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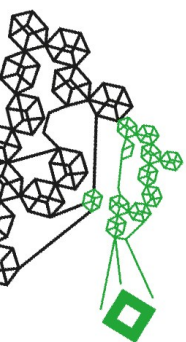
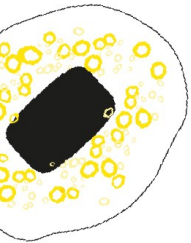
Faculty of Behavioural, Management & Social Sciences (BMS)

Master Thesis

Master of Science Business Administration

Investigating the relationship between the multidimensional composition of founding teams in USO and their funding ability

A study on university spin-off founder composition on start-up funding ability in the Netherlands



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ABSTRACT

The commercialization of research and the transfer of knowledge from academic settings to businesses significantly contributes to driving innovation and economic growth. The purpose of this research is to investigate the impact of founding team characteristics on the funding ability of university spin-offs (USOs). Drawing upon a sample of 200 USOs from Dutch research universities, the analysis aimed to identify the influence of founders' educational backgrounds, research impact, entrepreneurial experience, industry experience, cultural diversity on the USO's funding ability. A binary logistic regression analysis was performed to test the relationships between the independent variables and the dependent variable, funding ability. The results indicate that none of the tested hypotheses related to the founding team composition showed significant outcomes. However, the hypothesis testing the importance of the technology through patent ownership showed a significant outcome. The findings suggest that innovative technology is a more important predictor of funding ability than the founding team composition at USOs.

Keywords

University spin-off, USO, Academic entrepreneurship, Founder characteristics, External funding, PhD founders, Funding ability, Patents, Technology

1. INTRODUCTION

1.1 Problem statement

The commercialization of research and the transfer of knowledge from academia to industry plays an important role in driving innovation and economic growth of a country (Fini et al., 2018). Research and knowledge are often commercialised through a spin-off company of the university (hereinafter referred to as USO) (Breschi et al., 2003). Prinay et al. (2005) defined USOs as “*new firms created to exploit commercially some knowledge, technology or research results developed within a university*”. USOs are often founded by university staff, students, and/or researchers of the university. USOs distinguish themselves from traditional start-up companies through (often) being founded by academics and basing their activities around university knowledge and research. Examples of successful USOs from the University of Twente are NX Filtration, which went public in 2021 (NX Filtration, 2021) and Demcon, which now employs over a thousand workers (Demcon, 2023).

Even though there are successful cases, the failure rate among USOs remains high (Wennberg et al., 2011). Since their potential economic value and positive impact on society, it is therefore important that USOs are well understood. Academia has increasingly given attention to USOs, which is shown by the increase in academic papers on this subject (Miranda et al., 2017). Researchers have also studied, among others, success factors (Clarysse et al., 2005) of such ventures or the impact of government support and access to funding (Wright et al., 2005). While the authors found that external funding is a significant contributor to the success of USOs, the ability of a USO to raise funding is still less understood.

External financiers, such as venture capitalists and (business) angels, determine whether a venture is worth investing in based on multiple criteria, such as the founding team, the technology, or market related factors (Franke et al., 2008). There are various variables that could attribute to the fundability of a venture. The founding team plays an important role in this (Franke et al., 2008), and as such the founding team of USOs should be better understood to gain a better understanding of their ability to raise funding from external financiers.

Unlike traditional start-ups, USOs are often founded by members of a university, such as staff, students, or researchers (Breschi et al., 2003). The composition of the founding team and their characteristics is therefore also assumed to be different than traditional start-up companies. Whereas some characteristics might be considered favourable, other characteristics might be perceived unfavourable. Such characteristics could relate to demographic characteristics, such as founding team size or locality of the founding team. Other characteristics could be more related to the founding

teams' expertise, such as their education, past entrepreneurial experience, or their research impact. For example, founders with advanced degrees, such as doctorate degrees or PhDs, may bring valuable technical expertise and knowledge to the venture. Additionally, founders who are actively engaged in research may have access to resources and ideas that can be leveraged them to develop innovative products or services more effectively. However, it is not well understood whether these founder composition characteristics are associated with increased USO funding, and subsequently, increased USO success

Therefore, the purpose of this study is to investigate the influence of founder composition on funding ability, through answering the following research question: “*How does founding team composition affect a USOs ability to raise external funding?*”. This research will contribute to a better understanding of characteristics that impact the success of USOs and may inform strategies for supporting and promoting the development of these ventures.

