# Predicting probability of feasibility funding based on academic characteristics and entrepreneurial orientation

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**ABSTRACT**
Due to its societal and economic value commercialization of academic research became an important topic in recent years. However, academics often fail to secure funding for the early growth stages of the commercialization process. This paper combines academic characteristics and dimensions of entrepreneurial orientation, and investigates their impact on funding success. A sample of 115 proposals submitted to the Dutch Organization of Scientific Research for the application of the Valorization Grant Phase One have been analyzed. Results show that funding success increases when the research team includes an academic with a professor title. Further findings show that patent potential, competitive strategy and business development professionals contribute to funding success. This paper concludes with suggestions for further research and implications for improving future decision making in the funding process.

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# 1. INTRODUCTION

In recent years universities became more than just centers of education and research. From new fields and domains of research in technology, university spin-off companies started arising to commercialize their research (Link & Scott, 2005; Lockett & Wright, 2005). University entities in form of technology transfer offices emerged to share research based knowledge with practitioners contributing to the surrounding economy and society by transferring research knowledge to R&D departments of companies, helping them to innovate (Siegel, Waldman, Atwater & Link, 2004; Rasmussen, Moen & Gulbrandsen, 2006; O'Shea, Chugh & Allen, 2008). However, the trend is slowly shifting from technology transfer offices to self-commercialization of technology by means of academic entrepreneurship and university spin-off formation (Perez & Sanchez, 2003). This comes partially from the increasing amount of supporting resources contributed by the universities (O'Shea, Chugh & Allen., 2008). Nevertheless, academic entrepreneurship seems to be only a phenomenon of recent years, mainly because academics refuse to exploit research for reasons that go beyond the progress of knowledge (Ndonzuau, Pirnay & Surlemont, 2002). For many academics publications and progress in research seems to be the focus point, and money only a mean to finance their progress. In fact, it appears that research and commercial exploitation do not fit go well together. According to Ndonzuau Pirnay & Surlemont (2002, p.283) *"a single publication may be enough to remove all their originality value, since once they are in the public domain, they cannot benefit from legal protections such as patents, which are often decisive in a valorisation policy*". Hence, depending on the individual career focus, academics eventually need to decide between publication or commercialization. To overcome the commercialization hurdle, Clark (1998, as cited by O'Shea, Allen, O'Gorman & Roche, 2004) recommends to have academic top-down leaders who encourage entrepreneurship amongst academics. Correspondingly, academic seniors with a professorship are known to engage more into entrepreneurial activities than academics that stand at the beginning of their academic career (Haeussler & Colyvas, 2011). Furthermore, social pressures are forcing universities to show more accountability for society by transferring research outcomes to the public. Increasingly more universities therefore change their research missions by emphasizing the creation of a greater good to society and thereby giving a comprehensible reason to exploit research results (Chiesa & Piccaluga, 2000; Ndonzuau, Pirnay & Surlemont, 2002). When it comes to the point that an academic decides to actually commercialize research results, a whole range of potential barriers are encountered. While universities offer a support entities in the initiation phase, that being business advice or help with patent filing, the support ends there. According to Ndonzuau, Pirnay & Surlemont (2002) academic spin-offs start to struggle when it comes to financing important milestones such as prototyping and business planning. Venture capitalists are usually hesitant to invest into an early state spin-off. Thus, it becomes the academics task to make the spin-off investor-ready to be able to achieve sustainability (Wright, Vohora & Lockett, 2004). Many spin-offs take advantage of public grants to pass the first stages of initiation and development. An example of such grant in the Netherlands is the Valorization Take-off grant phase one, which is awarded by the Dutch Organization for Scientific Research to academic entrepreneurs willing to start commercializing their research results. However, not all spin-offs applying for funding, receive a grant in the end. A significant amount of all project applications are rejected and it seems not clear what determinants and the interplay between them are relevant for an increased chance of funding. This paper will focus on the academic seniority characteristic and the dimensions of entrepreneurial orientation formerly introduced by Lumpkin & Dess (1996). The dimensions are known to increase the chances of entrepreneurial success in established companies. Therefore, similar interactions are expected to take place in university spin-offs in their initiation phase. The research questions that rise up based on the listed issues are as followed:

RQ1: How does academic leadership influence the chance to be funded by a Dutch Valorization Take-off grant phase one?

RQ2: How do entrepreneurial orientation factors contribute to the chance of getting funded by a Dutch Valorization Take-off grant phase one?

This paper first explores the theoretical background of topics in the context of academic entrepreneurship and entrepreneurial orientation. Special attention is dedicated to innovativeness, proactiveness and risk-taking, three concepts important to entrepreneurial orientation. Furthermore, a short description of the research set up is given. Explanations of research subjects, the different variables and the operationalization are provided, followed by the results of the data analysis and an elaborated discussion on the findings. The paper is finalized with a conclusion, limitations and recommendations for further research.

# 2. THEORETICAL FRAMEWORK

## 2.1 University spin-offs and knowledge transfer

Lockett & Wright (2005, p.1044-1045) define university spin-offs as "*new ventures that are dependent upon licensing or assignment of the institution's intellectual property for initiation"* and focusing on capabilities and activities necessary to form a spin-off company. A more explicit definition emphasizes the transfer of core technology from the university to the open market, and underlines that academics dedicate, at least part of their time, to the work on the spin-off project (Pirnay & Surlemont, 2003; Walter, Auer & Ritter, 2006; Walter, Parboteeah, Riesenhuber & Hoegl, 2011). University spin-offs are thereby *"new firms created to exploit commercially some knowledge, technology or research results developed within a university"* (Pirnay & Surlemont, 2003, p.356). Walter, Auer & Ritter (2006) summarize different perspectives university spin-offs can be seen from. These perspectives can focus on closing the gap between theoretical and applied research, enabling a platform for employment, or simply making an economic contribution to the region. However, traditional academic culture often overlooks the potential options to exploit research in new ways and therefore only focuses on publications and educational purposes. The origin of this perspective might be the ambiguous relation to money that researchers have. Money in academic research is mainly used as a means to an end – namely a resource to progress with research (Ndonzuau, Pirnay & Surlemont, 2003). Other obstacles can originate from property rights. Protecting ideas and filing for patents cannot only be very costly but also a task for specialists that need to be hired externally. Further, necessary resources need to be acquired to the progress with the projects. These range from tangible resources such as machinery up to non-tangible resources such as supporting activities in e.g. marketing. Since universities rarely can provide these resources, additional funding from external grants needs to be gained to fulfill the resource needs. In the end it is often the case that projects fail to progress because proper funding could not be attained (Ndonzuau, Pirnay & Surlemont, 2003). This paper aims to uncover the determinants of what makes a project fundable in the context of the applications for the Valorization grant phase one.

