it is divided into research centers and labs, to facilitate collaborative research.

IIIT centralizes its few entrepreneurial offerings under the wing of the Center for Innovation and Entrepreneurship. This entrepreneurship center offers a complete set of incubator services, and housed around ten startups at the time of data gathering. Interestingly, IIIT does not offer any courses related to entrepreneurship. Eight entrepreneurs were interviewed at IIIT. All entrepreneurs ran their startup from the CIE incubator. However, not all founders graduated from IIIT. Some of the founders started their business outside the university, but joined the incubator later.

Example Offering at IIIT: Office Space – IIIT provides basic office infrastructure, such as desks, chairs, and Internet access. One unexpected aspect of the office infrastructure, at least from a western perspective, was that the startups also evaluated the reliable electrical power supply as an important offering. In Indian cities it is not unusual that power outages occur. For Internet based startups, with clients across the nation and all over the world, this posed a mission-critical risk. As one entrepreneur, who first started his company outside of the CIE, explains: *"The situation might be different here than where you come from in the Netherlands. One of the issues that we face is getting reasonable commercial space on a rental basis. There are serious power issues, especially during summer. You would have at least two to 3 h of power cut. You cannot survive with that kind of situation. What can you do without power? IIIT-H shielded us from all of this. So we could focus on our work."* Another advantage identified unanimously by the entrepreneurs at IIIT is the sharing of office space with other startups, enabling the companies to collaborate. Depending on size, some larger startups have their own office within the CIE, while others, with fewer employees, share the common working space. This closeness leads to knowledge sharing, such as knowledge on human resource practices and talent finding.

4.3. Utrecht University

Utrecht University (UU, est. 1636) is one of the oldest research universities in the Netherlands. It is the highest ranking university in the Netherlands according to the most recent Times Higher Education¹ ranking and the most recent Shanghai ranking.² Utrecht has traditionally been a research university focusing on high quality, fundamental research and academically oriented education. In the past few years, this focus has slowly been shifting: policymakers on both the European, national, and regional level try to persuade universities to more explicitly show their contribution to society. Universities are even stimulated to conduct 'contract research' for industry. In terms of education, the focus changes from exclusively teaching strict academic disciplines, to a wider curriculum that also prepares students for a life outside academia.

Entrepreneurship is one of the key components of the recent 'knowledge valorization' policy. The efforts are visible: in recent years, UU launched, amongst others, a technology transfer office, a center for entrepreneurship, a business incubator and several courses in entrepreneurship. All of these efforts should stimulate university faculty and students to obtain 'an entrepreneurial attitude'. Additionally, the efforts are expected to lead to a direct increase in the number of companies started by students and alumni. In this article, the effects of all these initiatives are evaluated by talking to university faculty involved with entrepreneurship, and students and alumni who have started a business in the software industry. Six entrepreneurs have been interviewed at UU. Three of the entrepreneurs were being incubated at Utrechts incubators (UU2,3 and 4). UU5 and UU6 already graduated from the incubator. UU1 combined his startup with his study.

Example Offering at UU: Business Plan Course – One of the courses that delivers the most start-ups at UU is the course on ICT Entrepreneurship, on which previous research has been conducted Nab et al. (2010). The course, in which student founding teams have to develop a software prototype and a business plan in a period of ten weeks, strives to provide an authentic start-up environment, to encourage students to consider and follow the path of an entrepreneur. According to the research of Nab et al. (2010), strong factors in the course are the involvement of successful entrepreneurs, the recreation of an authentic start-up environment for students, and the fact that students are exposed to actual start-up problems, such as creating a suitable financial plan and marketing plan. One of the interviewed entrepreneurs stated *"Beforehand I did not think of becoming an entrepreneur. The course awoke the dormant entrepreneur within me."*

5. Model evaluation

The EESOs at the three case studies have been gathered using data from the staff interviews and subsequently evaluated using data from the founder interviews. For each university, the offerings were ranked based on these evaluations. The offerings at the institutes are similar. Table 2 combines the individual overviews of university offerings, with those offerings that were present at two or three case universities. Note that a score of X means that the founders did not have any experience with the offering, not necessarily that it does not contribute towards success.

¹ <http://www.timeshighereducation.co.uk/world-university-rankings/2011-2012/top-400.html> [Accessed January 1, 2014].

² <http://www.shanghairanking.com/> [Accessed January 1, 2014].

