Moving past mediocre: identifying criteria and characteristics for early University Spin-Off funding acquisition and success.

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ABSTRACT

University Spin-offs (USOs) are vital in transferring knowledge to society, fostering innovation. USOs are a source of local and national economic growth and, therefore, of general economic impact. As USOs have ties to the university and different businesses and creditors, there is a highly complex structure. Due to the complexity of the structure of USOs, these firms might not always reach the desired outcome and enjoy the desired success. One challenge these USOs can face is the lack of financial resources when trying to create value due to the lack of credible historical data and the liability of newness. Not being able to acquire funding in this early stage of development could have a critical impact on the likelihood of survival of the USO in the long term. The goal here is to reduce the gap of unknown information regarding the funding of USOs. In this paper, efforts will be made to find more overarching factors of the acquisition of funding and USO success, using a database consisting of 242 feedback forms of funding proposals to the Dutch Research Council (NWO). Results show that having a comprehensive business model and having an appropriate team were significant factors that led to an increased likelihood of governmental funding.

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Keywords

USO – University Spin-off – business model – funding acquisition – USO survival – survival – team balance

1. INTRODUCTION

Would anyone want their firm to be of only ordinary or moderate quality, neither good nor bad, or barely adequate? The mediocrity of firms can be avoided, but how? In this research, efforts are made to discover which factors are essential for University Spin-off success (i.e., positive funding and survival). More USOs can move past being mediocre and start to build an empire build around their innovation, following these factors.

University Spin-offs (USOs) are vital in transferring knowledge to society (Miranda, Chamorro, & Rubio, 2018; Vohora, Wright, & Lockett, 2004), fostering innovation. This innovation relates to a sharing and learning organization culture that results in exploitative and explorative activities in society (Lin & McDonough III, 2011). USOs are a source of local and national economic growth (Bray & Lee, 2000) and widespread economic impact, including, e.g., job creation or stimulating economic activities leading to tax money. It is increasingly becoming more difficult to ignore the complex organizational culture that USOs have. This culture is incredibly complex due to the ties with the university, businesses, and creditors. USOs, amongst other activities, organize a bridge between business and the universities (Szopa, Marek, & Fafrowicz, 2015). Due to this complexity, USOs might not always reach the desired outcome and enjoy the desired success.

Among others, USO can face one challenge: the lack of financial resources when trying to create value, i.e., when implementing R&D, doing market research, doing initial testing, or developing prototypes. Suppose that financial resources are not acquired and spent wisely within a suitable timeframe. In that case, it will be impossible to develop the product or service further and bring it to the market. Funding is seen as a mechanism to overcome the barriers and failures at the early stage. This funding can come from many different creditors and can, e.g., be done through crowdfunding or loaned from a bank. Due to the complex structure, the link to the university, and the potential value, it is more reasonable for the USOs to have (a) liable and knowledgeable creditor(s). Typically, large creditors are unlikely to provide funding to an emerging firm or evidence to produce the product or service promised. Stinchcombe (1965) argued that new ventures have a higher chance to die than old organizations due to the liability of newness. Furthermore, he maintains that new-born organizations generally suffer from the low average quality of performance because they initially lack experience (Abatecola, Cafferata, & Poggesi, 2012). Also, these new ventures are unable to compete with established firms and have a low level of legitimacy (Singh, Tucker, & House, 1986; Stinchcombe, 1965). All these factors lead to a lower likeliness of the acquisition of funding.

Governmental programmes focus more on supporting new ventures with funding and are willing to bridge this funding gap by investing tax money in the early and critical moment that helps the USO survive. One crucial source of funding for start-ups in the Netherlands is the Dutch Research Council (NWO). NWO selects and funds research proposals based on recommendations from scientists and other experts in the Netherlands and abroad (NWO, 2021b). Even though this governmental organization provides funding, just like any other creditor, this council can only provide funding to a limited number of firms. There are, however, more stakeholders involved as it is taxpayer's money the NWO is spending. Therefore, the NWO has an enormous responsibility to invest the money wisely. Even though funding has a positive effect on the USOs, selecting the "wrong" projects can lead to significant losses for (governmental) creditors, investing money into projects that fail regardless. The more critical challenge for the assessors from the NWO is to identify the most promising USO projects and ideas correctly and allocate the funding to those projects that can provide the highest return. At this early stage of development, when there is a lack of operational and financial history, the selection process is incredibly challenging for the assessors of the proposals. Therefore, for the NWO, there is a need for a better understanding of this process and to know factors that might indicate future success. For entrepreneurs, it is of high importance to know how to receive the proper funding to survive.

Multiple researchers have studied the effects of timing and stages of development of USOs and their effect on success (van Geenhuizen & Soetanto, 2009; Vohora et al., 2004). Vohora et al. (2004) have focused on the stages of development, adding critical junctures which firms must overcome to succeed with their firm. They concluded that for a USO to reach its full potential, it must successfully transition between the development phases and deal with the defined critical junctures (Vohora et al., 2004). Another research by Van Geenhuizen and Soetanto (2009) suggested that there are different problematic stages in development models on academic spin-off firms. Each has particular segments and trends in obstacles to growth (van Geenhuizen & Soetanto, 2009). The papers of Vohora (2004) and van Geenhuizen and Soetanto (2009) both lay a basis for development stages/models in which the USOs can grow when overcoming some challenges. Acquiring the funding could help the entrepreneurs with overcoming critical junctures and move along the stages of development. With this funding, the USOs could find new customers, introduce the innovation to the market, or overcome liabilities, making survival more likely. Little research has been done on the underlying reasons for receiving or not receiving funding and the early stages of development when funding still has to be acquired. In this paper, efforts are made to find more overarching factors of the acquisition of funding and USO success. Furthermore, this research is focused on the early stage of development, making it unique to other papers. The goal here is to deal with the increasing complexity of USO development and reduce the gap of unknown information regarding the funding of USOs. This paper seeks to address the following research question:

Which characteristics of USO's and the academics involved are critical to early-stage spin-off success? (i.e., favourable funding and survival)

Entrepreneurs can use this paper to learn more about the factors and competencies needed to acquire governmental funding. They can use this information and implement it into their own USO or start-up to increase the likelihood of acquiring funding. Policymakers can adjust their funding criteria to the results of this study, making the chance of investing the governmental tax money more wisely and consistently higher.