## 2.2 Academic entrepreneurship

Although, obstacles in terms of funding persist, many academics venture the step to entrepreneurship. As summarized by Peris-Ortiz, Gomez, Merigo-Lindahl & Rueda-Armengot (2016), academic entrepreneurship is generally defined as the creation of a new business by one or a couple individuals related or affiliated to a university. A study by Powers & McDougall (2003) investigated the predictors of new business formations and initial public offerings (IPOs) related to a university, and found out that amongst financial and human resources, the quality of the faculty also played a tremendous role in predicting business formation and IPOs. The authors suggest to build and maintain a base of faculty leaders that the new business can work together towards a commercialization (Powers & McDougall, 2003). O'Shea, Allen, O'Gorman & Roche (2004) coincides with these findings summarizing that strong relations with university leaders can encourage entrepreneurship amongst academics. Further aspects mentioned are the individual attributes academics have that can lead to entrepreneurial activities. Thus an extroverted character is more likely to engage entrepreneurship. Furthermore, seniority and experience seem to contribute to this (Klofsten & Jones-Evans, 2000; O'Shea, Allen, O'Gorman & Roche, 2004). Haeussler & Colyvas (2011, p.47) argue that career stage is an important predictor and state that *"(...) Professors are engaged in commercial science to a larger degree than pre-tenure scientists".* Abreu & Grinevich (2013) add to that by stating that academics in older age are more likely to engage into entrepreneurial activities than their younger colleagues. While young academics put more focus on building a reputation and forwarding their career, senior academics tend to be more involved in commercial activities such as entrepreneurship because their career base is already built. (Abreu & Grinevich, 2013). Seniority is defined as a priority position in a working organization by taking into account the employees length of service period. Usually seniority employees are provided company benefits compared to regular employees. Thereby, seniority employees enjoy the priorities of promotions, vacation accrual, assignments, etc (US Legal, 2017). Seniority and experience are two interrelated concepts and usually have the similar outcome. The higher the academic rank, the more experienced the academic, and the more skills the academic is equipped with (Abreu & Ginevich, 2013). Powers & McDougall (2005) investigated the interaction between spin-off performance and the faculty quality in terms of human capital. It became clear that those two factors are positively related, agreeing with an earlier study by Finkle (1998) where spin-off performance strongly dependent on whether their CEO had a professorship or not. Based on these findings the following hypothesis is derived:

***H1: Applicants with a higher academic level (professor) have a higher chance of successful funding than applicants that have a lower academic level.***

## 2.3 Entrepreneurial orientation

As described by Wiklund & Sheperd (2005, p.74) entrepreneurial orientation *"(...) refers to a firm's strategic orientation, capturing specific entrepreneurial aspects of decision-making styles, methods, and practices."* Entrepreneurial orientation is a widely researched concept in the field of strategy management and entrepreneurship and an important factor in firm performance and success. Firms that are entrepreneurially oriented are more aware of changes in markets and trends which can help identifying opportunities and generating ideas for new businesses (Wiklund & Sheperd, 2005; Lumpkin, Cogliser & Schneider, 2009). According to Lumpkin & Dess (1996) five dimensions for entrepreneurial orientation seem to be important: autonomy, innovativeness, risk-taking, proactiveness and competitive aggressiveness. Although, Hughes & Morgan (2007) argue that not all five dimensions contribute equally to business performance. In fact, autonomy and competitive aggressiveness appear to not have any influence on performance whatsoever (Hughes & Morgan, 2007). This paper will therefore base its further research on the three dimensions that seem indeed influential on performance, namely innovativeness, risk-taking and proactiveness.

### *2.3.1 Innovativeness*

Innovativeness describes a firm's affinity to support new idea generation and creative processes that can lead to new business ideas and opportunities to engage into. Wang & Ahmed (2004) present five types of innovation being product innovativeness, market innovativeness, process innovativeness, behavioural innovativeness and strategic innovativeness. With regards to their definitions, process behavioral and strategic innovativeness seem to be characteristics typically applied by established firms and not spin-offs in their development. As summarized by Avlonitis & Salavou (2007), firms that have a higher product innovativeness, are usually also rated stronger in terms of entrepreneurial orientation. According to Hughes & Morgan (2007) innovativeness is positively related to product performance. Salavou & Avlonitis (2008) approve that when it comes to the comparison of innovativeness levels, product innovators, next to concept innovators and imitators, score the highest on the performance scale. Therefore:

***H2A: Academic spin-offs that show a higher level of product innovativeness are more likely to get funded than those that do not show a higher level of product innovativeness.***

Next to that, a crucial indicator for innovativeness and performance still seems to be the patent potential (Kleinknecht, van Montfort & Brouwer, 2002; Lanjow & Schankermann, 2004). Although some research considers patents as an indication for R&D input only, research proves that patents also have, if only delayed, a certain economic effect on firm performance (Ernst, 2001). According to Ernst (2001, p.144) *"One expression of technical success may be a patent application".* Since a patent application shows the novelty and potential monetary benefits for the issuer. From theory, the following can be derived:

***H2B: Academic spin-offs that show a higher patent potential are more likely to get funded than those that do not show higher patent potential***