1.2 Academic and practical relevance

This study is relevant for both academic and practice as it provides insights into the factors that influence the success of USOs. More specifically, the influence of the founding team composition on the ability to raise funding, which in turn affects their success probability. In academia, this study contributes to the existing literature on USOs and helps to identify areas for future research and development. In practice, the findings of this study can be used by policy makers, university administrators, founders, and other stakeholders gain insight in the creation of value and growth within USOs.

For academia, the understanding of funding ability of USOs is important for a variety of reasons. First of all, funding significantly increases the survival and success rate of USOs as shown by Wright et al. (2005). USOs play an important role in the commercialization of research and technology, otherwise known as knowledge valorisation, which can drive economic growth and innovation. By studying the influences that positively contribute to the funding of USOs, based on the outcome of this study, research may propose new approaches or improve existing methods for analysing and measuring the impact of founding team composition on external funding ability.

Second, the research will contribute to the development and/or refinement of existing theories in the fields of USO research.

Third, the outcome of this research might offer a basis for comparing and benchmarking USOs in different regions, countries, or industries, helping to identify best practices and areas for improvement.

In practice, the findings of this study can also be used to gain insight in the formation and growth of USOs and to support the transfer of knowledge and

research from academia to industry. The outcome of this study can aid policy makers and university administrators develop strategies and policies that support the creation and development of these ventures. Similarly, the insights gained from this study can aid external investors (e.g., incubators, accelerators, (business) angels, venture capitalist, etc.) in refining their investment strategy as well as providing better support to their portfolio companies, by for example strengthening or replacing the management team. Overall, the results of this study can help to support the development of a thriving ecosystem of USOs in the Netherlands and beyond, enabling further economic growth and welfare.

1.3 Structure of this paper

The remainder of this research paper is organized as follows. In section 2, a theoretical framework will be established through a review of existing literature on USOs founding team composition and funding. In section 3, the research design for the study will be defined, including the data collection and sample selection, measurements, and the data analysis method. The results will be presented in section 4. This section is followed by section 5 in which the results are discussed and a conclusion. Section 5 also includes a discussion on the limitations as well as areas for future research.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1 Defining university spin-offs

The literature on university spin-offs or USOs has increasingly received attention in academia (Miranda et al., 2017). Though the body of literature has exponentially grown, the study in this field remains fragmented (Rothaermel et al. 2007). In their review of the literature, Djokovic & Souitaris (2006) highlight the ambiguity in defining these ventures. However, the core elements transferred to a USO are the technology and/or people (Djokovic & Souitaris, 2006). One definition that only considers the core element people, is the definition of Smilor et al. (1990), which is as follows: *“a new company that is formed (1) by individuals who were former employees of a parent organisation and (2) is based on a core technology that is transferred from the parent organization”*. Mathisen & Rasmussen (2019) defined USOs as ventures initiated by researchers, students, or faculty members affiliated with a university, emerging from technology or intellectual property developed within a research institution. This definition is closer to the definition for USO as proposed by Pirnay et al. (2003): *“New firms created to exploit commercially some knowledge, technology or research results developed within a university*

This definition is broader than the defined by Smilor et al. (1990) and does not only consider former employees or technology as part of the definition for USOs, but also considers the transfer of knowledge and research. Moreover, this definition does not restrict USOs to only former employees of the university but attributes the university from which the knowledge, technology, or research emerged as the core element of a USO.

