

# ROAD TO SUCCESS: SURPASSING THE EARLY STAGES OF UNIVERSITY SPIN-OFF DEVELOPMENT

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## ABSTRACT

*University spin-offs (USO's) are ventures that are founded within a university and based on academic research, with the objective to commercialize a new technology or innovation. Although they represent a viable opportunity to transform academic knowledge into economically sustainable businesses, their potential is still not being utilized to the full extent. Existing academic literature shows that the ability to acquire funding is of high importance for USO's to surpass the early stages of development and become financially sustainable. This study builds on a USO development framework revealing five phases that academic ventures must transition through. There is little knowledge on the factors and characteristics that contribute to the acquisition of public funding. This study aims to determine these factors. This was done by performing a content analysis and a binary logistic regression on an aggregated dataset consisting of 242 funding proposals submitted to the NWO, the leading Dutch research authority that provides public funding for academic ventures. Results of the study show that the personal motivation and the level of elaboration of the business model have a significant impact on the ability of USO's to attract early-stage public funding, which is essential in the development of a spin-off company into a sustainable business. These results are put into context, translating them into practical implications for both entrepreneurs and public bodies.*

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## Keywords

*University spin-off; academic venture; criteria; funding; early-stage; business model; motivation*

## 1. INTRODUCTION

In recent years, there has been substantial development in the area of academic entrepreneurship. Universities are increasingly shifting from their traditional roles in the educational environment towards a higher position in promoting the creation of university spin-offs (Soetanto & van Geenhuizen, 2018). They are developing from a sole focus on academic learning and research to embrace the additional objective of supporting (high-tech) university spin-offs (short: USO's) in their development (Baroncelli, 2019). Universities have the potential to help new technology companies, acting as "seedbeds". In many countries, there is an increasing consideration for establishing new businesses based on academic research by including their interests in policymaking (Rasmussen & Wright, 2015). Governmental policy has increased its focus on the commercialization of academic research (Soetanto & van Geenhuizen, 2019). Still, university policy contributes most to creating a favourable setting for academic entrepreneurship (Baroncelli, 2019). Therefore, it can be stated that although USO's are becoming more and more important in modern society, they still face substantial threats in their path of development. For a spin-off company to grow and become a viable business, it must obtain the required funding, characterized by Hunady et al. (2019) as an essential element. Vohora et al. (2004) describe a framework based on five different phases, together with four "critical junctures". The authors identify that overcoming the junctures ahead is the most important step in acquiring the necessary funding.

However, only a very small percentage of university spin-offs acquire the required funding. The overall impression is that some businesses seem to have more success in accessing capital than others, which implies that there are possible attributes of young companies and their entrepreneurs, both of organizational and financial nature, that build trust in investors and ensure access to capital (Prohorovs et al., 2018). Apart from financial obstacles, the performance of USO's depends on entrepreneurial competencies, defined as the "ability of an entrepreneur to start and grow a venture and successfully identify and combine a variety of resources" (Gümüşay & Bohné, 2018, p. 364).

Although the creation of university spin-offs seems to benefit the commercialization of science in universities, their potential is not being utilized so far. Even though the creation of university spin-off companies appears to be a compelling way to convert expertise, their adoption is still only happening in a limited fashion, attributable to a lack of legislation or know-how of academic institutions (Hunady et al., 2018).

Accordingly, it can be concluded that the development of university spin-offs is a viable and promising option, but its potential is not fully being recognized yet. Furthermore, there is no universally applicable set of rules and guidelines concerning the characteristics spin-offs and the entrepreneurs themselves need to become (commercially) successful. Currently, there is almost no empirical knowledge into the resistance of obstacles that limit growth (van Geenhuizen & Soetanto, 2009). Therefore, to better understand the topic, it is necessary to examine these characteristics and criteria and determine how they influence the success of a university spin-off.

Hence, the following research question will be examined:

*What characteristics determine the success and growth of university spin-offs, especially in the early stages of development?*

This paper aims to contribute to existing research streams, entrepreneurs and their needs, and policymakers. Based on this research, further research can be conducted on the survival of USO's in the early development stages. This paper can assist entrepreneurs in identifying the characteristics they need to possess and the factors that influence their chances of acquiring public funding. The criteria defined in this paper can help the entrepreneur to identify factors and characteristics that are of high importance in the process of receiving public funding. Policymakers can use the knowledge obtained from this paper to optimize the process of distributing funding by increasing their focus on the development of characteristics and factors that influence the likelihood of acquiring public financing, with the most optimal distribution of tax money as a desirable outcome. The ultimate purpose of this paper is to increase the likelihood of success of spin-off companies, enabling them to make a positive contribution to the general society.