### *2.3.2 Risk-taking*

Risk-taking, as defined by Miller & Friesen (1978), is the *"(...) degree to which managers are willing to make large and risky resource commitments, i.e. those which have a reasonable chance of costly failure"* (as cited in Lumpkin & Dess, 1996, p.144). Risk-taking companies get involved in risky project and often act bravely without making thorough estimations and assumptions upfront with the aim to achieve organizational goals. These companies also tend to employ a risk-taking policy within their business strategy and have a higher tolerance towards uncertainty and risky projects (Jambulingam, Kathuria & Doucette, 2005). Hall & Woodward (2010) discuss that entrepreneurs from startup companies expose themselves to more risk than individuals employed by established corporations. However, those startup entrepreneurs then can also expect a higher return compared to their colleagues of the established firms. Naldi, Nordqvist, Sjöberg & Wiklund (2007) brought up an interesting finding while observing the risk-taking behavior in entrepreneurial family firms. According to their research results, family firms acted more risk averse compared to non-family firms. The reason behind that might be the high investments of own resources put into the firm and thereby the

| Table 1 - Definitions of dependent, independent and control variables | | |
|---|---|---|
| **Dependent variable** | | **Reference** |
| Feasability Funding | Based on whether or not spin-off was granted funding (0 – 1) | |
| **Independent variables** | | |
| Academic entrepreneurship | | |
| Professor as applicant | At least one applicant has a professorship status (0 – 1) | Finkle (1998) |
| EO Innovativeness | | |
| Product innovativeness | The product or service can be classified into a higher innovation level | Avlonitis & Salavou (2007), Hughes & Morgan (2007), Salavou & Avlonitis (2008) |
| Patent potential | Products have a potential to be patented | Ernst, 2001; Kleinknecht, van Montfort & Brouwer, 2001; Lanjow & Schankermann, 2004 |
| EO Risk-taking | | |
| Competitive strategy | The product competes on a higher strategy level | Slater & Narver (1996), Sandvik & Sandvik (2003), Li & Li (2008) |
| Resource effort | Academics used different types of resources when developing the concept or prototype | Barney, 1991; Galbreath, 2005; Cater & Cater, 2009 |
| EO Proactiveness | | |
| Market research | Market research and/or competitor analysis has already been done | Wiklund & Shepherd (2003), Verhees & Meulenberg (2004),Hult, Ketchen & Slater (2005) |
| Business development | Project has the necessary support environment to be prepared for commercialization | Lalkaka, 2002 |
| **Control variables** | | |
| Total publications | Number of total publications of main applicant | |
| Co-applicants | Status of project co-applicants (0-3) | |
| University code | University name (1-14) | |

hesitation of putting those resources into risk. Based on the research of Barney (1991) resources are heterogeneously distributed among organizations, and if possessing features that are imitable, they can possess a potential for competitive advantage. These, so called, strategic resources have a positive influence on organizational performance (Crook, Ketchen, Combs & Todd, 2008). Porter (1985) introduces two main strategies, namely cost-leadership and differentiation, with regards to product competitiveness. Whereas, cost leadership focuses on offering products that are cheaper than the competition, while differentiation puts emphasis on products with a unique selling point competitors cannot offer. According to Li & Li (2008) *"a differentiation strategy creates customer value through means such as innovative products, superior quality and technology, a differentiated brand image, good service, and so forth, which distinguish the firm from its rivals."* Slater & Narver (1996) show a connection between product innovation, market orientation and differentiation strategy. According to them market orientation has a positive effect on both, product innovativeness and differentiation strategy. This can be explained by the similar goal market orientation has towards its customers, namely designing products to increase value for the customer by obtaining market knowledge to create an organizational environment of responsiveness (Sandvik & Sandvik, 2003). In general, a certain strategy, be it cost-leadership or differentiation should be followed, otherwise one runs the risk to be "stuck in the middle" which does not offer any competitive advantage at all (Porter, 1985, p.16). Thus:

***H3A: Academic spin-offs that follow a higher level of competitive strategy are more likely to get funded than those that do not follow a higher level of competitive strategy.***

Cater & Cater (2009) investigated antecedents of competitive advantage and performance by looking at different types of resources and their impact on a cost strategy and differentiation strategy. Results showed that resource types in terms of human capital, financial resources and organizational resources in form of structures that enable knowledge exploitation, are especially important for a differentiation strategy to succeed (Cater & Cater, 2009). It seems to be a general believe in the resources based theory that intangible resources contribute far more to performance than tangible resources (Barney, 1991; Galbreath, 2005; Cater & Cater, 2009). However, in the research of Galbreath (2005) it is also shown that some tangible resources overrule intangible resources indicating that there might be tangible types of resources having a far larger impact on performance than formerly stated. Furthermore, it also contradicts with the fact that lack of financial resources poses a threat to a spin-offs existence, as introduced earlier. In the context of this research, it will therefore be important to investigate the resource effort put in, such as labor, material or actual financial investments, that interacts with the probability of getting funded. Consequently, it is assumed that:

***H3B: Academic spin-offs that show a higher resource effort are more likely to get funded than those that do not show higher resource effort.***

### *2.3.3 Proactiveness*

Proactiveness is another concept seemingly important for entrepreneurial orientation. The concept is defined as an act of change initiative to influence the environment and not be constrained by surrounding forces. Proactive personalities tend to see opportunities and follow up on them, until a change in the environment is initiated (Bateman & Crant, 1993; Crant, 1996; Kickul & Gundry, 2002). Consequently, proactive personalities tend to engage in proactive behavior. Researchers even suggest, that proactiveness has a direct link to career success (Seibert, Crant & Kraimer, 1999; Seibert, Kraimer & Crant, 2001) According to Crant (1996), proactive personality trades are associated with entrepreneurial intentions. As elaborated by Hughes & Morgan (2007), acting proactively can often give a

firm a first-mover advantage and therefore shape the direction of the business environment it operates. To grasp the first-mover advantage it is important to react quickly on market signals and customer needs. Proactive behavior translates into trend watching and mobilizing resources in a short time, which significantly increase the time to respond and consequently facilitates *success*. Therefore, firms that act proactively also show higher performance (Hughes & Morgan, 2007). Wiklund & Shepherd (2003) found out that increasing the market research can increase that ability to explore and find opportunities. Market research results often show real customer needs, and therefore an opportunity to satisfy those needs, and help to estimate the market value of a product. This also coincides with the definition of market orientation stated previously. Additionally to that Verhees & Meulenberg (2004) state that knowledge about the market can reinforce product innovation. Findings by Hult, Ketchen & Slater (2005) add that market knowledge can have a positive impact on performance when the right amount of firm responsiveness is give. Thus:

***H4A: Academic spin-offs that performed a detailed market research beforehand are more likely to get funded than those that did not perform a detailed market research.***

Business developers can usually assist with an extensive market research, because they are trained in this specific domain. Their tasks include amongst others spotting market trends and market opportunities, finding a customer base for products, and establishing networks to the industry, potential suppliers or manufacturers. It is for a reason, that incubator companies, that employ a pool of business developers, are the first contact reference for spin-off companies that search for business consultancy (Lalkaka, 2002). It can be argued that involving a business developer at an early stage of spin-off development shows a certain proactiveness, and thus:

***H4B: Academic spin-offs that involved a business developer or researcher with business development experience in their project are more likely to get funded than those that did not have anyone with business development experience.***

# 3. METHODOLOGY

## 3.1 Subjects of study

The subjects of this study are research projects of Dutch universities and affiliated academic entrepreneurs that applied for the high-tech Valorization Grant phase one of the Dutch Organization for Scientific Research. Currently, the Valorization Grant program is restructured and relabeled into Take-off program. The Dutch Organization for Scientific Research encourages, and supports commercialization of institutional knowledge and academic involvement in entrepreneurial activities. The take-off grant specifically focuses on stimulating entrepreneurial activities within the Dutch university environments. It aims to create innovations that build the base of knowledge development and utilization. These innovations can range from product, process and over to service innovations. The grant is being supported financially by the ministry of climate and economics, and the ministry of education, culture and science (NWO organization, 2018). The projects were led by researchers of the corresponding universities and research centers. The teams were employed by universities and research centers in the Netherlands. The team's proposals ranged from fields in process, service, and product innovation and covered the sectors of high tech systems & materials, life sciences, and information & communication technology.

## 3.2 Data measurements

### *3.2.1 Dependent variable*

*Feasibility funding* was used as dependent variable for this model. It defined whether a project has been granted funding after applying for the Valorization Grant phase one or not. Projects that received a feasibility funding were assigned a 1, and projects that did not receive feasibility funding, were assigned a 0.

### *3.2.2 Independent variables*

The independent variables were based on the theory of academic entrepreneurship and the concept of entrepreneurial orientation developed by Lumpkin & Dess (1996). According to the authors entrepreneurial orientation is based on five dimensions including autonomy, innovativeness, risk-taking, proactiveness, and competitive aggressiveness (Lumpkin & Dess, 1996). In this research, the dimensions of autonomy and competitive aggressiveness were purposely left out, following the research goals of the paper. The constructs for the individual dimensions were developed based on different theories and are listed in Table 1.

#### *3.2.2.1 Academic entrepreneurship*

*Professor as applicant* defines the presence of a professor in the application team that applied for the Valorization Grant. Theory concludes that project teams that include an academic with a professor position perform better than those that do not have an academic with a professor position. Presence of a professor is indicated with a 1, absence of a professor is indicated with a 0.

#### *3.2.2.2 Innovativeness*

*Product innovativeness* described the level on which the product or service would compete with the competition from the industry. Based on the findings of Salavou & Avlonitis (2008), that product innovators score higher on the performance scale than imitators. The measurement ranged here from 0 to 3, with (0) information is missing, (1) product or service shows only small technical improvements compared to existing technology (improvements that are not cost and/or efficiency related), (2) product or service is meant to improve costs and/or efficiency, and (3) major novelty is present in the new product or service. In the context of this research, (1) and (2) were considered to be the imitators because developing a product with small improvements or products competing on cost/efficiency great, would mean that these products have essentially the same setup. Especially for (2) close attention was paid to sentences that clearly mentioned the benefits related to cost and efficiency or productivity on that matter. Proposals that ranked on (3) clearly stated that their product or service is novel with sentences like: 'We are the first in developing such product' or 'Such product does not exist yet'.

*Patent potential* described the possibility on getting the proposed product or service patented. The variable is based on the statement of Ernst (2001) that patented products have a performance impact. The measurement scale ranged from 0 to 3 with the following ranks: (0) information is missing, (1) no patent possible/no patent claimed yet/academics do not aim to patent the product or service, (2) patent potential is being evaluated (e.g. by an attorney or legal advisor), (3) patent has been filed. Category (3) also included software that automatically fell under the European copyright law, because software is usually copyrighted automatically (EU copyright, 2018).

#### *3.2.2.3 Risk-taking*

*Competitive strategy* described the level on which the product or service competed with other products and services from the industry. For the development of this variable the theoretical argumentation of the theoretical framework was used. It was