This paper first gives a brief overview of the more well-known research into USO development and pre-defined success factors for these firms. The following chapter describes the design and methodology of this study. Subsequently, results will be reported, and theoretical and practical implications, limitations, and recommendations for future studies are discussed.

2. THEORETICAL FRAMEWORK

To continue this research, the term "University Spin-Off" or "USO" will have to be defined clearly to avoid misunderstanding. Previous research has led to many different definitions of USOs and academic entrepreneurship. All build

on the facts that USOs are new firms, which exploit an innovation or intellectual property commercially, as well as having ties to the parent university (Shane, 2004; Siegel & Wright, 2015; Soetanto & van Geenhuizen, 2019)

In this paper, USOs are defined as new ventures flowing from academic institutions aiming to transfer knowledge and exploit the developed technology or innovation commercially. Academic institutions are of high importance in this definition, as academic spinoffs based on high technology are likely to depend on long-term relations with the universities or academic institutions for long after the initial phase of spinning off (Johansson, Jacob, & Hellström, 2005). Knowledge gained at the university through research, and now this knowledge is transferred to a broader public. Commercially exploiting the USO can cause some difficulties. Many researchers have posed that typical researchers are not necessarily commercially focused and have to deal with the liability of, e.g., newness (Pattnaik & Pandey, 2014; Stinchcombe, 1965).

2.1 Development stages of USOs

As mentioned in the Introduction, there is a large volume of published studies describing the development stages of USOs, of which the most known is the one by Vohora et al. (2004). The study points to five different stages of development, with feedback within each development phase and a transition between the stages, as shown in Figure 1.

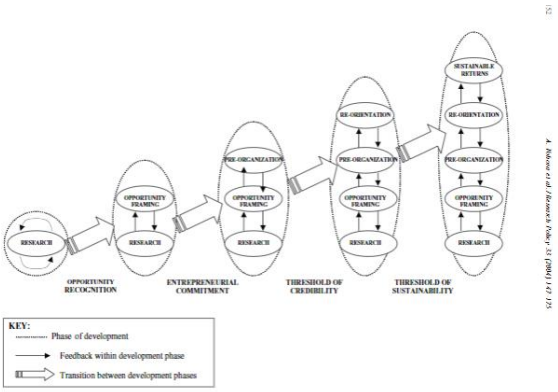

Figure 1: The critical junctures in the development of university spin-off companies (Vohora et al., 2004)

In the following sections, the five phases will be defined and further elaborated.

2.1.1 Research phase

During the research phase, the entrepreneurs focus on perfecting academic research and publication for a particular scientific community (Vohora et al., 2004). Within this phase, intellectual property is created, which creates the opportunity for commercialization. Furthermore, the capabilities and networks of founding teams are developed, which leaves an imprint on the spin-offs' performance (Huynh, Patton, Arias-Aranda, & Molina-Fernández, 2017). The capability and networks can broadly impact later success, as it is the basis of the business and can make or break the USO. The right capabilities in the right network of people can positively influence the success of the USO in later stages. In this stage, the researchers need to explore and exploit the innovation's potential fully. These activities may include exploring innovation applications or exploiting the innovation to different markets. This phase is all about defining the innovation and finetuning the innovation to potential customers' problems.

2.1.2 Opportunity framing phase

During the opportunity framing phase, the transition between a recognized opportunity and the organizational steps to create a new USO is taken, focusing on the academic and the Technology Transfer Offices (TTO) (Vohora et al., 2004). During this phase, an attempt is made to discover new markets and define how to best access the targeted customers. One book's subtitle states: ''…choose your customers, narrow your focus, dominate your market' (Treacy & Wiersema, 2007). This quote underlines the importance of finding the right customers and narrowing the focus to dominate the market. During this phase, it is of essence to find gain creators and pain relievers. Osterwalder et al. (2014) suggest that gain creators describe how your products or services create customer gains, whereas pain relievers describe how your products or services alleviate customer pain. If there is no pain somewhere for potential customers, there is no possible way that the entrepreneurs can make their innovation a success if it is not for luck. Furthermore, without a well-developed business model, innovators will fail to either deliver or capture value from their innovations (Teece, 2010)

Value proposition, i.e. the benefits that customers can expect from the products or services (Osterwalder, Pigneur, Bernarda, & Smith, 2014), is closely linked to exploring the market. Value proposition design and having a comprehensive business model can help understand the patterns of value creation successfully, leverage the experience and skills of the team, avoid wasting time on ideas that will not work (Osterwalder et al., 2014). Next to this, the researchers proposed ten characteristics of great value proposition, which show the importance of a business model to any firm. Amongst the characteristics of great value proposition lie factors such as great business models, focus on (unsatisfied) jobs, and uniqueness (Osterwalder et al., 2014). From these ten points, great value propositions will be essential for a firm to have and help gain visions for the entrepreneurs. A value proposition is, however, a never-ending process and can be revised at any point. It, therefore, is essential to evolve the value proposition to stay relevant to the customers (Osterwalder et al., 2014). In section 2.1.4, there will be more elaboration on this concept.

2.1.3 Pre-organization phase

The pre-organization phase includes managing the USO, developing and implementing strategic plans (Vohora et al., 2004). These plans involve developing resources and capabilities, the knowledge to acquire in the future, and how to access these resources. A key imperative is raising monetary funds to acquire the needed resources (Vohora et al., 2004). As such, this phase is essential for the survival of the organizations. This stage is seen through the application for grants, moving through the phases of the NWO. The organization then assesses the USO is on the proposals' technological and commercial feasibility (NWO, 2015). Proposals that complete the first phase can apply for the second phase, where the corporate development of the product and firm is valorised (NWO, 2015). Suppose the USO is unable to move from this stage through the critical juncture of credibility. In that case, the USO can not start the next phase of re-orientation as there are no funds to re-orientate or move further in any way, making this stage of great essence in the survival of USOs.