This study loans some elements from Pirnay et al. (2003) for defining USOs, but adds stricter boundaries to the founders. The definition used in this study is as follows: An USO is a “new company that is founded by a student and/or staff to exploit commercially some idea, knowledge, technology, or research developed within the respective university”. This definition aims to restrict founders of USOs to be related to the respective university. In some instances, commercial parties might, through some arrangement, obtain technology and/or research developed within a university for exploitation without any further relation to the university. In such case, under the definition coined by Pirnay et al. (2003), this new company would as a USO. However, the objective of this study is to study the student and/or staff founders of USOs and therefore requires a stricter definition. Finally, some USOs might have emerged just from ideation at the respective university, and while no technology or research precedes to forming the USO, such organizations can also be counted towards USOs as these USOs have a clear affiliation with the parent university.

2.2 Importance of USOs

USOs play an essential role in translating academic research into marketable products and services and have gained increasing importance in promoting economic growth, generating employment, and stimulating innovation (Wright et al., 2008).

Universities support USOs and their formation through various measures. Numerous universities have established technology transfer offices (TTOs) to facilitate the valorisation process by managing patenting issues and offering guidance on funding opportunities (Rothaermel, Agung, & Jiang, 2007). Additionally, some institutions have created incubators or accelerators (Grimaldi & Grandi, 2005) to provide USOs with enhanced access to knowledge resources and broader networks. Despite their potential, USOs encounter several challenges, such as limited resources, fierce competition, and difficulties in securing experienced management teams (Lockett & Wright, 2005). Consequently, a considerable number of USOs struggle to survive beyond their initial years (Wennberg, et al., 2011).

Bigliardi et al. (2013) identified over 40 factors contributing to the performance of USOs, thereby underscoring the complexity of examining

USOs. One factor frequently mentioned as having a substantial impact on USO performance and their ability to secure funding is the founding team, which has garnered significant attention in the literature (Tagliazucchi et al., 2021; Hayter et al., 2016; Visintin & Pittino, 2014; Knockaert et al., 2010).

2.2 Importance of securing funding

Various types of funding sources are available to USOs, which are crucial for their growth and development. One of the primary sources of funding for USOs is government grants and subsidies. These funds are often allocated to support research, development, and innovation activities in science and technology-based ventures (D'Este, Guy, & Iammarino, 2013). Government funding programs, such as the InnovatieKrediet (Innovation Credit) in the Netherlands, play a significant role in fostering the early-stage development of high-tech firms, including USOs (Zhou et al., 2022). For example, the InnovatieKrediet is an initiative by the Dutch government to enable founders to develop technology with high risk but attractive market potential through providing capital as a form of subsidy (Rijksdienst voor Ondernemend Nederland, 2023). While there are requirements to such forms of subsidies, government funding programs often do not have a profit motive.

Another critical source of early-stage funding for USOs is venture capital. Venture capital firms invest in high-potential early-stage companies with promising (sometimes ground-breaking) technologies and substantial growth prospects in exchange for an (equity) stake in the company. These firms often do not commit only capital to these high-risk ventures, but also provide strategic guidance, mentoring, and access to networks that can help USOs grow and develop (Colombo & Grilli 2010). Bertoni et al. (2011) found further evidence that venture capital positively influences firm growth and Hall & Lerner (2010) point out that venture backed firms are also more effective at patenting than even traditional corporations, subsequently leading to more innovation. Bertoni et al. (2011) also provide further evidence that venture capital investments also lead to economic growth due to job creation at the venture backed firms. Like venture capital firms, high net worth individuals or (business) angels investing their personal funds, may also provide financial support to USOs – though contributing smaller amounts (Harrison, Mason, & Smith, 2015).

In addition to these traditional funding sources, USOs can also benefit from alternative financing options, such as crowdfunding. Crowdfunding platforms enable start-ups to raise funds from a large number of individuals who contribute small amounts of money in exchange for rewards, equity, or debt securities (Kuma & Yosuff, 2022). This financing method can be particularly useful for USOs in the early stages of development when they lack a track record or have not yet

generated significant revenue (Belleflamme et al., 2014). While crowdfunding is often deemed to either be donation or reward based, debt and equity crowdfunding also remain viable options for USOs. However, this type of financing remains a small portion of the total funding available (Block et al., 2017).