In the following four subsections we highlight the topics that were identified as the main categories in the grounded theory analysis: Educational Offerings, Incubator Services, University Culture, and Entrepreneurship Coordination within the University. For some of the rows in Table 2 we also discuss how the SEEOs were appreciated at each of the universities.

5.1. Educational offerings

Both MIT and UU offer several courses that focus on entrepreneurship. These entrepreneurship courses can be divided into two broad categories:

- **Business plan courses:** students work in teams on a business idea (and sometimes simultaneously on product development, as is the case with ICT Entrepreneurship at UU (Nab et al., 2010)). These courses aim to offer an authentic entrepreneurship experience, as they expose students to real world startup problems and opportunities. At both MIT and UU, participation in business plan courses has been identified as being the point at which several of the interviewed entrepreneurs decided to found a company: *“The most important thing I learned is that entrepreneurship is not magic, and that I could just do it. And I learned that you did not need a large investment to launch a software company. A chair and a laptop in the attic and go!”*. Business plan courses help students by:
 - **Forming founding teams:** Several entrepreneurs at both MIT and UU explained that a business plan course was their first experience working with a team of founders. Some had positive experiences and decided to continue with the same founding team configuration. Others experienced difficulties and had to change the team configuration afterward. Nonetheless, they all learned of the importance of a well functioning founding team, with members that complement each other.
 - **Consider more than just the product:** following the contents of a business plan, the founding teams have to consider their strategy, target market, customers, competitors, product price, and marketing strategy. This proved helpful as students are often tempted to focus solely on the idea itself, and only start to consider other aspects, such as the financial model, when the product is already finished.
 - **Setting deadlines:** The courses help students to take their ideas and actually start doing something. The interviewed entrepreneurs indicated that it was helpful to have forced deadlines so that they actually had to start working. This not only applied to courses, but also to business plan-competitions and accelerator programs.
 - **Pitching:** Another important aspect of the business plan courses is that they force students to practice their pitch. The students have to pitch their ideas to juries consisting of lecturers or experienced entrepreneurs and investors. These pitching rounds offer an important source of feedback, and also prepares the founder for real pitches later on. Prizes in pitching contest were typically seen as secondary: *“It was really stimulating to win. We had the feeling that we just HAD to continue because it was seemingly a good idea. In the end I think I would be less motivated to continue, so I'm not sure if I would have continued.”*
 - **Assess entrepreneurial skill:** The final benefit of business plan courses is that they teach students what it takes to become an entrepreneur. Therefore, students can assess whether they have the right skill set to pursue an entrepreneurial career.

Table 2

The table lists the summarized perceived contribution of an offering, as found in the SEEM, to the entrepreneurs' success. ++ means the offering was evaluated to provide a positive contribution towards success. + means that the offering was seen to be helpful towards becoming a successful entrepreneur, but not essential. – means that there was no contribution to success. 0 means that none of the entrepreneurs found that the EESO contributed to their success. Finally, X means that the entrepreneurs had no experience with the offering. In the final column the results have been averaged out, to provide insight into how the EESOs were appreciated overall.

	MIT	IIT	UU	Effectiveness
Educate				
E1. Provide supportive staff and facilities	++	++	–	++
E2. Highlight role models and success stories	+	+	+	+
E3. Offer introductory entrepreneurship courses	–	X	0	0/–
Stimulate				
S1. Support founding team formation	++	++	X	++
S2. Provide mechanisms for idea validation	+	+	0	+
S3. Provide pitching opportunities	+	+	+	+
S4. Support business plan creation	+	X	+	+
S5. Enable prototype development	+	+	++	+
Incubate				
I1: Meet and work with other entrepreneurs	++	++	++	++
I2: Provide office space	++	++	+	++
I3: Offer mentoring to start-ups	+	+	++	+
I4: Provide networking opportunities	++	+	+	+
I5: Organize business plan competitions	+	X	+	+
I6: Establish accelerator programs	0	+	0	0
I7: Provide funding	X	–	0	0/–