2.1.4 Re-orientation phase

During the re-orientation phase, the USO has gained sufficient credibility to access and acquire resources to start the business, and the USO will now attempt to generate returns (Vohora et al., 2004). USOs that have received funding will be more likely

to continue through this phase and re-organize the firm. During this phase, it might also be essential to evolve the value proposition. Osterwalder et al. (2014) stated that it is essential to measure and monitor the value proposition and business model to improve and reinvent them to stay relevant continuously. Though some future activities are already dealt with in the initial business plan, it might be wise to revise to create the most optimal situation for the USO.

2.1.5 Sustainable returns phase

The final phase of the five is characterized by the USO retaining sustainable returns. The USO will now have addressed most uncertainties and becomes an established and more sustainable firm (Vohora et al., 2004). As this stage is focused on long-term success, the evolution of the value proposition and business model, as mentioned in section Re-orientation phase, must be regularly implemented to keep relevant. As this can only be achieved over a more extended period, this phase will exceed the scope of this research.

2.1.6 Critical Junctures

Next to the five developmental phases that USOs go through, researchers defined critical junctures, i.e., ‘‘complex problems that occur at a point along a new… venture’s expansion path…’’ (Vohora et al., 2004, p. 159). These include opportunity recognition, entrepreneurial commitment, credibility, and sustainable returns. The opportunity recognition juncture is faced between phases 1 and 2, where there needs to be a match between an unfulfilled market and a solution to satisfy the needs (Bhave, 1994). Knowing the USOs’ customers and the firms’ market segment are essential factors to start-up success (Roure & Maidique, 1986; Song, Podoynitsyna, Van Der Bij, & Halman, 2008) as this can increase innovation (von Hippel, 2005). Market and business opportunities may also arise from extensive customer research, and thus knowing the customers will reach either the market push or pull effect. Both can be essential to be innovative (Bessant, 2003). This statement amplifies the importance of knowing the firm’s customers and market to exploit the innovation successfully commercially. When having a clear market segmentation and knowing the customers’ needs, different advantages come to play. For example, pioneering advantages, related to the first-mover advantages, occur primarily during the initial stages of the product life cycle and generate a substantial amount of company profit. Having this clear vision of customers and the successful commercialization of the innovation might let investors gain confidence in the USO and the innovation. When investors have more trust and confidence in the positive outcome of a USO, they are more likely to invest money in this firm. Therefore it is, besides the other benefits, beneficial for the likelihood of acquiring funding. Even though the importance of market segmentation and customer focus has been significant for other kinds of start-ups, this factor and the effect on the acquisition of funding have not been defined as one for USOs. Therefore, the following hypotheses for USOs can be formulated:

H1a: having a comprehensive market segmentation and customer focus will increase the likelihood of governmental funding.

H1b: having a comprehensive market segmentation and customer focus will increase the likelihood of USO survival.

As elaborated on in research, having a comprehensive business model will increase understanding of patterns, leverage the team’s experience and skills, and avoid wasting time on ideas that will not work (Markides & Sosa, 2013; Osterwalder et al., 2014). A comprehensive business model can, e.g., increase the likelihood of exploiting the first-mover advantages (FMAs) for early entrants to the market. Being a first-mover can, among other benefits, help with obtaining positive economic profits and funding as the consequence of early market entry (Frynas, Mellahi, & Pigman, 2006), which is what the USOs need to survive. Being a first-mover can be an attractive factor for investors, making them more likely to provide the USO with funding, making “having a business model’’ relevant for funding acquisition. The significance of comprehensive business models has been researched for other kinds of start-ups. For USOs, this connection of having a comprehensive business model and successful funding or success, in general, has not been researched yet. Therefore, this information gap led to two hypotheses which can be stated as follows:

H2a: having a comprehensive business model will increase the likelihood of governmental funding.

H2b: having a comprehensive business model will increase the likelihood of USO survival.

Moving to the next stage of development, another credibility juncture will have to be overcome. A lack of credibility constrains the entrepreneur’s ability to access and acquire critical resources: finance and human capital (Vohora et al., 2004). It also relates to the acquisition of customers for USOs (Vohora et al., 2004). This lack of credibility and the liability of this has also been research by Stinchcombe (1965), who proposed that these factors decrease the likelihood of early-stage funding. The last critical juncture is the sustainable returns juncture, in which “the entrepreneurial team has to acquire the ability to continuously re-configure existing resource weaknesses, inadequate capabilities, and social liabilities into resources strengths, distinct capabilities, and social capital that will enable the USO to generate returns” (Vohora et al., 2004, p. 166).

For a USO to reach its full potential, it must successfully transition between the development phases and deal with the defined critical junctures (Vohora et al., 2004). Even though this is a complete framework, these critical junctures might not be the only factors that come to play during these phases, nor are these the only factors that can influence USO success. Other factors from different sources of literature will be discussed in the following sections.

In literature, there are many causal effects to be found regarding the success of USOs (Antoncic, Bratkovic Kregar, Singh, & DeNoble, 2015; Berbegal-Mirabent, Ribeiro-Soriano, & GarcÝa, 2015; Gorgievski & Stephan, 2016; Rasmussen, Mosey, & Wright, 2011). Even though there are many different views on and explanations of USO success, all this additional research can be brought back to a few categories of individual, organizational and institutional factors that influence the success of a USO, which can be found in Table 1. In the following section, a few factors in each category will be discussed. Two factors of importance are the environment and business. Research suggests that technology-based start-ups show that those firms with a solid external environmental orientation have significantly higher networking frequencies and build more extensive networks, which can be of essence on survival (Dickel, Hörisch, & Ritter, 2018). USOs can have a tremendous competitive advantage over other start-ups due to advanced knowledge gained in the research phase. However, not much research has gone into the environment and businesses with which USOs have to deal specifically and how this affects the firm's success. Due to the scope, these will not be elaborated on in this research. These factors are added in Table 1 for clarification purposes.