## 2. THEORETICAL FRAMEWORK

### 2.1 Defining the concept

There is a large volume of published studies on the topic of university spin-offs. In this section, a definition for the concept is to be determined and an elaboration on the importance of the topic. Previous literature about university spin-offs shows different definitions of the concept. According to van Geenhuizen & Soetanto (2009), "academic spin-offs are defined as a particular set of spin-offs created for the purpose of commercially exploiting a new technology or research results developed within a university" (p. 671). This statement is supported by Siegel & Wright (2015), who state that the purpose of USO's is the "commercialization of science and other forms of university technology transfer" (p. 582). Perkmann et al. (2013) also support the previously mentioned definitions, using the term academic entrepreneurship, which is defined as "the founding of a firm with the objective to commercially exploit a patented invention, or in some cases, a body of unpatented expertise" (p.424). Rasmussen & Wright (2015) refer to university spin-offs as "firms that exploit intellectual property or patented inventions generated from university research" (p. 783). According to Vohora et al. (2004), a university spin-off can be defined as a "venture founded by employees of the university around a core technological innovation which had initially been developed at the university" (p. 149). The concepts that are commonly found in the mentioned definitions are "commercialization", "venture", "university", "(technological) innovation" and "success". For this study, the following definition will be used:

*"University spin-offs (USO's) can be described as ventures that are founded within a university and based on academic research,*

with the objective to commercialize a new technology or innovation”.

Furthermore, synonymously to the term USO's, other terms such as “university spin-out”, “academic spin-out” (ASO) or “academic entrepreneurship” will be used in this paper.

## 2.2 Importance of university spin-offs

The topic of academic entrepreneurship has gained substantial attention over the last few years, both within the academic literature and the policy community (Perkmann et al., 2013). Within the academic field, an increase in developments focusing on the stimulation of entrepreneurship in universities has been experienced (Grimaldi et al., 2011), which means that an increasing number of universities start to promote commercialization on campus. It even goes so far that some universities include such activities in their economic development mission (Siegel & Wright, 2015). According to Rasmussen & Wright (2015), “universities can play an important role as seedbeds of new technology ventures, and the creation of new businesses on the basis of university research has become an important part of innovation policy in most countries” (p. 783). Especially university spin-offs can provide great benefits to society (Siegel & Wright, 2015). The creation of a university spin-off has the potential to transform the results of academic research into a functional, value-adding product for society (Vohora et al., 2004), which can positively impact the national and regional economy (Fini et al., 2016)

However, although there is clear evidence of the relevance and impact of university spin-offs, public funding for university spin-offs and knowledge about the topic is limited. Research about USO's and their commercialization is a rather new field within literature (Fini et al., 2016). Even though the number of USO's has constantly increased over the last years, the majority of these spin-offs experience limited growth (Fini et al., 2016). Thus, many university spin-offs cannot obtain the required funding or complete other phases of development and consequently cannot transform themselves into a commercially successful business.

The limited success of university spin-offs can have a wide range of causes due to the complexity of the field. Many actors are involved in the process, which requires various competencies and other criteria (Fini et al., 2016). Thus, it is important to determine the general process of developing a university spin-off and the required criteria, competencies and factors that contribute to the success of university spin-offs.

## 2.3 Phases of university spin-off development

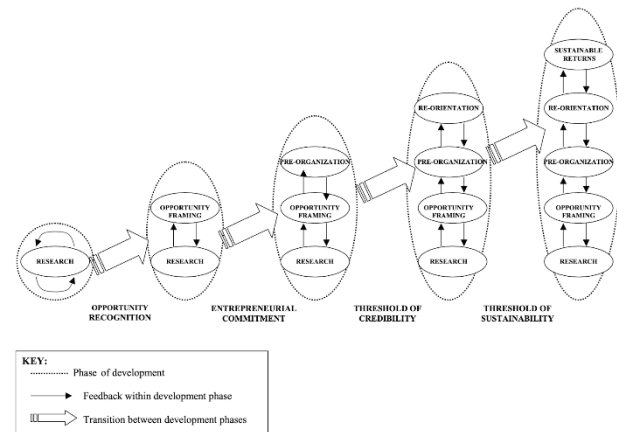
According to Vohora et al. (2004), the development of university spin-offs can be divided into five phases. These phases are the “research phase”, the “opportunity framing phase”, the “pre-organization phase”, the “re-orientation phase”, and the “sustainable returns phase”. Each phase brings about a set of activities and a strategic focus. The company must complete the previous phase to move on to the next (Vohora et al., 2004).

Within these five phases, Vohora et al. (2004) further include the transition from one phase to another, called “critical

junctions”. They define a critical juncture as “a complex problem that occurs at a point along a new high-tech venture's expansion path preventing it from achieving the transition from one development phase to the next” (p. 159). Within the phases of USO development, Vohora et al. (2004) identify four critical junctures, namely “opportunity recognition”, “entrepreneurial commitment”, “venture credibility”, and “venture sustainability”. These junctures will be further explained after each corresponding phase. Figure 1 shows the visualization of the five phases and related critical junctures.