- **Entrepreneurial skill courses:** In contrast with the broader business plan courses, entrepreneurial skill courses focus on specific skills that are relevant to entrepreneurs. Subjects range from entrepreneurial finance to entrepreneurial strategy or sales and marketing. Only a few entrepreneurs indicated that they followed such specific entrepreneurial skill courses. Entrepreneurs that followed such courses, enrolled after they already started their company. They chose the subjects specifically because they felt that they lacked knowledge in that area. However, they did not indicate that these courses provided a significant contribution towards the success of their entrepreneurial ventures. Overall, the entrepreneurial skill courses seem less effective in contributing to entrepreneurial success. It would make more sense to offer such courses for entrepreneurs at a later stage, when the entrepreneur realizes which skills need more training. For example, universities could offer such courses in the form of professional courses for alumni. As a professor at Utrecht University said *“It’s challenging to offer an activating course for students in the master program that both awakens the entrepreneur in students and that is academically challenging. Most academic entrepreneurship courses seem to take an observational analytical approach. Performing market analysis for instance, which is an academic skill, does not immediately lead to a start-up that can conquer that market.”*

The classroom is potentially the first place where students are made aware of the career option of entrepreneurship. Any university that aims to become an entrepreneurial university must provide a broad offering of courses for students. There are several strategies possible, such as offering specific entrepreneurship courses or making entrepreneurship a part of every course. The latter is possible by showing how the course goals may support a career as an entrepreneur as well. This does require adoption from the staff, which in some universities may be challenging.

5.2. Incubator services

The three institutes provide incubator services. IIIT and MIT offer this as part of their Center for Entrepreneurship, whereas UU has a separate incubator. The incubator services at MIT are offered free of charge for current students and are not open to alumni. At IIIT and UU the incubator services are open for current students, alumni, and external entrepreneurs. However, these institutes charge a usage fee or take up an equity position. The incubator services consist of:

- **Common working space together with other entrepreneurs:** incubators bring together entrepreneurs of startups in a similar life phase. This proved to be the single most important contribution of an incubator everywhere. Young entrepreneurs motivate each other, help each other out with common problems, and share each others networks and resources. As mentioned by an MIT student: *“Really being able to bounce ideas of each other, share thoughts and resources etc. I wanted to meet real entrepreneurs, and the e-center filtered out the real entrepreneur from the people who were just interested in entrepreneurship.”*
- **Professional office space:** All interviewed entrepreneurs at the three institutes identified the access to subsidized professional office space as one of the most valuable aspects of an incubator. It allows them to work in a professional environment, boosting productivity and motivation. They host meetings and receive (potential) clients, investors, or other visitors. At IIIT, the founders also identified the solid infrastructure as an important contribution towards their success. In India it is not uncommon for power outages to occur, or for the Internet to go down. Reliable electricity and a decent Internet connection are critical for software companies. The university shields the entrepreneurs from power failures by providing backup generators and redundant Internet connections. An interesting advantage is found at IIIT: *“It also helps just to be inside the university environment. I hired a lot of IIIT students. This would not have been possible if we had been in a different setting. Even if we would have just been 2 km away. I consider it a very helpful factor. I hear from other entrepreneurs outside of university environments that it is too hard to hire good people. We dont have that problem.”*
- **Mentoring:** The three institutes offer mentoring services as part of their incubation offerings. The mentoring consists of several elements:
 - **Experienced Faculty mentoring:** In the three cases, one of the elements of the support provided by the incubators was that the people involved with the incubator were always available to offer formal and informal advice to the founders. They served as a guide that connect the students to other people and offerings both inside and outside the institute. This support was unanimously evaluated as a helpful offering.
 - **Entrepreneurs in Residence (EIR):** Both UU and MIT offer entrepreneurs in residence: experienced entrepreneurs that spend time at the incubator and share their experience and knowledge with their younger colleagues. Only a few founders mentioned this as helpful, so it is not considered a crucial aspect of the incubator offerings. However, as these EIRs often offer a large network with important contacts, they do contribute to the networking services, which is considered a crucial incubator service.
 - **Accelerator programs:** The three incubators offer accelerator programs as part of their mentoring services. These programs follow a tight schedule, during which participating startups get a chance to further develop their business. At MIT this accelerator program takes place during the summer months. As the first edition was held in 2012, the founders did not have any experience with this offering. At UU all new ‘incubatees’ join the pressure cooker program. This accelerator program helps to get new incubatees quickly on the right track. *“The incubator program adds to the rush of the process. We have concrete deadlines and compete indirectly with other entrepreneurs. We always wanted to come out best and felt better when other teams missed targets too.”*