Furthermore, USOs can also form strategic partnerships and alliances with established firms or industry partners. Through these collaborations, USOs can gain access to the necessary resources, expertise, and markets to help commercialize their technology and grow their business (Prigge, 2005).

While USOs have several alternatives for sourcing funds, one more traditional source of funding remains challenges to obtain. Given the high risk involved, banks are often reluctant to provide loans to start-ups like USO (Block et al., 2017) and USOs therefore often rely on equity financing.

As the literature shows, the importance of attracting external funding from financiers such as VC and angels is twofold. On one hand, the financial support allows USOs to grow by investing in personnel, development, etc. whereas on the other hand, the financier may also bring wealth of expertise and access to networks that greatly enhance the success for USOs in the competitive market landscape.

2.3 Funding criteria

To come to the decision to invest, venture capital firms and (business) angels use various criteria in their assessment of (start-up) companies (Franke et al., 2008). A multitude of funding decision factors have been identified (Gompers et al., 2019), which are outlined in the following section.

2.3.1 Importance of the founding team

Hayter et al. (2016) highlights the importance of the founding team in shaping the growth trajectories and performance of USOs and suggest that that understanding the role and composition of the founding team is crucial for designing effective policies and support mechanisms aimed at fostering USO creation and success. Vanaelst et al. (2006) found that founding teams in the early stages of USOs appear unbalanced in terms of experience and their experience is often highly concentrated on research and development. Especially those that are still deciding how to commercialize their knowledges, show lack of entrepreneurial experience. However, Vanaelst et al. (2006) also found that as USOs developed, their team becomes less heterogenous. Hayter et al. (2016) found evidence that initial founding team might not be the optimal one and provides further importance for gaining a better understanding of founding team composition.

As the existing literature has shown, the founding team composition plays a crucial role in the ability of USOs to secure external funding. Various

studies have emphasized the importance of a diverse and well-rounded founding team in attracting investment from different sources, such as government grants and subsidies, venture capital, and (business) angel investors (Colombo & Piva, 2012; Hayter et al., 2018).

The diversity of the founding team in terms of expertise, experience, and networks is crucial for attracting external funding. Teams with complementary skills and backgrounds are more likely to develop a comprehensive understanding of the market and its challenges, thereby increasing their chances of raising capital (Engel & Keilbach, 2007).

2.3.2 Other important factors

Besides the founding team as one of the important criteria, several other assessment criteria have been identified (Gompers et al., 2019). Among these are criteria related to the (start-up) company, i.e., company-specific criteria and market-specific criteria. Among company-specific criteria, evaluation criteria include strategy, business model, product, technology. Market-specific criteria on the other hand include, amongst others, competition and market dynamics. Though at the earlier stage of USOs, sometimes the business may not have yet matured to the point that a clear business model is developed or that a product-market fit has been found so that only the technology, with patents at its core, is serving as the foundation for the company that is yet to develop.

2.6 Theoretical framework

In the previous sections, the literature review provided a comprehensive overview of the key concepts and research findings related to USOs, the founding team composition, and the impact of external funding on USOs. Based on the insights gathered from the literature, it is evident that both the founding team composition and the type of funding sources play important roles in the growth and performance of USOs.

The proposed theoretical framework serves as a basis for developing research hypotheses and guiding the empirical analysis in this study. By testing the relationships posited in the framework, the findings of this research will contribute to a deeper understanding of the factors that influence the funding ability and performance of USO.

2.5.1 Educational background

Engel and Keilbach (2007) discovered empirical evidence indicating that founding teams comprised of individuals holding doctoral degrees (i.e., PhD degrees) exhibit a stronger positive correlation with securing venture capital funding within one year of USO establishment. Similarly, Shane and Stuart (2002) identified the quality of human capital within the founding team as a crucial determinant of success for USOs. Specifically, they determined that ventures founded by teams possessing advanced levels of

education and experience exhibited higher survival rates, suggesting that the expertise and experience of the founding team are key factors influencing a venture's success.