**Figure 1**

*The critical junctures in the development of university spin-out companies (Vohora et al., 2004)*



### 2.3.1 RESEARCH PHASE

The first phase, known as the “research phase”, concerns creating intellectual property, know-how, and technological assets. Successful USO's involve academics who have a particularly high level of knowledge in the field. In this phase, potential opportunities for commercialization are discovered and developed (Vohora et al., 2004).

The related critical juncture that prevents USO's from transitioning from this phase to the next is the critical juncture “opportunity recognition”. This juncture is about finding a solution for an unsolved market need to proceed towards the commercialization of their idea. So only if these requirements are given, the USO can move to the next phase (Vohora et al., 2004).

### 2.3.2 OPPORTUNITY FRAMING PHASE

The second phase, known as the “opportunity framing phase”, is the transition from a potential opportunity to taking the first steps to creating the academic venture. During this phase, the academic and the TTO (technology transfer office) work together to evaluate the potential of the technology related to the USO. After the technology is evaluated and perceived as favourable, it is framed into a reasonable commercial opportunity in a potential market. Thereby it is elaborated on how to best access this potential market and the target audience (Vohora et al., 2004).

To finish this phase and move to the next one, the USO faces the second critical juncture, “entrepreneurial commitment”. At this juncture, the engagement of the entrepreneurs involved in the USO must move from the simple idea and vision of the

innovation to actions that carry it further to an actual business (Vohora et al., 2004).

### 2.3.3 PRE-ORGANIZATION PHASE

In the third phase, the “pre-organization phase,” the USO ventures’ management begins implementing strategic plans. Therefore, it is determined which resources and knowledge need to be acquired and how access to these is ensured (Vohora et al., 2004). Accordingly, Vohora et al. (2004) highlight that this phase is especially important since limited resources and wrong decisions can greatly impact the venture’s future success.

To move from this phase to the next, USO’s have to overcome the third critical juncture, “venture credibility”. To surpass this juncture, the entrepreneurs need the ability to access and acquire the valuable resources necessary to start the business. Without the ability to access necessary resources, the USO cannot move into the next phase (Vohora et al., 2004).

### 2.3.4 RE-ORIENTATION PHASE

After credible resources and knowledge have been gained by the USO’s, the fourth phase, the “re-orientation phase”, is initiated. In this phase, the entrepreneurs start attempting to get returns. Thereby, they must offer a valuable service to the customers. During this phase, the entrepreneurs simultaneously have to continually identify, acquire and integrate resources and reconfigure them according to the venture’s needs. This can be especially challenging if the venture is developed with a poor endowment, capital, resources and knowledge (Vohora et al., 2004).

The last critical juncture that the USO has to overcome during the development process is the juncture of “venture sustainability”. To move to the final phase of the process, the entrepreneurs need to strengthen their resources, capabilities and capital. Only if the entrepreneurs can generate value, such as customer returns, they can move into the last phase (Vohora et al., 2004).

### 2.3.5 SUSTAINABLE RETURNS PHASE

The USO’s generate sustainable returns in the last phase, known as the “sustainable returns phase”. When attending this phase, the USO venture will have addressed and solved the majority of previous uncertainties by accessing and reconfiguring important resources and capabilities within a detailed business plan (Vohora et al., 2004).

## 2.4 Theoretical constructs

### 2.4.1 The role of personal competencies of the entrepreneur on USO success

For a USO to be successful, the entrepreneur needs to possess a set of personal competencies. Following a definition set by Danneels (2016), competence can be defined as “the ability to perform an activity using a set of resources” (p. 2175). Entrepreneurial competencies can be seen as esteemed,

improvable personal characteristics and skills that can aid in the accomplishment of tasks, thereby using a combination of resources (Gümüşay & Bohné, 2018). Furthermore, it can be said that the mentioned personal characteristics can determine the success of entrepreneurs in conducting their business (Vega-Gómez et al., 2020). Previous research shows that the ability to combine new resources and explore new opportunities is vital in obtaining a competitive advantage (Rasmussen et al., 2011). In the previously introduced framework by Vohora et al. (2004), the determination of the necessary competencies falls into the third phase, the “pre-organization phase”. Therefore, it is required for a spin-off to succeed through this phase to develop the right personal competencies. For the purpose of this research, it was chosen to analyze the effects of personal motivation, leveraging competency and the ability to create networks. Research has shown that the creation of networks in the early phases of USO development often aids in later stages of the spin-off (Huynh et al., 2017). These networks can therefore be beneficial in the acquisition of early-stage funding. Personal, intrinsic motivation also appears to be an important ability of entrepreneurs in pursuing their objectives (Lam, 2011). This means that an entrepreneur with high motivation has a higher chance of attracting the necessary funding. Lastly, Rasmussen et al. (2011) have mentioned that the ability to develop credibility among investors as well as experience is needed for USO’s to acquire resources.