- **Networking services:** another important incubator offering identified in the three case studies are networking services. The incubators assist the young entrepreneurs in reaching the right people. The type of contacts that the incubators help to connect with were most often investors, but also consist of lawyers, accountants, potential partners, and clients. Especially in regions with fewer venture capitalists and other sources of venture funding, this networking was considered essential.
- **Funding:** The incubators at UU and IIT offer seed funding to the entrepreneurs, in the form of loans or investments in equity. Several of the interviewed founders indicated to have used these funds, however not a single founder rated the funding as a crucial offering. The majority of the founders indicated that they did not require such seed funding, or did not want to commit to a loan. MIT does not offer seed funding as it holds the opinion that it cannot guarantee objectivity if it starts investing in student companies. As one of the professors at MIT said: *“The funding climate around Cambridge is exceptional. We strongly believe that if the start-ups can’t do it on their own, we should be the last ones to invest in them.”*

Providing incubator services at a university is challenging: some are wildly popular (e.g., office space) whereas others (e.g., accelerator programs) have trouble attracting enough participants (students). These services seem to change in level of demand as well: at UU the accelerator program became extremely popular in 2013, whereas in 2011 it was still not actively used by students. University culture can play a part here too: if professors make students aware of the incubator services offered, they are likely to become more popular.

5.3. The university culture

The founder interviews highlighted several implicit offerings that also provided a significant contribution in terms of inspiration, motivation, and advice. These implicit influences are categorized as university culture, and relate to what Etzkowitz defined as the entrepreneurial university: a university environment that recognizes the importance of entrepreneurship and supports entrepreneurial thinking among its members.

Supporting faculty: Independent of explicit offerings, founders at the three universities rated the supporting attitude of their professors as an incredibly important contribution. Some even argued that they would not have become an entrepreneur if it had not been for their encouraging professors. At IIT several interviewees explained how their professor was just as interested in the commercialization of their research that they were prepared to join as co-founders in the new venture. At MIT, interviewees explained how faculty inspired them to become entrepreneurs as they told stories of their own entrepreneurial ventures. At UU, the founders praised the flexible attitude of professors as the students struggled to keep up their study efforts next to setting up their businesses.

Role Models: Another important aspect that provided entrepreneurs with inspiration to pursue an entrepreneurial career was introducing the students to role models. Several entrepreneurs identified that meeting role models from their own university provided inspiration, and encouraged them that they could also do it. The university should provide a stage for these alumni that became successful entrepreneurs. At MIT students were exposed to successful entrepreneurs as guest lecturers during class, attend public talks or discussion panels, or they could be involved as mentors. At IIT and UU this happened only occasionally.

One of the most interesting comments made by the staff at MIT is that students there “self-select”, by going to MIT. The university culture of entrepreneurship grew over a period of 50 years, indicating that entrepreneurship is something that can be encouraged, but also requires a university wide focus on entrepreneurship. At the basis of university culture are the staff members and creating a culture of entrepreneurship requires awareness of staff members as well. We therefore recommend that universities also make their staff (more) aware of entrepreneurship as a career option for their students and make it educational policy to encourage entrepreneurship by highlighting entrepreneurial career paths that could follow from the courses, where possible. An MIT alumnus stated *“I came to MIT with an idea that was changed, reshaped, and mangled along the way. With the original idea we would have never succeeded, but I always wanted to become an entrepreneur.”* The interviewees at MIT suggest that the self-selection mechanism leads to a positive feedback loop: *“The more entrepreneurs MIT produces, the stronger the entrepreneurial environment and reputation, the more likely entrepreneurs, both students and faculty, are attracted to come to MIT”.*

5.4. Organization: center for entrepreneurship and technology transfer

The three institutes aim to centralize their entrepreneurial offerings under the wing of centers for entrepreneurship. Generally these centers serve as a place to go for students who are considering starting a business. Additionally, the centers help increase overall visibility of entrepreneurial offerings. At both MIT and UU, these centers also organize university-wide educational offerings. At MIT and IIT, the Centers for Entrepreneurship provide incubator services, such as free or subsidized office space, networking, and mentoring services. The entrepreneurship centers also organize all kinds of smaller activities, such as talks by experienced entrepreneurs, to inspire students that are interested in entrepreneurship.

In the three cases, the entrepreneurship center is an independent organization within the university. It is not dependent on faculties, schools, or departments. Therefore, these centers are able to independently coordinate university-wide entrepreneurial offerings, such as education and incubation. Centers for entrepreneurship can be beneficial in coordinating efforts of a university to become more “entrepreneurial”. Their missions and visions typically are broad and student entrepreneurship covers a small part of the portfolio of services that they offer. An advantage of a center for entrepreneurship is that it is not

dependent on the core process of the university, which is to educate and conduct research. A potential danger however is that these centers are too far removed from the universities' staff and these centers must continuously strive for penetration within the faculties.