Table 1: Concise Model of Influences of USO success

Category	Factor	Relationship to USO success	Found by
Universities	Technology Transfer Offices (TTO)	+	(Berbegal-Mirabent et al., 2015)
	Entrepreneurial Culture	+	(Berbegal-Mirabent et al., 2015)
	University capabilities	+	(Rasmussen & Borch, 2010)
Entrepreneurs	The Big Five	+ -	(Gorgievski & Stephan, 2016)
	The Big Five for predicting openness and intentions	+ -	(Antoncic et al., 2015)
	Balance natures	+	(Visintin & Pittino, 2014)
	Team composition	+ -	(Visintin & Pittino, 2014)
The Environment	Networking	+	(Dickel et al., 2018)
	Minimal University Integration	-	(Calderón-Hernández, Jiménez-Zapata, & Serna-Gomez, 2020)
	Regional Context	+ -	(Sternberg, 2014)
Businesses	Social Proximity	+	(Soetanto & van Geenhuizen, 2019)

2.2.1. The role of university research commercialisation support on USO success

Universities contribute to their region's economic development by promoting effective university–industry relationships to exploit and commercialize research findings, which can be done through USOs (Berbegal-Mirabent et al., 2015). Universities have different manners in which they can contribute to the possible success of USO. For example, Berbegal-Mirabent et al. (2015) found that the university can, use Technology Transfer Offices (TTOs) to assist academic entrepreneurs. Furthermore, the study elaborated on the presence of an entrepreneurial culture that can promote academic entrepreneurship (Berbegal-Mirabent et al., 2015). Having these offices and this culture could encourage students and researchers to start their own USO. Other studies focus on the regulations in university environments like one that proposes three university capabilities that facilitate the venture-formation process (1) creating new paths of action, (2) balancing both academic and commercial interests, and (3) integrating new resources (Rasmussen & Borch, 2010). These three university capabilities could lead to a higher turn-out rate of USOs. All these factors, and more, make the university an essential part of the USO's formation and development. It can be stated that universities are a significant facilitator of spin-offs, and research supports that this is mainly due to the support of TTOs.

2.2.2. The role of entrepreneurs on USO success

Entrepreneurs drive the organization and its visions, hence why entrepreneurs play a significant role in achieving its success. Different researchers point to several factors that entrepreneurs must obtain or be to create a successful spinoff. Much research has gone into personal skills in combination with entrepreneurship, like the Big Five, which is a model that seeks to construct a profile of the entrepreneurial personality (Gorgievski & Stephan, 2016). The characteristics in the model are openness, conscientiousness, extraversion, agreeableness, and neuroticism. These are called the OCEAN factors (Goldberg, 1981, 1992). In a different study, the conclusion that the big five personality traits can potentially be used for predicting entrepreneurial start-ups and entrepreneurial intentions was found (Antoncic et al., 2015). Other research has focused on team structure and skills rather than on individual skills and competencies. Visintin and Pittino (2014), e.g., suggested that university spin-offs, due to their nature, need to balance their scientific and business orientations properly. The appropriate composition of the founding team may help to achieve this balance through the combination of members' traits that, on the one hand, promote and, on the other hand, favour integration of business and research efforts (Visintin & Pittino, 2014). Here, a clear impact of team structure is shown, keeping individual factors in mind. A balance between scientific and business orientation is an essential factor in the success of start-ups and USOs (Visintin & Pittino, 2014). USOs often focus more on technology development than other business aspects (Pattnaik & Pandey, 2014; Visintin & Pittino, 2014). This shifted focus can harm the balance between scientific and business balance and can lead to the commercialization of the innovation will not go as planned or hoped. If this balance is present, both research efforts and business efforts should move more smoothly, making the USO more attractive to creditors. Therefore, the following hypotheses were designed:

H3a: the appropriate balance between scientific and business orientations will increase the likelihood of receiving governmental funding.

H3b: the appropriate balance between scientific and business orientations will increase the likelihood of USO survival.

Visintin and Pittino (2014) have also looked into the team composition of such start-ups. They found strong support for the importance of a balanced demographic structure in the USO entrepreneurial team to simultaneously pursue research and business goals and achieve adequate performance levels (Visintin & Pittino, 2014). Furthermore, the importance of a heterogeneous composition in the founding teams was emphasized (Beckman, Burton, & O'Reilly, 2007; Chowdhury, 2005; Visintin & Pittino, 2014). Therefore, the following hypotheses were designed:

H4a: the appropriate team composition will increase the likelihood of receiving governmental funding.

H4b: the appropriate team composition will increase the likelihood of USO success.

3. RESEARCH DESIGN

3.1 Subjects of Study

In this research, 242 anonymized and aggregated University Spin-offs (USOs) grant proposals submitted for evaluation in the Valorisation Grant (VG) programme (between 2007 and 2014) managed by the Dutch Research Council (NWO) are analysed according to the ability to attain early-stage funding from this governmental creditor. NWO is "... one of the most important science funding bodies in the Netherlands and realises quality and innovation in science.'' (NWO, 2021b). Being one of the most crucial science funding bodies in the Netherlands, the NWO invests close to 1 billion euros into "curiosity-driven research, research related to societal challenges and research infrastructure" (NWO, 2021b). The

Valorisation Grant (VG) programme (now, Take-off) was one of the financing instruments for academic entrepreneurs from Dutch research institutions to help further develop knowledge innovations within the high-tech domain into new activities and entrepreneurship. These activities and types of entrepreneurship can concern product, process, care, or service innovations in the broadest sense of the word (NWO, 2021a).

Two phases must be applied for one after the other in the VG program. During the first phase, the USOs' proposal is assessed on the technological and commercial feasibility, where a maximum of 25.000 euros is funded (NWO, 2015). Proposals that complete the first phase can apply for the second phase, where the corporate development of the product and firm is valorised (NWO, 2015). There is maximum funding of 200.000 euros set for this phase (NWO, 2015).

In this study, we focus on USO proposals submitted to Phase 2 of the programme, reflecting active preparation for the valorisation phase. As this research relies on an existing database from the NWO, where specific feedback is provided, this study can move further than other previous studies where the data had to be collected in other manners. The research is focused on finding key factors which play a role in acquiring funding to improve the performance of USOs. When this happens, governmental money is spent wisely, and the USOs can further develop and commercialize their firm.

3.2 Measurements

3.2.1. Dependent Variables

Dependent variables are the ones that depend on other factors that are measured, and are expected to change as a result of experimenting with independent variables (Cramer & Howitt, 2004). The dependent variables in this research are *early-stage USO funding* and *USO survival*. The funding makes the USO move through the developmental phases and critical junctures, thus only become a success. This variable is binary, with 0) and 1), where 1) indicates that funding was granted and 0) that the funding was rejected. USO survival is binary as well, where 0) indicated the USO did not survive, and 1) indicates survival of the USO.