The following hypotheses can be formulated:

*H1: “A high level of intrinsic motivation has a positive effect on USO funding.”*

*H2: “The ability of the entrepreneur to leverage company image to convince an organization or individual to contribute to the USO’s development has a positive effect on USO funding.”*

*H3: “The ability to create a network in the form of a business partner (launching customer, business alliance or university) has a positive effect on USO funding.”*

### 2.4.2 The role of business model development on USO success

Next to the personal competencies of an entrepreneur, another factor contributing to the funding of USO’s is the composition of the business model. According to De Angelis & Feola (2019), a business model “refers to the way in which companies create, deliver and capture value” (p. 1). Wannakrairoj & Velu (2021) argue that the business model “summarizes the architecture and logic of a business and defines the organization’s value proposition and its approach to value creation and value capture” (p. 2), thereby acting “as the means to translate the benefits of technologies to customer value via markets” (p. 2). It can therefore be concluded that the business model is a central element of a USO. (Public) Institutions that provide funding often evaluate the business model to figure whether to provide financing to a USO (NWO, 2021). The importance of the business model is further highlighted by Markides & Sosa

(2013), who emphasized the essential importance of innovative business models for companies in the early development stages. For a university spin-off to receive funding and achieve long-lasting survival, the business model needs to fulfil certain criteria and must be elaborated to a certain extent to be evaluated by third parties. The following hypothesis can be formulated:

*H4: “An elaborated business model has a positive effect on USO funding.”*

### 2.4.3 The role of market competencies on USO success

Next to personal competencies and the business model, market competencies are an important factor in the survival of USO's. The spin-off company can only compete effectively if it can adapt quickly to market needs and requirements. According to Versaavel (2015), the “relative ability of firms to be more nimble, more able to change quickly, and more alert to changes in their competitive environment” (p. 442) can be seen as a source of competitive advantage. Following Sousa-Ginel et al. (2021), it can be said that USO's typically operate in highly competitive markets, thus requiring them to develop the ability to assess markets and recognize opportunities and the ability to react to changes quickly to become and remain competitive. Research, including the Bayh-Dole Act from 1980, has shown that intellectual property rights (IPR) are an important element in the development of USO's, contributing to their financial success (Czarnitzki et al., 2016). The legal basis for patent exploitation was introduced with the Bayh-Dole Act; however, the academic venture and its entrepreneur require the ability to exploit patents. To measure the impact of the mentioned characteristics on a USO's ability to acquire funding, the following hypotheses can be formulated:

*H5: “The ability of the entrepreneur to assess potential markets has a positive effect on USO funding.”*

*H6: “A high level of market knowledge of the entrepreneur has a positive effect on USO funding.”*

*H7: “The ability to commercially exploit a patent has a positive effect on USO funding.”*

## 3. METHOD

### 3.1 Subjects of Study

This study analyzed 242 anonymized and aggregated university spin-off grant proposals submitted for evaluation in the Valorisation Grant (VG) programme (between 2007 and 2014) managed by the Dutch Research Council (NWO). The NWO is “one of the most important science funding bodies in the Netherlands and realizes quality and innovation in science. Each year, NWO invests almost 1 billion euros in curiosity-driven research, research related to societal challenges and research infrastructure” (NWO, 2021). The mission of the NWO is to advance world-class scientific research that is generating scientific and societal impact by means of excellent, curiosity-

driven disciplinary, interdisciplinary and multidisciplinary research (NWO, 2021). The organization additionally selects and funds “...the personnel and material cost for scientific research and knowledge exchange and impact activities of Dutch universities and public research institutes. NWO invites partners from industry, the government and societal organizations to contribute their knowledge agendas and questions to the programming, realization and co-funding of research” (NWO, 2021). Hence, the Valorisation Grant programme (now, Take-off) was one of the financing instruments targeted at academic entrepreneurs from Dutch research institutions to help further develop knowledge innovations within the high-tech domain into new activity and entrepreneurship. It may concern product, process, care or service innovations in the broadest sense of the word (NWO, 2021).

The VG has two phases: Phase 1 is the feasibility study with maximum funding of 25,000 Euro that must be completed within six months. Projects that complete Phase 1 could submit their applications for Phase 2 - the valorization phase with a maximum subsidy amount of 200,000 Euro (NWO Annual Report, 2014). Phase 2 projects that received the funding must be completed within two years, including an interim evaluation (NWO Annual Report, 2014). This study focuses on USO proposals submitted to Phase 2 of the programme, reflecting active preparation for the valorization phase.