The three universities all offer technology transfer offices, i.e., organizations that are specialized in providing support in making a technology developed at the university a success. Technology transfer offices typically assist academics and entrepreneurs who have developed technology that are highly capital intensive to roll out, such as medicines or mechanical innovations. Only interviewed founders at IIT explicitly used the technology transfer office.

6. Discussion, limitations, and future research opportunities

The growth of the concept of the entrepreneurial university is a positive influence on the development of the innovativeness of universities. The start-up channel provides universities with a direct line to 'valorize' and implement inventions made in the laboratories. Furthermore, as students are at the beginning of their careers after graduation, this may be one of the best times to influence them to continue as entrepreneurs. In no other settings are highly educated people at a turning point in their lives as clustered together as in academia. Universities can thus strongly support nations in their strategies of making their economies more innovative.

As university resources are limited, however, policymakers should be aware that universities and their entrepreneurial responsibility can only be stretched to a certain extent. Universities have the responsibility to educate, innovate, and increasingly make their contributions to society visible. We recommend a strong separation in responsibilities between different organizations in the entrepreneurial ecosystem. The incubation stage from the SEEM, for instance, should be in the hands of a different entity than the university. A student's success at a university must be defined in academic achievements, in terms of grades, prizes, publications, etc. We do not believe that student success should be measured in sports achievements, capital gains through entrepreneurship, or political affiliations and achievements.

As the field of entrepreneurship is maturing and becoming more ingrained it is starting to take its place in academic curricula as highly relevant and applicable across different education programs. In that sense it takes a similar role as other courses and educational themes, such as 'innovation management', 'sustainability', 'research methods', and even 'scientific programming' in most science programs. These courses are fundamental requirements but compete directly with a specialization that the student might follow. It is up to society to define the boundaries between *general education* versus the level of specialization that students require to become effective on the labor market in later years.

Some of the EESOs are situational: the funding climate at MIT is more favorable so the university chooses not to do any investment or provide any loans. At the Utrecht University incubator and at IIT relatively favorable loans are provided, in collaboration with local banks, to enable start-ups to do small investments in the company to get beyond the start-up phase. The professors at MIT, however, illustrate the problems with that vividly: *"If we provide seed funds, if we take an equity position, that is not consistent with our educational mission. If we invest in A and don't invest in B than people say, 'what is wrong with B?' It is like in a family, you love all your children. We help everyone: our job is education. We would run in all kinds of problems if we start investing in companies."*

At MIT several founders got inspired by university research and technology, but they had no need for support from the university to roll it out. An interesting observation was made by one of the professors at Utrecht University: *"student start-ups are quite typically consumer oriented and do not necessarily have a hugely innovation potential. We should do more to stimulate students and even staff to start companies surrounding innovations developed within the university."*

The incubator at Utrecht University guides start-ups from their first prototype to a professional business that can stand on its own legs. The start-ups pay very little rent for office space in the first years, but as time progresses the rent increases dramatically, to a point where the start-up is forced out. This has enabled the incubator to keep the flow of new start-ups going.

6.1. Future research and opportunities

There are several directions for further research that validate, improve, or extend the findings from this research. First of all, the proposed SEEM should be tested on completeness and generalizability by validating it through further case studies at other universities. The current SEEM is based on case studies at universities in Europe, the US and India. However, at this point we are unaware whether the model applies at universities from different parts of the world, such as China, South America, or Africa? Furthermore, it is unclear what other effects are at play in the decision of students and alumni to become entrepreneurs, such as hereditary factors.

Additionally, the present research only considered existing offerings and evaluated their contribution *ex post*. It would be interesting to measure the effect of individual offerings by comparing the situation before, during, and after implementation. To what extent do specific offerings affect the number of direct entrepreneurs (entrepreneurs that start right after graduation) and indirect entrepreneurs (that become entrepreneurs later in their career)? To what extent do the career intentions change? Another research direction that we would be interested to investigate to what extent specific offerings affect entrepreneurs and their companies, by comparing entrepreneurs that did and did not use specific offerings. What are the differences between the two entrepreneurs, and how do they relate to that specific offering? Does a single offering have a measurable contribution to a startups success? It is also interesting to investigate the entrepreneurs that did not succeed. Why did they start, and more importantly, why did they quit? In addition, how does this relate to the university offerings?