| Table 2 – Explanation of entrepreneurial orientation concepts | |
|---|---|
| **Innovativeness** | |
| Product innovativeness | The product or service has an innovation status<br>0 – information is missing<br>1 – product or service shows only small technical improvements compared to existing technology (improvements not cost and/or efficiency related)<br>2 – product or service is meant to improve costs and/or efficiency<br>3 – major novelty is present in the new product or service |
| Patent potential | Product or service has a potential to be patented<br>0 – information is missing<br>1 – No patent possible/academics do not aim to patent the product or service<br>2 – Patent potential is being evaluated (e.g. patent search by an attorney or legal advisor)<br>3 – Patent has been filed |
| **Risk-taking** | |
| Competitive strategy | Level of competitive strategy the product followed<br>0 – information is missing<br>1 – product or service does not compete on any level with existing products or services<br>2 – product or service does compete on cost level<br>3 – product or service does compete on cost and/or efficiency level or increases quality of usage |
| Resource effort | Academics engaged into financial distress or use of resources before proper funding was secured<br>0 – information is missing<br>1 – academic spent a significant amount of time to develop concept of product or service<br>2 – academic used a significant amount of physical resources (e.g materials, machines, etc.) to develop a prototype of product or service (financial resources not included)<br>3 – academic invested a significant amount of financial resources to develop a prototype of product or service |
| **Proactiveness** | |
| Market research | Market research and/or competitor analysis has already been done<br>0 – information is missing<br>1 – market and competitor analysis is short and vague<br>2 – market analysis is detailed but competitor analysis is vague or short/market analysis is vague or short but competitor analysis is detailed<br>3 – both, market and competitor analysis were executed in a detailed manner |
| Business development | Project has the necessary business development environment to be prepared for commercialization<br>0 – information is missing<br>1 – project does not involve any support on business development/academic has no previous experience<br>2 – academic himself has already experience in business development<br>3 – project involves a business developer or advisory company |

argued that products competing on the differentiation level excel the products on cost-leadership level (Slater & Narver, 1996; Sandvik & Sandvik, 2003). The measurement scale was developed accordingly from (0) information is missing, (1) product does not seem to compete on any level with existing products and services (2) product or service competes on a cost level, and (3) product or service competes on cost and efficiency or aims to improve quality of usage. Quality of usage refers especially to those products and services that, for example, make the working environment safer or more pleasant for employees, or improves a medical treatment of patients by having fewer side effects.

*Resource effort* described the degree to which the researcher or research team invested own resources into their project before they secured funding. The variable was derived from theory emphasizing the different importance level of tangible and intangible resources (Galbreath, 2005; Cater & Cater, 2009). The scale applied was as follows: (0) information is missing, (1) academic spent a significant amount of labor time to develop a concept of the product or service, (2) academic used a significant amount of physical resources (e.g. materials, machines, etc.) to develop a prototype of product or service, (3) academic invested a significant amount of financial resources to develop a prototype of product or service.

#### *3.2.2.4 Proactiveness*

*Market research* described in how far market knowledge was already obtained by the research team. This variable was backed by the assumption that market research reinforces performance levels (Hult, Ketchen & Slater (2005). The scale was used as follows: (0) information is missing, (1) market and competitor analysis is short and vague, (2) market analysis is detailed but competitor analysis is vague or short/ market analysis is vague or short but competitor analysis is detailed, and (3) both, market and competitor analysis were executed in a detailed manner. To evaluate to which category a single case should be assigned to, key information such as market size, customer base, existing competitors and a SWOT analysis were reviewed. But also simply the length of the analysis was taken into account.

*Business development* described to what extent experts in business development are participating in the project. A guiding theory for this variable was the assumption that firms that involve a business development expert perform better than those that do not. The measurement ranged as follows: (0) information is missing, (1) project does not involve any support on business development/academic has no previous experience in business development (2) academic himself/herself has already experience in business development, and (3) project involves a business developer or an advisory company.

### *3.2.3 Control variables*

This research chose three control variables: *Total number of publications* counted the total number of publications the academic published so far. This variable was numeric and depended on the number found in Google Scholar data. *Co-applicants* referred to the field the co-applicants came from. The scale used was as followed: (0) the project has no co-applicants, (1) project co-applicants are solely from academia, (2) project co-applicants are from industry, (3) project co-applicants are both from academia and industry. *University code* indicates the university or institution the applicants were from. The codes were assigned as followed: (1) Delft University of Technology, (2) Eindhoven University, (3) University of Twente, (4) Leiden

University, (5) Vrije Universiteit Amsterdam, (6) Radboud University Nijmegen, (7) Wageningen University & Research, (8) Maastricht University, (9) University of Amsterdam, (10) Utrecht University, (11) Academic Medical Center Amsterdam, (12) Leiden University Medical Center, (13) Dutch National Institute for Subatomic Physics (NIKHEF), and (14) Radboud University Medical Center Nijmegen.

## 3.3 Data collection

To test the hypotheses, the research team of this study has been granted access to anonymized and aggregated set of grant proposals by the Dutch Organization for Scientific Research organization. The proposals have been submitted to STW as part of their application for the Valorization Grant phase one during the year of 2010-2014. A total of 115 proposals have been used to develop a logistic regression model. Every proposal followed a template provided by the Dutch Organization for Scientific Research which included information excerpts about the innovative aspects of the proposed product, a section of describing the commercial aspects including a market and competition analysis, a section describing the patent position, and lastly a project plan with a timeline. To compile a data set with the before mentioned variables, the proposals were read in detail one by one. Depending on the information that was given in the proposal, the scale levels described in the data measurements sections were applied accordingly.

## 3.4 Data analysis

To test the hypotheses, binary logistic regression was applied. Binary logistic regression is commonly used in cases with a dichotomous dependent variable Y predicted by a set of independent variables X (Harrell Jr., 2015).

For further analysis purposes the *university code* control variable has been recoded into dummy variables. The variable appeared to be significant during the first analysis round and was used to evaluate whether university origin of the applicant had an effect on feasibility funding success.

# 4. RESULTS

Table 3 shows the descriptives of the variables used in the analysis. The correlation threshold was laid on 0.7 according to Cohen, Cohen, West & Aiken (2013). Since all correlation values fell below that point, the chosen variables were used for the analysis.

The results of the binary logistic regression are shown in Table 5 Model 9. Table 4 Models 2-6 and Table 5 Models 7-8 show the impact of the individual independent variables. It can be observed that the significant independent variables from Model 9 remain significant when tested individually (see Model 2, 4, 5, and 8, and compare with Model 9). The following results are based on the full binary logistic regression results (Model 9).