## 3.2. Measurements

### 3.2.1 Dependent variables

The variable “positive funding” was the dependent variable throughout this study. Positive funding is understood as a situation where a company is granted funding to develop its product or service commercially. The variable was assigned a “0” if no funding was granted and the company could not develop itself, and a “1” if the USO managed to obtain funding and develop itself into a commercially successful business.

### 3.2.2 Independent variables

#### 3.2.2.1 Market knowledge

Market knowledge was defined as the ability to assess the potential of new markets. This variable was measured using an ordinal scale, where it was covered to a great extent (2), sufficient (1), neutral (0) or lacking (-1).

#### 3.2.2.2 Market selection

Market selection was defined as the effective selection of the market based on the market plan, the importance of the market, and market size. This variable was measured using an ordinal scale, where it was positively mentioned (1), neutral (0) or negatively mentioned (-1).

#### 3.2.2.3 Commercialization

Commercialization was defined as the ability to exploit a patented invention commercially, or in some cases, technology transfer. It was measured using an ordinal scale, where it was positively mentioned (1), neutral (0) or negatively mentioned (-1).

### 3.2.2.4 Motivation

Motivation was defined as the ability of personal motivation and enthusiasm for the asset. It was measured using an ordinal scale, where it was sufficient (1), neutral (0) or lacking (-1).

### 3.2.2.5 Ability to involve organizations and people (championing)

Championing was defined as the ability to leverage company image to convince an organization or individual to contribute to the USO's development. It was measured using an ordinal scale, where this involvement was either beneficial (1), neutral (0) or lacking (-1).

### 3.2.2.6 Network

Network was defined as the ability to build a network, thereby involving a business partner in the form of either a launching customer, business alliance or university. It was measured using an ordinal scale, where this partner was present (1), neutral (0) or lacking (-1).

### 3.2.2.7 Business model

Business model was defined as the way in which companies create, deliver and capture value. It was measured using an ordinal scale, where the business model was either strong (3), sufficient (2), weak (1) or lacking (0).

### 3.2.3. Control Variables

For the study, control variables were used. A control variable has the property that it is a constant during a study. While these variables do not always contribute to the aim of the study, they have a potential influence on the outcome of the study (Bhandari, 2021). For this study, the type of industry was a control variable. According to their NACE code, the subjects were classified as a system used within the EU to classify industries. The NACE codes were split into two variables (L1 and L2), where L1 ranked the general industry, and L2 added more specificity. Another control variable used was the "H-Index", a system used to assign scores to the academic entrepreneurs involved in the USO's. The scores ranged between 0 and 92, based on the number of publications and citations an entrepreneur has. The last control variable was the parent university. This variable has ten different values, one for each of the parent universities.

## 3.3. Data collection

To conduct a comprehensive analysis and test the proposed hypotheses, this study built on a fully aggregated and anonymized research dataset provided to the author of this study. A content analysis was performed on the aggregated evaluation results regarding the feasibility and valorization potential of selected USO proposals to construct a part of the independent variables. To further enhance the research model, information was retrieved regarding the performance of business incubators and technology transfer offices of the leading Dutch technical universities from their websites and open-source reports. Furthermore, scientometric information was retrieved about the scientific output and its impact (i.e., the number of peer-reviewed publications, citations, citation networks) in the past 20 years by the leading Dutch technical universities. The research fields of

publications and USO grant proposals were matched with the NACE industry codes.

## 3.4. Data analysis

To analyze the data, open, selective and axial coding was used. The first step was open coding, where the data were broken up into discrete parts and "codes" were assigned to each record as a means of labelling the data. The intention was to derive theoretical concepts from the data as it was being coded. The next step was axial coding, where connections between data entries were being created. Data were grouped into categories. In the last step, axial coding, these categories were further generalized. These generalized categories were then compared to the data to find connections. (Babbie, 2015)

The technique that was used for the analysis of the data is binary logistic regression. This form of regression is characterized by the dependent variable being a dummy variable. In binary logistic regression, the dependent variable is a dummy variable, while the independent variables are continuous, categorical or both (Midi et al., 2010). A dummy variable takes either the value 0 or 1, which indicates the presence or absence of some categorical effect.

Three possible values were assigned to the independent variables, being "1" for positive, "-1" for negative and "0" for neutral. An exception was the independent variable "business model", which was assigned the values "3" for strong, "2" for sufficient, "1" for weak or "0" for lacking.

For the use of linear regression models, it was assumed that (a) no important variables are omitted, (b) no extraneous variables are included, (c) the explanatory variables are measured without error, (d) the observations are independent, and (e) errors are binomially distributed (Midi et al., 2010). These general assumptions also applied to this analysis. Afterwards, it was possible to see the dependent variable's relationship with independent variables through the predictors, two classes defined by the indicator variables.