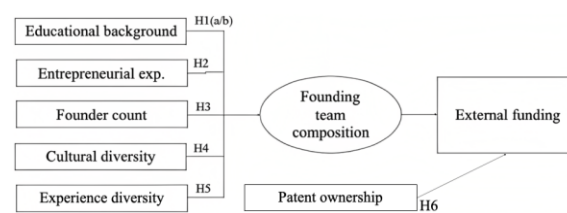


Fig. 1 Conceptual Model.

Founders with PhD degree are more academically senior than those with bachelor's or masters' degrees and therefore are more likely to possess more knowledge in certain domains. Moreover, their network gives them access to other scientists as well as enables them to spot emerging (technological) trends. This increases their potential to develop more advanced technology and build leading products.

While scholars such as Colombo and Piva (2012) have investigated the distinctions between academic entrepreneurs (i.e., entrepreneurs possessing academic backgrounds, including PhDs, who have founded USOs) and non-academic entrepreneurs, the academic community has devoted less attention to examining the impact of PhD founders on their ability to raise funding. Though Eesly et al. (2013) used doctorate degree as a control variable in their study on start-up performance. Furthermore, the influence of founding teams comprising high-impact academics on their capacity to raise funding remains an underexplored area of research. The impact of academics can be quantified by the *h*-index as proposed by Hirsch (2005). The *h*-index In light of these gaps in the research, this study aims to investigate the following hypotheses:

Hypothesis H1a: "Founding teams composed of only PhD degree holders have a positive effect on USO funding."

Hypothesis H1b: "Founding teams with high impact academics have a positive effect on USO funding."

By examining these hypotheses, this research seeks to contribute to the understanding of the role played by the academic background and impact of founding team members in shaping the funding outcomes for USOs.

2.5.2 Entrepreneurial experience

Rasmussen et al. (2014) found evidence that entrepreneurial support from universities positively affects USO development as opposed to USOs that do not have access to such facilities. Prior entrepreneurial experience can, amongst other factors, be detrimental to a USOs success, especially at the pre-organization phase when critical decisions

have to be made (Vohora et al., 2004). Frank et al. (2008) found a consensus in their study that past entrepreneurial experience is an important element in the selection criteria of venture capitalists as it adds to the credibility of the founder. Past entrepreneurial experience among founders is valuable because with the skills, knowledge, and insights gained, the experienced founder can navigate the various challenges to grow and develop USOs more effectively, making less mistakes. Moreover, experienced founders, even if their former venture failed, are found to be more resilient and adaptive to obstacles on their path developing the venture (Korber & McNaughton, 2017).

Though entrepreneurial experience is not yet widely studied in the context of USOs, implying an existing gap in the literature between funding of USOs in particular and entrepreneurial experience. Therefore, the following hypotheses can be formulated:

Hypothesis H2: *“Founding teams with past entrepreneurial experience have a positive effect on USO funding.”*

By investigating this hypothesis, the current research aims to not only contribute to but also expand upon the existing literature that explores the significance of entrepreneurial experience in the context of USO founding teams, thereby providing a more comprehensive understanding of this phenomenon.

2.5.3 Founding team size

USOs are more frequently founded by teams rather than single entrepreneurs. Founding teams that are larger have been shown to show better performance than smaller founding teams in start-ups (Eesley et al., 2013). One such reason is that a larger founding team can have a broader body of knowledge (Eesley et al., 2013) as each of the individual founders bring their own skill set and knowledge to the USO. Moreover, the USO likely also benefits from a wider network that these founders have access to. Having a large number of founders can also benefit the USOs growth and development by enabling professionalization through specialized roles and responsibilities for each founder as well as facilitating the establishment of formal structures and procedures. As such, having a larger founding team might be indicative of a higher degree of professionalisation in early-stage development signalling higher credibility to potential investor and ultimately positively affecting the USOs funding ability. The hypotheses can therefore be formulated as follows:

Hypothesis H3: *“Having multiple founders has a positive the effect on USO funding.”*

2.5.4 Professional diversity

Foreign, or non-local, founders might bring a wealth of diverse perspectives, experiences, potentially leading to enhanced creativity and problem-solving abilities through their different cultural backgrounds (Pieterse et al., 2013). Cultural diversity of the founding team can therefore be a positive attribute to firm performance. Furthermore, non-local founders may have access to international resources (like networks) and markets that could benefit the USO and its funding prospects (Kerr & Kerr, 2011). Though it is less understood whether investors value this criterion in a founding team. However, Hart (2011) found that founder nationality has little impact on start-up performance. This finding may suggest that factors other than cultural diversity within founding teams could play a more significant role in determining the success and funding potential of USOs.

Therefore, it is essential to explore other aspects of diversity within founding teams, such as their educational backgrounds and professional experiences. For instance, industry founders (i.e., founders not affiliated with the parent university, but with industry experience) or founders with past entrepreneurial experience can play an important role in the founding team of USOs, as they bring valuable practical expertise and industry knowledge to the venture (Visintin & Pittino, 2014). Under the umbrella of diversity, the following hypotheses can be formulated:

Hypothesis H4: *“Cultural diversity within the founding team has a positive effect on USO funding”*

Hypothesis H5: *“Experience diversity has a positive effect on USO funding.”*

2.5.3 Technology

In the case of USOs, the transfer of university knowledge and technology is central and could be of relative more importance to the funding decision than any other factor. Munari & Toschi (2014) found that start-ups in the nanotechnology sector with core technology patents were more likely to be funded by investors than those who were not in possession of such core technology patents. Provided that at the core of USOs underlies this commercialization of university knowledge and research, patents ownership may be even more important than the founders, even if they may have filed the patent. It is not uncommon that founder-CEOs may be replaced. Ewens & Marx (2017) found that one fifth of founder CEOs was replaced. Not only did the authors find that founders were replaced from their executive roles, but replacement of founders by external management showed improved start-up performance. In a USO, where technology is key, the role of the founding team might be less significant. The importance of technology may be more important in such ventures and can provide another angle on funding decision.

On the other hand, founding teams possessing patents may also signal their technological expertise and credibility to investors and, by doing so, overcome the liability of newness and positively impact their funding ability. The following hypothesis can be formulated:

Hypothesis H6: “*Technological innovation has a positive effect on USO funding.*”

In conclusion, this section presented a comprehensive overview of the factors that may influence the funding prospects of USOs. By exploring these factors and formulating hypotheses, this study seeks to contribute to the existing body of knowledge in the field. The subsequent empirical analysis will test the aforementioned hypotheses, assessing the relationships between founding team characteristics and the ability of USOs to raise funding. Ultimately, this research aims to offer valuable insights for both academics and practitioners, providing a deeper understanding of the critical elements that can drive the success of USOs in obtaining financial support.

3. RESEARCH DESIGN

In the following section, the subject of this study, the measurement, the data collection method and the methods of analysis are explained in greater detail.

3.1 Subject of the study

This unit of analysis of this study is the founding teams of USOs in the Netherlands founded between 2000 and 2022. The year 2000 has been taken as the cut-off point, as the older the USO, the increasingly difficult it became to find information on said USOs. Moreover, the USOs, which are the object of analysis of this study, included in the study are anonymized and their spin-off status is recognized by their respective parent university or university associated incubator, accelerator, or TTO. The USOs part of this study are linked to either one of the following major universities in the Netherlands:

- Delft University of Technology (TUD, 49 USOs);
- Eindhoven University of Technology (TU/e, 27 USOs);
- University of Twente (UT, 26 USOs);
- University of Amsterdam (UvA, 22 USOs);
- Wageningen University & Research (WUR, 16 USOs);
- Radboud University Nijmegen (RU, 12 USOs);
- Erasmus University Rotterdam (EUR, 11 USOs);
- University of Utrecht (UU, 11 USOs).
- University of Groningen (RUG, 9 USOs);
- VU University Amsterdam (VU, 7 USOs);
- University of Maastricht (UM, 5 USOs);