3.2.2. Independent Variables

Independent variables are the presumed cause for the change in the dependent variable (Cramer & Howitt, 2004). The independent variables that can be drawn from the hypothesis are noted as a) comprehensive business model, b) market segmentation, c) customer focus, d) a balance between scientific and business orientation and e) team composition. All these variables can or will impact the dependent variables. From the information in the feedback forms, the data was coded according to all independent variables (see Table 2). For each independent variable, measurements were designed for all coders to have the same manner of coding.

A comprehensive business model can help understand the patterns of value creation successfully, leverage the experience and skills of the team, avoid wasting time with ideas that will not work (Osterwalder et al., 2014). This independent variable can be defined on an extended categorial level, where 1) – lacking ability to develop a comprehensive business model, 2) – neutral ability to develop a comprehensive business model, 3) – sufficient or strong ability to develop a comprehensive business model.

Knowing the customers and the market segment of the firm are essential factors to start-up success. The market segment will be measured on the more extensive variable "market selection". This variable can also be defined on a categorical level design, where 1) lacking ability of doing market segmentation, 2) neutral ability of doing market segmentation, 3) – sufficient or robust ability of doing market segmentation.

Customer focus, similar to having a comprehensive market segmentation, is essential to start-up success, as, without customers, the firm will not sustain. This variable can also be defined on a categorical level, where 1) lacking ability to focus on customers, 2) neutral ability to focus on customers, 3) sufficient ability to focus on customers, 4) strong ability to focus on customers. This variable was later recoded, as level four 'strong ability to focus on customers' was poorly represented by the data. Therefore, it was removed, and the ones with this level, were recoded into level 3 'sufficient ability to focus on customers'.

A balance between scientific and business orientation is seen as an essential factor in the success of start-ups (Visintin & Pittino, 2014). In this case, the balance between the two can be measured on a scale, where is implied that 1) lacking ability to balance scientific and business orientations, 2) neutral ability to balance scientific and business orientations, and 3) sufficient ability to balance scientific and business orientations.

Lastly, *team composition* can influence the likelihood of funding, as well as it can influence the scientific-business balance. The variable "proper founding team can measure team composition" on a categorical level where 1) lacking ability to compose a proper team composition, 2) neutral ability to compose a proper team composition, and 3) strong team ability to compose a proper team composition.

3.2.3. Control Variables

Control variables are not changed but are constant throughout the experiment (Troy, 2021). One variable that comes into play for any business is the *industry*: we know from theory that industry is relevant, and we can expect to find this effect. This variable is coded using the NACE codes level 1. Furthermore, the parent university can be of influence in the outcome of the study. This is also coded for in the analysis.

3.3 Data Collection

The database used for the research is provided by the University of Twente, collected by the Dutch Research Council (NWO). This study builds on a fully aggregated and anonymized research dataset to conduct a comprehensive analysis and test our proposed hypotheses. The data is collected between 2007 and 2014 on 242 USOs. To construct a part of the independent variables, content analysis on the aggregated evaluation results regarding feasibility and valorisation potential of selected USO proposals was used. Furthermore, information regarding the performance of business incubators and technology transfer offices of the leading Dutch technical universities was retrieved from their websites and open-source reports. Besides this, scientometric information about the scientific output and its impact (i.e., the number of peer-reviewed publications, citations, or citation networks) in the past 20 years by the leading Dutch technical universities was found. Lastly, the research fields of publications and USO grant proposals with the NACE industry codes were matched.

3.4 Analysis

For analysing the research results, the program SPSS is used, mainly due to the program's options for the intended goals of the analysis. As the research aims is to find the most critical success factors and construct statistical models to support these findings, a quantitative method is used. With this method, data is converted into numbers without losing its meaning. In this study a list of specific determinants was derived that, according to theory, are expected to have an impact of likelihood of USO funding and USO's success. During the process, string data was

converted to numeric data. Specifically, binary logistic regression is used to analyse the data after coding it first. To thoroughly analyse the data, content analysis using open, selective, and axial coding was done. These steps are part of the grounded theory method of analysis (Corbin & Strauss, 1990). The first step of grounded theory is open coding, where textual data is taken and broken into discrete parts. After this, during the axial coding phase, connections between codes are drawn. Finally, selective coding is used where one main category is chosen, which connects all the codes from the analysis and captures the essence of the research (Delve, n.d.).

Binary logistic regression is a type of regression analysis where the dependent variable is dichotomous, i.e., one which takes the value 0 or 1 to indicate the absence or presence of some categorical effect. As both dependent variables are dichotomous variables, binary logistic regression can be used. It can be a valuable tool for analysing data that includes categorical response variables, such as those present in this study (Midi, Sarkar, & Rana, 2010). There are some general assumptions of linear regression models, which include: a) the dependent variables are binary, b) all data must be independent, c) the independent variables must not be highly correlated. These assumptions also apply to this analysis.

4. RESULTS

This research has been based on an 242 grant proposal feedback forms collected from the NWO. First, the data was coded according to the independent variables using open coding. After this open coding, some variables seemed to overlap or be poorly represented in the data, after which new categories of variables were designed. All independent variables which have been coded can be found in Appendix A; Table 2. After the coding process, the data was transferred to SPSS, from where the results were created and analysed. In the following sections, all hypotheses will be discussed and proven/dismissed.

First, the assumptions of the regression must be met. The first assumption was that the dependent variable must be binary.