## 4. RESULTS

This research study was based on a pre-existing database consisting of 242 grant proposals from university spin-offs submitted in the second phase of the Valorisation Grant Program of the NWO. After developing the independent variables used in this study, the data were analyzed using open coding content analysis. This process revealed that some variables were underrepresented in the dataset while others were overlapping. The categories and variables were newly formulated and coded according to the specifications in Table A1; see Appendix A. After completion of the coding, a binary logistic regression was performed using the computer programme SPSS. In the following section, the results of this analysis will be discussed, including deciding on the acceptance or rejection of the proposed hypotheses.

The first step of the process was to check whether the assumptions of a binary logistic regression were fulfilled. Our first assumption was that the dependent variable is binary. This assumption was satisfied as our dependent variable "USO funding acquisition" was coded using (1) for funding received

**Table 1.** Range, Means, Standard Deviations and Correlations of the Variables (N=242)

	Minimum	Maximum	Mean	Std. Deviation	1	2	3	4	5	6	7	8	9	10	11
[1] USO Funding Decision	0	1	.41	.493	1										
[2] Market Knowledge	-1.000	2.000	.17	.974	.266**	1									
[3] Market Selection	-1.000	1.000	.10	.827	.087	.407**	1								
[4] Commercialization	-1.000	1.000	-.21	.750	.252**	.157*	.045	1							
[5] Motivation	-1.000	1.000	.31	.624	.274**	.061	-.122	.155*	1						
[6] Business Model	-1.000	3.000	.40	.892	.309**	.231**	.089	.172**	.121	1					
[7] Ability to involve organizations and people	-1.000	1.000	.08	.577	.202**	.181**	.018	.001	.228**	.113	1				
[8] Presence of a network	-1.000	1.000	.15	.616	.149*	.066	.077	-.039	.060	.048	.431**	1			
[9] NACE Code L1	0.000	19.000	8.49	6210	-.086	-.037	-.050	-.047	-.019	.044	-.107	-.077	1		
[10] Parent university	1.000	9.000	3.64	2446	.080	-.049	.035	-.061	-.096	-.083	-.105	.086	.008	1	
[11] H-Index	0.000	92.000	25.08	18977	.009	-.019	.157*	-.019	-.067	-.030	-.090	.069	.170**	-.010	1
N of cases	242														

\*\* correlation is significant at the 0.01 level (2-tailed). \* Correlation is significant at the 0.05 level (2-tailed).

**Table 2.** Logistic Binary Regression Model for Dependent Variable: USO Funding Acquisition

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9	
	B	s.e.	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	-0.448	.33	-.665	.349	-.443	.331	-.418	.341	-.957	.371	-.904	.363	-.707	.350	-.491	.223	-1.478	.429
Market Knowledge			.596	.147													.481	.186
Market Selection					.205	.165											-.059	.213
Commercialization							.751	.187									.633	.212
Motivation									1.011	.241							.877	.276
Business Model											.832	.177					.663	.193
Ability to involve organizations and people													.776	.246			.401	.312
Presence of a network															.435	.223	.270	.285
NACE Code L1	-0.031	.022	-.031	.023	-.029	.022	-.029	.023	-.033	.023	-.042	.024	-.025	.022	-.027	.022	-.039	.026
Parent University	.074	.054	.094	.056	.073	.054	.094	.056	.103	.057	.109	.058	.097	.056	.065	.055	.168	.066
H-Index	.003	.007	.004	.007	.001	.007	.003	.007	.006	.007	.005	.007	.005	.007	.002	.007	.007	.008
-2 Log likelihood	319.750		301.994		318.189		302.612		300.122		293.563		309.175		315.855		254.071	
Nagelkerke R Square	.021		.116		.03		.113		.126		.159		.079		.043		.34	
N=242																		

\* $p < 0,05$ ; \*\* $p < 0,01$ ; Hosmer and Lemeshow is not significant ( $p > 0,05$ )

and (0) for no funding received, thus making it a binary variable. Table 1 (overview of descriptive statistics and correlations) shows that the correlations between the variables are overall low to moderate. This implies that multicollinearity is not an issue in this research. It can also be concluded that the assumption of independence and the assumption of low correlation are fulfilled. Therefore, all assumptions of the binary logistic regression model are fulfilled.

The next criterion to consider was the variance inflation factor (VIF), of which the critical threshold value is normally set at 5. Within this analysis, the values for VIF were lower or equal to 1, which is below the set threshold.

Table 2 displays the results of the binary logistic regression. The first model of the analysis shows the effect of the control variables on the dependent variable. For this study, the control variables used were the NACE industry codes, the parent university of the entrepreneur associated with the corresponding USO, and the H-Index of these entrepreneurs. Models 2-8 analyzed the effect of each independent variable on the dependent variable separately, thereby keeping the control variables in the analysis. Lastly, model 9 examined the effects of all independent variables on the dependent variable, including the control variables in the analysis. To analyze the proposed hypotheses, the results of model 9 were used.