Hypothesis 1 predicts that feasibility funding is dependent on the presence of a professor in the research project. Model 9 shows a positive significant relationship between *professor as applicant* and *feasibility funding. Professor as applicant* remains significant under the level of 0.05. Therefore, hypothesis 1 is confirmed. In other words, if a professor is part of the research team that applied for the Valorization Grant, the odds to get funded increase by a factor of 1,14.

Hypothesis 2A investigates the level of *product innovativeness* on *feasibility funding.* The analysis does not show any significant results according to Model 9, and the hypothesis is therefore rejected. Hypotheses 2B predicts an impact of *patent potential* on *feasibility funding.* This relationship is positive and significant at the level of 0.05. Therefore, hypothesis 2B is confirmed. The odds to get funded increase by 1,065, if patent potential increases by one level. Hypothesis 2B investigates the degree of *product development* on *research funding.* The analysis does not show any significant results according to model 9, and the hypothesis is rejected.

Hypothesis 3A states a relationship between the level of *competitive strategy* and *feasibility funding.* At the level of 0.05 there is a positive relationship between the two variables (b=2,505). It can therefore be said, that hypothesis 3A is confirmed. Hypothesis 3B analyzes the impact of *resource effort* on *feasibility funding.* According to Model 9, a significance of this relationship cannot be found. Therefore, hypothesis 3B is rejected.

Hypothesis 4A predicts a relationship between *market research* and *feasibility funding.* Model 9 shows no significant relationship between the two variables. Hypothesis 4A is therefore rejected. Hypothesis 4B investiagtes the relation between *business development* and *feasibility funding.* Model 9 shows a positive significant relationship at the level of 0.05 (b=1,403). As a consequence, hypothesis 4B is confirmed.

With regards to the control variables, noticeable is that the university variable *University Delft* has a positive impact on *feasibility funding*. The relationship is positive under the level of 0.05 (b=2,853). Other control variables do not show any significance towards feasibility funding.

# 5. DISCUSSION & CONCLUSION

Extensive research has been done on success factors of academic spin-offs. While Niosi (2006) reviewed the issue from a shallow perspective on venture capitalism, Hayter (2013) tried to explain success factors based on the individual entrepreneur, university, firm and policy, whereas Sternberg (2014) looked closer at regional environment aspects. This research took on a practical approach by investigating a set of research proposals and analyzing them based on an academic entrepreneurship characteristic and the dimensions on entrepreneurial orientation developed by Lumpkin & Dess (1996). Results showed that four key aspects played a role when it came to successful feasibility funding, namely presence of an academic professor in the application team, patent potential of the newly developed product, level of competitive strategy, and business development professionals involved on the project.

Professor as applicant shows a positive relationship with feasibility and therefore supports previous research of Finkle (1998) that professorship influences performance. This can be explained with the assumption that academic professors already gained proper experience and established network ties to the industry in their years as academics (Abreu & Grinevich, 2005). Networks to the industry is an important factor in the early growth stages of a firm. Networks can improve or facilitate certain vital entrepreneurial processes such as discovering new business opportunities, securing resources, and obtaining legitimacy (Elfering & Hulsink, 2003). Professors that gained entrepreneurial experiences before can only be of an advantage of university spin-off firms because knowledge about different aspects of business development has already been gained and can be applied to the new setting. Furthermore, professors are usually far progressed in their academic career and have already built a proper reputation for themselves. As explained by Abreu & Grinevich (2005, p.411) *"Early career researchers have a strong incentive to publish rather than commercialise their work, as they seek to establish their reputations and achieve tenure, while older, more senior academics have more time to invest in commercialization."* In that context, it can be assumed that professors seek other challenges outside of the academic environment and commercializing research can be one of them.

Patent potential seems to be one aspect that affects feasibility funding. Filing a patent proves a product or service to be innovative in an official manner. It enables the inventor to exploit the invented product and to create a new business opportunity out of it. As summarized by Ernst (2001, p. 144) *"(…), patents can be regarded as the result, or output of technically successful R&D activities"*. Patents signal that no other product in the world has the same properties and therefore the absence of competition. Ernst (2001) showed that patents have, if only delayed, an economic impact on a firm's performance. Big international companies prove that patents create opportunities to build a monopoly, at least for the period of time until the patent expires. An example are Senseo and Nespresso, that revolutionized the coffee industry, or Apple and Samsung that changed the whole telecommunication industry. But not only big companies profit from patents. Farre-Mensa, Hegde and Ljungqvist (2017) argue that young companies experience 80% of sales growth five years after patent initiation and simplifies access to subsequent funding.

Level of product strategy plays a role with regards to feasibility funding in a positive manner and coincides with previous research. Previous argumentation showed that lack of strategy can influence performance in a negative way. Dess & Davis (1984) argue that Porter's (1985) generic strategies such as cost-leadership and differentiation outperformed companies that were 'stuck-in-the-middle'. Data from the sample proposals is consistent with the research results. In fact, some applicants clearly mentioned their level of competitive strategy, this being either cost-focused or differentiated with a focus on serving customer needs. Others, however, did not indicate a strategy at all, being considered as the ones that 'stuck-in-the-middle'. In those cases it rather seemed that applicants ignored customer needs and were too product oriented. On the contrary, those that phrased a strategy direction were also able to express certain customer needs they wanted to serve. The clear strategy winners seem to be the market oriented applicants that followed a differentiation strategy. This is also supported by the results of Verhees & Meulenberg (2004) and Spencer, Joiner & Salmon (2009). A good example were applicants from the field of medicine and biotechnology. Those applicants were able to explain customer needs fairly well mentioning side effects of medical prescription drugs or uncomfort using medical devices such as prosthesis. The products proposed focused thereby on decreasing the amount of side effects or improving overall quality of life.

Business development was the third factor found to influene research funding. This makes sense as academics or researchers that do not have a business background and never gathered experience in establishing an own company, struggle with the managerial and organizational site of the business development. The emergence and current number of technology transfer offices and university incubator programs confirms this perspective. Academics usually need professional help in the topics of marketing, financial and legal advice, to know which steps to take and how to set up an own spin-off company. An example from Canada shows that academic spin-off companies that kept growing did not only file patents but also received help from a professional business development company (Niosi, 2006). Furthermore, spin-off companies benefit from the established business networks business development professionals and programs offer. As mentioned in a previous part, spin-offs profit from networks by gaining access to information about business opportunities and organizational aspects.