The dependent variables in this research were USO funding and USO survival, which were either funded/survived (1) or not (0). This 0 and 1 coding makes it a binary variable, thus meeting the first assumption. Table 2 and Table 4 present overviews of descriptive statistics and correlations for all the variables used in the models. Correlations are generally low to moderate, which indicates that multicollinearity is not an issue in the analysis. These correlations imply that all variables are indeed independent. Additionally, the variance inflation factor (VIF) values are lower than 1.5, which is well below the critical threshold, where a cut-off value of 5 is standard. These values confirm the last two assumptions that applied for this research. Table 3 and Table 5 present the binary logistics regression results for both independent variables (USO funding and USO success). In these tables, model 1 analyses the effect of control variables (NACE codes for industry, the parent university, and USO funding [for dependent variable USO survival]). Models 2-6 examine the influence of each independent variable separately, keeping the control variables in the model. Model 7 presents a complete model with all independent variables and control. Model 8 does the same, keeping one outlier found out of the model (only for USO funding). To analyse the proposed

Table 2: Descriptive Statistics and Correlations for Dependent Variable ''USO Funding''

	Min	Max	Mean	S.D.	1	2	3	4	5	6	7	8
[1] USO Funding Decision	0	1	0.41	.493	1							
[2] Market selection	1	3	2.09	.833	.014	1						
[3] Customer focus	1	4	1.76	.973	.093	.169**	1					
[4] Business Model	1	4	1.86	.657	.248**	.-.068	.082	1				
[5] Scientific Business Balance	1	3	1.50	.701	.030	.124	.109	.068	1			
[6] Proper founding team	1	3	1.74	.880	.199**	-.031	.014	.128*	.279**	1		
[7] NACE Codes L1	0	19	8.48	6.21	.175**	.015	-.162*	-.045	-.033	-.109	1	
[8] University	1	25	5.56	5.72	.031	-.094	.057	.038	-.036	-.034	.066	1
N of cases 242												

** Correlation is signification at level 0.01 (two-tailed) * Correlation is signification at level 0.05 (two-tailed)

Table 3: Binary Logistic Regression for Dependent Variable ''USO Funding''

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	B	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**
Constant	-.907	.261	-.975	.430	-2.593	.521	-2.681	.463	-1.075	.395	-1.958	.418	-3.829	.772	-4.278	.813
Market selection			.033	.160									.046	.176	.010	.180
Customer focus					.269	.141							.260	.153	.269	.174
Business model							.869**	.225					.795**	.231	.936**	.242
Scientific business balance									.108	.189			-.173	.216	-.186	.223
Proper founding team											.535**	.157	.534*	.172	.597**	.176
NACE code L1	.057	.022	.057	.022	.065	.022	.065	.022	.060	.022	.068	.022	.081	.024	.092*	.025
University	.007	.023	.008	.023	.004	.023	.004	.024	.008	.023	.010	.024	.004	.024	.007	.025
-2 Log likelihood	319.936		319.895		316.238		303.270		319.612		307.881		290.395		278.619	
Nagelkerke R Square	.041		.041		.061		.128		.043		.105		.191		.224	

N = 242

*p<.05; **p<.01 ; Hosmer and Lemeshow is not significant (p>0.05)

Table 4: Descriptive Statistics and Correlations for Dependent Variable ''USO Survival''

	Min	Max	Mean	S.D.	1	2	3	4	5	6	7	8	9
[1] Survival	0	1	.50	.502	1								
[2] Market selection	1	3	2.291	.812	-.052	1							
[3] Customer focus	1	4	1.854	.984	-.167	.103	1						
[4] Business Model	1	3	1.582	.721	-.035	.176	.355**	1					
[5] Scientific Business Balance	1	3	1.864	.754	-.153	.033	.065	.291**	1				
[6] Proper founding team	1	3	1.941	.894	-.065	-.098	.068	.281**	.337**	1			
[7] USO funding decision	0	1	.35	.479	.237*	.063	-.016	.058	-.111	-.112	1		
[8] NACE Codes L1	0	19	9.05	5.928	.084	.026	.055	.103	-.084	-.059	.073	1	
[9] University	1	25	6.54	6.560	.008	-.021	.099	-.045	.072	.019	.151	-.013	1
N of cases 103													

** Correlation is signification at level 0.01 (two-tailed) * Correlation is signification at level 0.05 (two-tailed)

Table 5: Binary Logistic Regression Model for Dependent Variable ''USO Survival''

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	B	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**	**B**	**s.e.**
Constant	-.491	.437	-.081	.713	.118	.562	-.239	.605	.180	.686	-.321	.640	.986	1.020
Market selection			-.184	.254									-.156	.266
Customer focus					-.369	.215							-.388	.232
Business model							-.171	.287					.165	.345
Scientific business balance									-.347	.276			-.372	.308
Proper founding team											-.083	.230	-.007	.259
USO funding decision	1.027	.439	1.054	.442	1.029	.446	1.046	.441	.997	.444	1.011	.442	.978	.457
NACE codes level 1	.024	.035	.025	.035	.028	.035	.026	.035	.021	.035	.023	.035	.023	.036
University	-.009	.032	-.009	.032	-.003	.032	-.010	.032	-.006	.032	-.008	.032	.001	.033
-2 Log likelihood	136.333		135.806		133.314		135.976		134.729		136.203		131.397	
Nagelkerke R Square	.081		.087		.117		.085		.190		.082		.139	
N = 103														

*p<.05; **p<.01 ; Hosmer and Lemeshow is not significant (p>0.05)

hypotheses, the following argumentation is based on Table 3, Model 8, and Table 5, Model 7.

Hypothesis 1 proposed that market segmentation and customer focus will increase the likelihood (a) of governmental funding and (b) surviving on the market. Table 3 shows that both market segmentation and customer focus have a reasonably small positive effect on USO funding; however, it is insignificant for both variables. Therefore, we can reject Hypothesis 1a. Results in Table 5 show that there is a negative effect of market selection of USO survival, however as it is insignificant, is it not possible to confirm the previously stated hypothesis. Hypothesis 1b can be therefore be rejected.

In Hypothesis 2, I proposed that a comprehensive business model will increase the likelihood of (a) governmental funding and (b) surviving on the market. The results in Table 3 show that the variable business model has a significant positive effect on the likelihood of acquiring funding ($B = .936$, $p < .01$). The results show that when with a more substantial business model, the expected increase in log-odds of USO funding will be .936 ($p<.01$), holding all other control and independent variables constant. Hence why Hypothesis 2a can be confirmed. Table 5 shows a slight positive effect of a comprehensive business model on the likelihood of USO survival. However, this effect is insignificant, hence why Hypothesis 2b can be rejected.

In Hypothesis 3, I proposed that the appropriate balance between scientific and business orientations will increase the likelihood of receiving (a) governmental funding and (b) survival in the market. As mentioned above and can be found in Table 3, this variable harms on the likelihood to acquire funding; however, since this effect is insignificant, Hypothesis 3a can be rejected. The results in Table 5 show a relatively adverse effect of a scientific business balance on the likelihood of USO survival. This result is, however, found to be insignificant hence why Hypothesis 3b can be rejected.