The first hypothesis (H1) proposed that a high level of personal motivation and enthusiasm for the cause positively affects the acquisition of funding. Based on the results in table 2, it can be seen that this independent variable has a significant positive effect on the ability of the USO to acquire funding ( $B = 0.877$ ,  $p < 0.01$ ). Therefore, H1 can be confirmed. The second hypothesis (H2) proposed that the ability of the entrepreneur to leverage company image to convince an organization or individual to contribute to the USO's development has a positive effect on USO funding. Based on the results in table 2, it can be seen that this independent variable ( $B = 0.401$ ,  $p < 0.01$ ). Therefore, H2 can be confirmed. The third hypothesis (H3) proposed that the ability to create a network including a business partner (launching customer, business alliance or university) has a positive effect on USO funding. Based on the results in table 2, it can be seen that this independent variable has a moderately positive effect on the ability of the USO to acquire funding ( $B = 0.270$ ,  $p < 0.01$ ). Therefore, H3 can be confirmed. The fourth hypothesis (H4) proposed that a highly elaborated business model positively affects USO funding. Based on the results in table 2, it can be seen that this independent variable has a significant positive effect on the ability of the USO to acquire funding ( $B = 0.663$ ,  $p < 0.01$ ). Therefore, H4 can be confirmed. The fifth hypothesis (H5) proposed that the ability of the entrepreneur to assess potential markets has a positive effect on USO funding. Based on the results in table 2, it can be seen that this independent variable has a negative effect on the ability of the USO to acquire funding ( $B = -0.059$ ,  $p < 0.01$ ). Therefore, H5 can be rejected. The sixth hypothesis (H6) proposed that a high level of market knowledge of the entrepreneur positively affects USO funding. Based on the results in table 2, it can be seen that this independent variable has a significant positive effect on the ability of the USO to acquire funding ( $B = 0.481$ ,  $p < 0.01$ ). Therefore, H6 can be confirmed. The seventh and last hypothesis

(H7) proposed that the ability to exploit a patent commercially has a positive effect on USO funding. Based on the results in table 2, it can be seen that this independent variable has a significant positive effect on the funding acquisition of USOs ( $B = 0.633$ ,  $p < 0.01$ ). Therefore, H7 can be confirmed.

## 5. DISCUSSION

The need for a clear understanding of university spin-offs and their importance for the academic environment and society has increased over the last few years. It has become evident that USO's can transfer economic knowledge and bring economic prosperity to their environment (Rasmussen & Wright, 2015; Vohora et al., 2004).

However, the development of university spin-offs is still only happening on a limited scale (Hunady et al., 2018). Many studies have created insights into characteristics that influence the success of USO's. Yet, so far, there are no clear and universally applicable guidelines on factors that directly impact the ability of academic ventures to obtain funding from public institutions like the NWO in the early stages of their development. The acquisition of financing from a public body can give a spin-off company more credibility, enabling it to grow into a commercially successful business.

This study aimed to discover the criteria and characteristics USO's need to become commercially successful, which is viewed as acquiring positive funding from the NWO. For this purpose, a dataset consisting of 242 anonymized university spin-off grant proposals from the years 2007-2014 was analyzed.

The results of this study show that the personal motivation of the entrepreneur has a strong positive influence on the ability to acquire funding. Founders of USO's need a strong inner ability to motivate themselves. This matches the findings of Lam (2011), who states that "intrinsic" motivation is a key driver of entrepreneurs. Vega-Gómez et al. (2020) support this finding, stating that personal characteristics are of high influence on business success.

Next to this, research has shown that a highly elaborated business model has a strong positive influence on the ability to acquire funding. University spin-offs with well-developed and concrete business models are more likely to receive funding, thus making the business model a crucial element for (commercial) success. This finding is supported by Markides & Sosa (2013), who emphasized the essential importance of innovative business models for companies in the early development stages.

The findings of the study also suggest that the ability to create a network has a positive influence on USO success. This is supported by Huynh et al. (2017), who state that network creation in early stages of development can have positive effects in later stages.

Unlike the findings presented by Sousa-Ginel et al. (2021), the study has not found a significant effect of the entrepreneur's ability to assess markets. This can be explained by the fact that USO's often already have chosen their markets.

Entrepreneurs now know that their personal motivation, as well as a highly elaborated business model, have



a significant influence on the likelihood of their company receiving funding.

Furthermore, the study results indicate that the ability of the entrepreneur to exploit an idea or patent commercially has a strong influence on the likelihood of acquiring funding. Lastly, results suggest that a high level of market knowledge, as well as the ability to involve organizations and other people in the venture and the ability to build a network in the form of, e.g., business alliances or university contact have a positive impact on the chances of acquiring funding. However, this impact is of less significance. The ability to assess market potential and select markets seems to have little to no influence on the chances of acquiring funding.