An additional significant relationship towards feasibility funding showed the University Delft control variable. This might result from the entrepreneurial support the University of Delft offers. In the proposals several applicants mentioned a collaboration with the university business incubator YES! Delft. Although some research disconfirms a direct effect of incubators on spin-off performance, others state indirect effects that influence the overall entrepreneurial environment such as improvements of collaborations and access to public subsidies (Colombo & Delmastro, 2002; O'Shea, Allen, Chevalier & Roche, 2005). Further factors supporting this result are general university structures that support university spin-off creation, such as financial support for patenting and business development capabilities (Lockett & Wright, 2005).

Three independent variables fail to show any significance towards feasibility funding. Those being product innovativeness, resource effort and market research. Lack of significance in product innovativeness might descend from problems in the proposal template provided by the Dutch Organization for Scientific Research. This template might cover aspects that seem not relevant for the grant committee after all. Resource effort might not play a role in feasibility funding because most of the resources used in the development phase of a project come from the university and not from the applicant. Even costs for patent filing are sometimes taken over by universities. Apart from that, projects that are solely based on software products, do rarely require any physical or financial resources, and still receive funding. Market research fails to show significance, although previous research clearly states the importance with connection to its performance (Verhees & Meulenberg, 2004; Hult, Ketchen & Slater, 2005). However, previous research limits itself on established firms, not firms in their initiation phase. For spin-off companies, that belong to the later category, market research might not be valuable at that point and the grant committee might see it in the same way.

# 6. THEORETICAL AND MANAGERIAL IMPLICATIONS

Research in the field of academic entrepreneurship and university knowledge transfer has done quite some elaborated work in the area of university spin-offs and performance indicators. Whereas some papers observe internal capabilities of university spin-offs, others look at the external environment and its effect on spin-off performance (O'Shea, Allen, Chevalier & Roche, 2005; Walter, Auer & Ritter, 2006; O'shea, Chugh & Allen, 2008; Rasmussen, Mosey & Wright, 2011). This paper contributes to research by combining dimensions of entrepreneurial orientation and academic characteristics and investigating their impact on early stage university spin-off funding. Practitioners from funding organizations benefit by gaining insights on what factors are dominant when decisions in terms of funding are made. Finding high potential projects and funding them will eventually also bring more value to economy and society. Lastly, academic entrepreneurs profit with knowledge on what factors are crucial for their potential spin-off to succeed.

**Table 3**

Range, mean, standard deviation and correlations of the variables (N = 115)

| | Range | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Research funding | 0-1 | 0,37 | 0,486 | 1 | | | | | | | | | | | | | | |
| Professor as applicant | 0-1 | 0,37 | 0,484 | 0,198* | 1 | | | | | | | | | | | | | |
| Product innovativeness | 0-3 | 2,29 | 0,672 | 0,071 | -0,028 | 1 | | | | | | | | | | | | |
| Patent potential | 0-3 | 2,01 | 0,941 | 0,357** | 0,089 | -0,087 | 1 | | | | | | | | | | | |
| Competitive strategy | 0-3 | 2,72 | 0,643 | 0,280** | 0,048 | 0,268** | 0,048 | 1 | | | | | | | | | | |
| Resource effort | 0-3 | 1,53 | 0,567 | 0,133 | 0,183 | -0,035 | 0,041 | 0,216* | 1 | | | | | | | | | |
| Market research | 0-3 | 2,09 | 0,790 | 0,052 | 0,031 | 0,068 | -0,060 | 0,083 | 0,131 | 1 | | | | | | | | |
| Business development | 0-3 | 0,30 | 0,880 | 0,203* | 0,108 | 0,118 | -0,077 | -0,144 | -0,45 | 0,050 | 1 | | | | | | | |
| Total publications | 2-521 | 99,92 | 106,440 | 0,106 | 0,375** | 0,013 | 0,129 | 0,045 | 0,129 | 0,081 | 0,079 | 1 | | | | | | |
| Co-applicants | 0-3 | 1,47 | 0,911 | 0,115 | -0,014 | -0,107 | 0,128 | 0,030 | -0,130 | -0,021 | 0,050 | 0,019 | 1 | | | | | |
| University Delft | 0-1 | 0,53 | 0,501 | 0,115 | -0,227* | -0,143 | -0,066 | 0,054 | 0,143 | -0,029 | -0,131 | -0,060 | 0,045 | 1 | | | | |
| University Eindhoven | 0-1 | 0,16 | 0,365 | -0,086 | 0,021 | 0,101 | 0,047 | 0,075 | 0,104 | 0,013 | -0,068 | -0,046 | -0,038 | -0,458** | 1 | | | |
| University Twente | 0-1 | 0,10 | 0,295 | 0,054 | 0,122 | -0,007 | 0,029 | -0,090 | -0,044 | 0,077 | 0,089 | -0,062 | 0,190* | -0,346** | -0,140 | 1 | | |
| University Leiden | 0-1 | 0,08 | 0,270 | 0,042 | 0,048 | 0,117 | 0,170 | -0,076 | -0,159 | -0,115 | 0,010 | -0,030 | -0,079 | -0,310** | -0,126 | -0,095 | 1 | |
| University Others | 0-1 | 0,14 | 0,348 | -0,155* | 0,165 | 0,015 | -,111 | -0,022 | 0,155 | 0,051 | 0,176 | 0,211* | -0,125 | -0,427** | -0,173* | -0,131 | -0,117 | 1 |
| N of cases 115 | | | | | | | | | | | | | | | | | | |