In Hypothesis 4, I proposed that the appropriate team composition (proper founding team) will increase the likelihood of (a) receiving governmental funding and (b) survival in the market. The results in Table 3 show that variable has a significant positive effect on the likelihood to acquire funding ($B = .597$, $p < .01$). Therefore, Hypothesis 4a can be confirmed. Table 5 shows that the appropriate team balance seems to have a small negative effect on the likelihood of USO survival. However, the effect is insignificant hence why Hypothesis 4b can be rejected.

5. DISCUSSION

As established in research (Miranda et al., 2018; Vohora et al., 2004), University Spin-offs (USOs) are vital in the process of transferring knowledge to society and fostering innovation. Much information regarding USOs is established; however, there is little knowledge about USOs' funding in the early stages of development. If the USOs obtain funding, it could help overcome critical junctures and move along the stages of development. With this funding, the USOs could find new customers, introduce the innovation to the market, or overcome liabilities, making survival more likely. The purpose of this research was to identify characteristics of USOs and the academics involved, which are critical to USO success (i.e., favourable funding and survival). Hypotheses were drawn,

from which five independent variables (market selection, customer focus, business model, team composition, and scientific-business balance) were posed to positively affect the likelihood of USO funding and survival. This research found that having a comprehensive business model and having an appropriate team are essential characteristics of USOs and will lead to early-stage spin-off funding, as seen in the Results.

The findings suggest that to move from the pre-orientation phase to the re-orientation phase of development, a comprehensive business model is vital, as the likelihood of obtaining funding in the pre-orientation phase increases with this factor. Preparing a comprehensive business model before trying to apply for funding, therefore, is of great essence. Business models provide the entrepreneurs with an overview of the operations, customers, and market. Building on this model, entrepreneurs get a clear vision of the firm, which results of importance, as, where would anyone be without a vision? As the effect of a business model on the likelihood of funding is that strong ($R = .944$, $p < .001$), USOs cannot compensate with other variables for a lacking business model.

Besides the comprehensive business model, the USO needs an appropriate team to move towards the next development stage. Teams of entrepreneurs drive the firm, and for that, having the appropriate team is of major essence. Keywords used to describe these teams were: intense, driven, good, and persuasive. These words, amongst other keywords, led the coders to believe there was a strong team present, which results showed, led to a higher likelihood of acquiring funding. The USOs with a more appropriate team were more likely to receive funding and pass the USO development stages (Vohora et al., 2004). With the funding, the USO could also invest in its team members' personal and professional development, which can help bring out and restore joy in their profession (McMahon, 2017). Based on this, for the long term, even though not established in this research, one could argue that this is an essential factor to keep the appropriate team together.

For the other three independent variables, market selection, customer focus, and scientific-business balance, no significant effects on either USO funding or survival were established. This could be primarily due to the early-stage of development of the USOs when applying for the grands. Under the conditions of the dataset, with these chosen variables, there were no significant effects found. This finding, however, does not mean it is useless or cannot be confirmed otherwise with different data. Following the research of others, these tested variables should positively impact the likelihood of USO survival. This fact that no significance could be established is mainly due to the data set, as there was limited information about the failure or success of all 242 cases. Not having significant effects on USO survival is logical since it is difficult to estimate a positive effect of the previous failure, especially in the context of venture funding (Skute, 2020). At the same time, venture survival is a long-term achievement of the USO; the results indicate that different data sets and conditions should be considered for further research.

5.1 Theoretical Implications

This study offers several contributions to the existing literature on USOs. First, the findings provide an overarching view of factors that influence the likelihood of funding in the early stages of development, mainly covering USO teams, business models, and appropriate teams. It builds on research from, amongst others, Osterwalder et al., Visintin and Pittino, and Vohora et al., to achieve this goal of finding an overarching view.

Extending the findings of Osterwalder et al. (2014), having a comprehensive business model has a positive on the likelihood of funding. Besides there being an importance of business models for outgrowing the competition, amongst nine other characteristics, being more attractive to creditors can be one additional factor that can be added to the list of 'characteristics of value propositions'. Furthermore, using a comprehensive business model can, for example, increase the likelihood of exploiting the first-mover advantages (FMAs) for early entrants to the market, making it more attractive for future creditors (Frynas et al., 2006). The data contributes a clearer understanding of the importance of comprehensive business models as a factor for acquiring governmental funding, following previous research (Frynas et al., 2006; Osterwalder et al., 2014; Teece, 2010).

Furthermore, Visintin and Pittino (2014) showed the importance of a balanced demographic structure in the USO entrepreneurial team to simultaneously pursue research and business goals and achieve good performance levels. In this study, a similar effect is found. In this previous research, a clear impact of team structure is shown, keeping individual factors in mind. This individual level cannot be directly drawn from this data but can be analysed in further research with a different or more extensive dataset. The team level, however, can be established to be of a positive effect on the likelihood of USO funding. Therefore, Visintin and Pittino's findings can be substantiated by these findings.

However, no significant effects were found of the tested independent variables (market selection, customer focus, business model, scientific business balance, and proper founding team) on the dependent variable 'USO survival'. This contradicts previous research, where these factors were established as to be of significance. As elaborated on in section 5, this can be due to the specific data set used, as well as to the early-stage of development, where it is complicated to predict or have insights about survival.

5.2 Managerial and Policy Implications

From this study, entrepreneurs can learn that having a comprehensive business model and an appropriate team can increase the likelihood of acquiring funding. These entrepreneurs can use this information to their advantage when wanting to apply for funding. Suppose they make sure that the business model they have is robust and an appropriate team with the combination of members' traits that favour the integration of business and research efforts is present. In that case, the USO is more likely to move through the development stages and become a success. Especially in the early stage of development, where many problems related to funding arise (like the liability of newness and a lack of credible historical data), it is of great essence to understand which factors can lead to an increased likelihood of funding to move along these developmental stages (Vohora et al., 2004). For the firms, it is essential to recognize the innovative products that they have. What is more critical, is how to get them funded. It takes time for them to get approved by the authorities and in the meantime they can have difficulties and go bankrupt or end up not putting the product on the market because they made the wrong decisions and are slow to implement something (Postelnicu, 2019). Therefore, Identifying where the problems arise and solving them with identifiable success criteria can help avoid or dimmish future USOs' problems. When academics with a USO rely on this research and thoroughly implement the proposed success criteria, the chances of a USO's success rate will be higher. When more and more USOs succeed, there will be a high knowledge-transferring value for society and other

start-ups. Ultimately there will be a better entrepreneurial system in which USOs prosper and increase in value over time. Jobs can be created due to the firm's success, and stimulate economic activities leading to tax money (Bray & Lee, 2000).