A final challenge was identified by a Utrecht University professor: “Building a business takes time. In the two years students are with us, we can only enable them so much: them getting their master's degree is of prime importance. We do offer students the opportunity to perform a graduation project on their enterprise, as long as we find academic merit in it. That's a nine month investment other entrepreneurs do not have time for.” There perhaps exist opportunities to enable students to start a business at the beginning of their educational program and allow it to be the subject of all their coursework. There is, however, no literature to support this concept of *life-long entrepreneuring* as of yet.

Finally, there are still many unanswered questions in the domain of post-academic research. Should PhD students, who are exposed to academic innovations much longer and more intense than regular students, also be further encouraged to start their own enterprise, as most of them will not continue as academics anyway? Should alumni regularly be ‘called back’ to university for new entrepreneurship education and stimulation? And how can alumni be tracked over their lifetime to monitor their work choices in the future? How many of them will stay active in their domain (calling for more focus in education) and how many venture outside of it (calling for more general education programs)?

6.2. Research limitations

During the research, several limitations were encountered, mostly due to time and resource constraints.

Model development: Another important limitation of this research relates to the proposed fostering student entrepreneurship model. The SEEM is the result of an analysis of all university offerings at the three case universities. What did these offerings contribute towards startup success? Based on evaluations from the founder interviews, these contributions were ranked in the SEEM. It is important to realize that the SEEM is only valid for the observations at the three case universities. It is not evaluated or validated through further case studies or interviews. The SEEM is a proposition, and further research should be conducted to validate and (possibly) change or extend the SEEM based on observations at other universities.

Entrepreneurial university: Student entrepreneurship is but a small part of an entrepreneurial university: staff entrepreneurship, technology transfer programs, valorization offices, funding agencies, and many other organizational entities can contribute to making a university more entrepreneurial. Taking the limited scope of student entrepreneurship has enabled the definition of offerings specifically for students, but may put offerings that do not target students in a bad light. As future work, it may be possible to take our approach of targeting one audience (university professors, for instance) and re-assessing the offerings from their perspective, to gain a more complete view of what makes an entrepreneurial university.

Overall, these limitations and issues do not necessarily affect the validity of the findings. The successful offerings and the resulting SEEM provided in this research can serve as a tool in assessing a university's offerings for student entrepreneurship encouragement.

7. Conclusion and further research

In this article we present the Student Entrepreneurship Encouragement Model, containing fifteen Entrepreneurship Education and Support Offerings. The model is evaluated in three different universities: MIT, IIT, and Utrecht University. The model provides a complete overview of offerings that academic institutions can select and implement to further create a university's entrepreneurial ecosystem. Finally, we open up the discussion on the role of universities in society and its functions as devices to create more new ventures and enterprises. Based on these interviews, three stages could be identified in which entrepreneurs significantly benefit from certain entrepreneurial offerings at their university. The stages over which a university can coordinate its offerings are the stimulation stage, the education stage, and the incubation stage.

Each stage contains specific needs and activities that should be covered by university offerings. For example, offerings covering the stimulation stage should focus on creating awareness of the opportunities regarding entrepreneurship, by having supportive faculty that are enthusiastic about entrepreneurship, by highlighting role models and success stories, and by providing introductory courses that introduce the main concepts of entrepreneurship. The education stage should facilitate interested students by teaching them the skills and letting them experience what it is like to be an entrepreneur, as to make students aware of entrepreneurship as a career option. Lastly, the incubation stage covers activities to support young startup teams. It covers things such as office space, meeting other entrepreneurs, and mentoring services. At the three studied institutes, there were several inspiring examples of offerings that addressed these specific stages, such as the courses “*New Ventures*” at MIT and “*ICT Entrepreneurship*” at UU. Another example is the Center for Entrepreneurship at IIT, which supports the incubation phase. The offerings identified in this research are not new, and most of them are not unique. However, this research adds to the body of knowledge by identifying the specific factors that make these offerings successful for students and startups, and by dividing and ordering the offerings over different phases. Comparing the interviews with 20 entrepreneurs from three different universities that share the intention to foster entrepreneurship, led to the discovery of several general success-patterns. As to the best of the authors' knowledge, this has not yet been done before.

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