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

**Table 4**
**Determinants of Research Funding of STW proposals**

| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | S.E. | B | S.E | B | S.E. | B | S.E. | B | S.E. | B | S.E. |
| Professor as applicant | | | 1,022* | 0,466 | | | | | | | | |
| Product innovativeness | | | | | 0,338 | 0,322 | | | | | | |
| Patent potential | | | | | | | 0,838** | 0,243 | | | | |
| Competitive strategy | | | | | | | | | 2,280** | 0,819 | | |
| Resource effort | | | | | | | | | | | 0,525 | 0,393 |
| Market research | | | | | | | | | | | | |
| Business development | | | | | | | | | | | | |
| Total publications | 0,003 | 0,002 | 0,002 | 0,002 | 0,003 | 0,002 | 0,002 | 0,002 | 0,003 | 0,002 | 0,003 | 0,002 |
| Co-applicants | 0,200 | 0,226 | 0,238 | 0,233 | 0,225 | 0,228 | 0,131 | 0,244 | 0,184 | 0,238 | 0,262 | 0,234 |
| University Delft | 1,355* | 0,736 | 1,643** | 0,766 | 1,418* | 0,747 | 1,248* | 0,767 | 1,577** | 0,778 | 1,185 | 0,748 |
| University Eindhoven | 0,718 | 0,868 | 0,834 | 0,886 | 0,699 | 0,874 | 0,418 | 0,906 | 0,806 | 0,908 | 0,526 | 0,880 |
| University Twente | 1,426 | 0,955 | 1,361 | 0,980 | 1,453 | 0,960 | 1,246 | 0,986 | 1,821* | 1,018 | 1,310 | 0,965 |
| University Leiden | 1,505 | 0,962 | 1,608 | 0,987 | 1,458 | 0,967 | 0,883 | 1,014 | 1,844* | 1,041 | 1,638* | 0,969 |
| Constant | -2,241 | 0,807 | -2,724 | 0,873 | -3,088 | 1,167 | -3,663 | 0,972 | -8,966 | 2,668 | -2,981 | 1,007 |
| | | | | | | | | | | | | |
| Nagelkerke $R^2$ | 0,090 | | 0,144 | | 0,103 | | 0,228 | | 0,249 | | 0,110 | |
| Hosmer and Lemeshow test | 0,880 | | 0,723 | | 0,779 | | 0,735 | | 0,275 | | 0,652 | |
| (df = 8) | | | | | | | | | | | | |
| -2 log likelihood | 144,166 | | 139,218 | | 143,032 | | 131,037 | | 128,882 | | 142,336 | |

*significant at 10%
**significant at 5%

**Table 4**
**Determinants of Research Funding of STW proposals**

| | 7 | | 8 | | 9 | |
|---|---|---|---|---|---|---|
| | B | S.E. | B | S.E. | B | S.E. |
| Professor as applicant | | | | | 1,140* | 0,601 |
| Product innovativeness | | | | | 0,412 | 0,406 |
| Patent potential | | | | | 1,065** | 0,309 |
| Competitive strategy | | | | | 2,505** | 0,952 |
| Resource effort | | | | | 0,286 | 0.498 |
| Market research | 0,167 | 0,259 | | | 0,036 | 0,321 |
| Business development | | | 0,602** | 0,264 | 1,403** | 0,463 |
| Total publications | 0,003 | 0,002 | 0,003 | 0,002 | 0,000 | 0,003 |
| Co-applicants | 0,208 | 0,226 | 0,171 | 0,233 | 0,194 | 0,309 |
| University Delft | 1,388* | 0,745 | 1,814** | 0,821 | 2,853** | 1,078 |
| University Eindhoven | 0,743 | 0,874 | 1,161 | 0,944 | 1,381 | 1,182 |
| University Twente | 1,419 | 0,957 | 1,679* | 1,016 | 2,276 | 1,333 |
| University Leiden | 1,587 | 0,977 | 1,880* | 1,034 | 2,199 | 1,344 |
| Constant | -2,623 | 1,016 | -2,755 | 0,887 | -14,615 | 3,548 |
| | | | | | | |
| Nagelkerke $R^2$ | 0,095 | | 0,155 | | 0,506 | |
| Hosmer and Lemeshow test (df = 8) | 0,544 | | 0,783 | | 0,579 | |
| -2 log likelihood | 143,747 | | 138,173 | | 98,688 | |

*significant at 10%
**significant at 5%

# 7. LIMITATIONS & FURTHER RESEARCH

The performed study comes with a few limitations. First, this research focused mainly on the research environment of the Netherlands. The research proposals made available for this study stem from Dutch research institutions and Dutch research universities, as well as the research grants have been given out by the Dutch Organization for Scientific Research. The results identified can therefore differ per country. Further research should explore success factors that play a role in other countries, but also success factors that play a role for other organizations giving out research grants.

Second, this research study only focused funding success of the Valorization Grants in phase one. Phase one Valorization Grants only cover so much that most research projects apply for the phase two grant to continue with the spin-off initiation. Many research projects get do not make until phase two and get dropped during the process for many reasons. It is therefore important to differentiate between funding success and later business success. It would be interesting to continue this research by evaluating whether the spin-off actually made it to a commercialization and, to go even further, whether it passed the *threshold of sustainability* and was able to make continuous profit.

Third, not all result variables are applicable to every kind of innovation. Some proposals in the sector of information technology did not decide to patent their software for the reason that it would already be copyrighted. Other proposals simply did not feel the need to patent their invention for reasons not mentioned. Further research should examine, how meaningful patent potential would be for different sectors. For biotechnology patenting seems to be the norm, for other sectors opinions seem to differ.

Fourth, this research investigated some other indicating aspects for feasibility funding by control variables. A significant effect showed the university factor *University Delft*. Assumptions were tried to make in the discussion part but a detailed research on that factor is out of this research scope. A point for further research would be to look into this.

Fifth, three seemingly important variables that were analyzed during this study came out be not significant for feasibility funding. It has been assumed that this outcome might have come from flaws in the proposal template provided by the Dutch Organization for Scientific Research. More research should be done to evaluate why those variables are seemingly not important for the decision of the grant committee and adjust the template appropriately.

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