Besides entrepreneurs, policymakers can also learn from this research. In this case, especially the NWO can look at the current criteria and see which factors now lead to funding and whether it necessarily leads to success. As proposed in the Introduction, the selection process is incredibly challenging for the assessors of the proposals, as there is a lack of operational and financial history of the USO. Therefore, for the NWO, there is a need for a better understanding of this process and to know factors that might indicate future success. The NWO can adjust their funding criteria to the results of this study, making the chance of investing governmental tax money more wisely and consistently. The assessors of the proposals, for example, could look into the business model of USOs, as well as the composition of the team, as these were significant factors for deciding on funding. Besides these significant findings, the NWO can also look at non-significant outcomes of this study, as these variables (market selection, customer focus and scientific-business balance) were found to be of importance by other studies. Hence, these factors are also essential to consider when evaluating the proposals of the USOs. When this is done more consistently, the more it is likely that money is spent more wisely, as it is clear which factors are essential and will lead to success later on. There is a rising trend of these funding mechanisms, as a government-funded initiative was launched in Belgium to support medtech and eHealth projects in getting access to the resources needed to accelerate growth (Postelnicu, 2019) . One company funded by this initiative has found its software to be one which is standardized and can therefore be deployed to many different countries. One success story which shows the effect that the acquisition of funding could have. Ultimately, there is a win-win-win situation in which taxpayer's money is spent wisely, NWO invests in the right projects and can claim more returns, and USOs can achieve their wanted goals and succeed with their innovation.

One important takeaway is that failing to receive a funding in the early stage of USO development should not be considered purely as a failure (Skute, 2020). This additional entrepreneurial experience allows the USO to identify weaknesses in the process of development and the status quo. One setback should not determine the firm's entire future, nor does it mean that the firm is unable ever to receive such funding.

5.3 Limitations and Future Research

This study has potential limitations, which were found throughout this research. First of all, the opinion formed by analysing the data is based on the opinion of the assessors of the USO grant proposals. Therefore, biases such as a framing effect can occur. With a framing effect, the choices are influenced by how something is presented. This effect may limit the choices made during coding and, therefore, the outcome of the analysis. The outcomes of this study are based mainly on the database the framing effect is bound to happen. Furthermore, the scope of this research is limited as it focuses on the early-stage development of the USOs, and the funding in later stages of development is neglected within this study. Though this paper is unique in the focus on early-stage development, this paper, combined with others that focus on later stages of development leads to a complete view of factors of USO success. Another limitation is the location of the research, as it was bound to information regarding Dutch USOs. Therefore, it cannot be generalized to other countries.

Further research is needed to establish which factors are of significant effect on USO survival. With this dataset, the factors that could influence USO survival were not significant, making it impossible to confirm the hypothesis regarding this dependent variable. In the future, a more extensive database with information regarding the survival of USOs is needed to determine these factors. Furthermore, future research may use a more independent database that assesses the USOs, making framing issues less likely. Also, it would be interesting to find whether there are cross-cultural differences in funding criteria. Therefore, I would suggest doing similar research in different parts of the world and understanding about the cultural effect on these factors and criteria.

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8. APPENDIX A

Table 2: Independent Variables Used in the Analysis

Independent Variable	Item Label	Item	Definition	Definition of Scale
Marketing Competencies	MComp1	Customer focus	The ability to access the needs of the customers	Ordinal scale, where it is well defined (2), present (2), not mentioned (0) or negatively mentioned (-1)
	MComp2	Societal need	The presence of a healthcare or environmental benefit	Dichotomy, either present (1) or not (0)
	MComp3	Market knowledge	The ability to access the potential of new markets	Ordinal, where is it well defined (2), present (1), not mentioned (0) or negatively mentioned (-1)
	MComp4	Market selection	The effective selection on the market, based on the market plan, importance of the market, market size.	Measured by negative mention (-1), not mentioned (0), or positive (1)
	MComp4	Commercialization	The ability to commercially exploit a patented invention, or in some cases technology transfer	Measured by negative mention (-1), not mentioned (0), or positive (1)
	MComp5	Ability to research new competitors/customers	Whether the research into customers and competitors was properly done	Measured by negative mention (-1), not mentioned (0), or positive (1)
Business/Entrepreneurship Competencies	BEComp1	Proper founding team	Having a well balanced and motivated team	Measured by negative mention (-1), not mentioned (0), or positive (1)
	BEComp2	Business model	Whether the business model is properly defined and implemented	Categorial, (0) lacking, (1) weak, (2) sufficient, (3) strong model
	BEComp3	Motivation (championing)	The ability of personal motivation and enthusiasm for the asset	Measured by (-1) lacking, (0) not mentioned, or (1) well developed
	BEComp4	Scientific-business balance	to which extend the scientific (research) and the business efforts of the USO are balanced (Visintin & Pittino)	Measured by negative mention (-1), not mentioned (0), or positive (1)
	BEComp5	Ability to involve the right people	The ability to involve an organization or individuals to contribute to the USO's development	Ordinal, (1) beneficial, (0) not mentioned, (-1) lacking
	BEComp6	Network (suppliers etc.)	The presence of a business partner in the form of either a: launching customer, business alliance or university.	Measured by no network mention (-1), not mentioned (0), or positive (1)
	BEComp7	Access to financial funds	Access to prior financial funds	Access to funds (1), not mentioned (0), or no access (-1)
Technology Competencies	TComp1	Technological innovations	The ability to access their advantage through competitor products	Measured by ordinal scale where it is well defined (2), sufficiently defined (1), not specified (0) or lacking (-1)
	TComp2	IP Position	IP definition and establishment	Measured by well established (2), existent (1), not specified (0) or difficult position (-1)