To conclude, entrepreneurs can use the findings derived from this work to determine the qualities and abilities they need to increase their likelihood of success. They can actively evaluate themselves and their business partners based on the findings of this study, thus enabling them to improve their performance.

### 5.1 Theoretical implications

The paper contributes to the literature on academic entrepreneurship by creating new insights into the factors that contribute to USO success. The most important implication for entrepreneurs is that personal motivation, as well as a highly elaborated business model, are important factors that influence the likelihood of acquiring public funding.

Lam (2011) supported the findings about motivation, stating that intrinsic motivation is an important element of entrepreneurship. Specific information from the dataset shows that the evaluations place special emphasis on motivation, indicating that this is an important factor in USO success.

The results about the business model are supported by the findings of Wannakraioj & Velu (2021), who state that business models compile the logic of a company and are crucial in determining a company's "approach to value creation". Specific findings from the dataset indicate that "flexibility" and "accessibility" were key features of the business model, connecting these to positive characteristics of academic ventures.

Both characteristics of USO's are vital for success, as they can support the USO in passing through the early stages of the framework as presented by Vohora et al. (2004).

### 5.2 Managerial and Policy Implications

This study contributes to existing research about university spin-off companies by providing guidance to entrepreneurs, universities and policymakers. The results of the research project present an approachable overview of the factors that contribute to the acquisition of public funding by university spin-offs. The distinctive characteristic of this study lies in the fact that it is directly based on a set of valorization grant proposals directly provided by the NWO. The nature of the data enabled this study to offer special insights into the topic.

The research findings can aid the NWO in making funding decisions, offering a perspective on the characteristics that are of the highest importance in the evaluation process of academic ventures. This can lead to more accurate funding

decisions, which in practice, results in more efficient use of taxpayer money.

Founders of academic ventures now have a better understanding of the characteristics they have to focus on, both in their personal skills and in their venture. Referring back to Vohora et al. (2004), this knowledge can be applied especially in the third phase, the "pre-organization phase", where it is of vital importance that businesses have a proper plan. The characteristics revealed by the study give entrepreneurs an idea of the ways with which they can increase the chances of acquiring funding, which is a crucial element in company survival (Hunady, Orviska & Pisar, 2019) and is required to arrive at the fourth stage as mentioned by Vohora et al. (2004), where the business starts to generate returns and is on its way to becoming financially sustainable.

### 5.3 Limitations and future research avenues

Within the process of this study, limitations became apparent at different stages. First of all, due to the nature of the data, there were limitations in the methods chosen for analysis. The data consisted of evaluations of proposals submitted to the NWO. The structure of these evaluations limited the available options for processing and analyzing the data. The scope of the study was limited to the early stages of development. It does not account for later stages in USO development. Furthermore, the purpose of the study was limited to the attraction of limited public funding. Other sources of financing, e.g., venture capital, were not considered in this study.

Future research can build on this study by including the presented findings in research that analyzes the factors important for later-stage development of academic ventures. Next to this, future research can also implement other sources of funding, thus presenting a more applicable set of guidelines to spin-off companies that are not limited to the acquisition of public funding.

Lastly, future research can apply a configurational approach, combining different sets of USO success factors and thus determining their impact on USO development.

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## 7. APPENDIX

### Appendix A

**Table A1**

*Independent Variables Used in the Analysis*

Construct	Item Label	Item	Item Definition	Scale Definition
Market competencies	MARKET_KNOWLEDGE	Market Knowledge	The ability to assess the potential of new markets	Ordinal scale, where it is covered to a great extent (2), sufficient (1), neutral (0) or lacking (-1)
	MARKET_SELECTION	Market Selection	The effective selection on the market, based on the market plan, importance of the market, market size.	Ordinal scale, where it is positively mentioned (1), neutral (0) or negatively mentioned (-1)
	COMMERCIALIZATION	Commercialization	The ability to commercially exploit a patented invention, or in some cases technology transfer	Ordinal scale, where it is positively mentioned (1), neutral (0) or negatively mentioned (-1)
Personal competencies	MOTIVATION	Motivation	The ability of personal motivation and enthusiasm for the asset	Ordinal scale, where it is sufficient (1), neutral (0) or lacking (-1)
	ABILITY_INVOLVE	Ability to involve organizations and people (championing)	The ability to leverage company image to convince an organization or individuals to contribute to the USO's development	Ordinal scale, where this involvement is either, beneficial (1), neutral (0) or lacking (-1).
	NETWORK	Network	The ability to create a network involving a business partner: launching customer, business alliance or university	Ordinal scale, where this partner is present (1), neutral (0) or lacking (-1).
Business model	BUSINESS_MODEL	Business model	The way in which companies create, deliver and capture value	Ordinal scale, where the business model is either strong (3), sufficient (2), weak (1) or lacking (0)