- Leiden University (LU, 4 USOs);
- Tilburg University (TU, 0 USOs);

For one major university, Tilburg University, no USOs were identified (nor provided by the respective TTO) and therefore no USOs for this university is included in the dataset. Section 3.3 describes the collection method in greater detail. Moreover, the USOs in the sample are from 44 distinct industries (according to the respective LinkedIn company pages). The number of industries was reduced to reduce complexity and the list of industries was reviewed and commonalities were identified that allowed for the creation of broader categories that encompass multiple related industries. Through this process, the number of categories was consolidated to only 9, as follows:

- Energy & Utilities (9 USOs)
- Food & Agriculture (8 USOs)
- Healthcare, Biotechnology & Pharmaceutical (71 USOs)
- High Tech & Nanotechnology (24 USOs)
- Information Technology (29 USOs)
- Manufacturing & Construction (30 USOs)
- Research & Education (7 USOs)
- Services (15 USOs)
- Other (4 USOs)

Section 3.3 describes the collection method in greater detail.

3.2 Measurement

In the theoretical framework key variables were identified. In the following section each variable studied in this paper is described in further detail.

3.2.1 Dependent variables

3.2.1.1 External funding

This variable denotes the acquisition of external funding by a USO, designated as either having obtained funding (1) or not (0). The specific funding category is also identified and classified based on the most first funding round type. These categories include 'Grant' (pertaining to both public and private grants), 'Pre-Seed,' 'Seed,' 'Series A,' 'Series B,' and so forth, as well as 'Venture' (for private rounds that are not explicitly specified). In instances where an initial public offering (IPO) occurred, the funding type is labelled accordingly. These categories facilitate a more comprehensive analysis. Additionally, any follow-on rounds (i.e., funding rounds subsequent to the initial round) is also recorded but was not found relevant for the study.

3.2.2 Independent variables

The dependent variables outlined in the previous section may be affected by a range of independent variables. The impact of these independent variables

on the dependent variables can be positive, negative, or potentially show no correlation at all. Drawing upon the hypotheses outlined in Section 2, the study seeks to examine the influence of specific independent variables on the aforementioned dependent variable. This section provides a comprehensive description of these independent variables under consideration.

3.2.2.1 All PhD (or advanced degree) founders

The variable “All PhD (or advanced degree founders)” variable refers to the count of founding team members who hold a PhD degree, indicating their advanced academic background and expertise. It is measured as a discrete numerical value, representing the total number of PhD holders in the founding team. Additionally, for each PhD founder, their name (string value), *h*-index (numerical value), number of publications (numerical value), number of citations (numerical value), and number of citing sources (numerical value) is captured.

3.2.2.2 Academic impact

The “Academic impact” variable measures the academic impact within the founding team and is measured through the highest performing academic in the founding team, meaning the academic with the highest *h*-index score. The maximum number of publications is taken as measurement under the assumption that the most active/impactful academic is the largest predictor of funding among the academics in the founding team.

3.2.2.3 Multiple founders

The “multiple founders” variable refers to the whether the original founding team of a USO consists of a solo founder or multiple founders. This variable is measured as a binary value, representing solo founders (0) or founding teams with at least one founder (1).

3.2.2.4 Entrepreneurial experience

Entrepreneurial experience denotes whether the founding team includes at least one member with prior entrepreneurial experience (1) or not (0). It is measured as a binary variable, capturing the presence or absence of entrepreneurial experience within the founding team. Founders that have founded ventures previously are those who are considered to have entrepreneurial experience.

3.2.2.5 Industry experience

Industry experience refers to whether the original founding team of a USO consists of founders not affiliated to the parent university, but those with industry experience through roles in company within the relevant industry. This variable measures the number of founders with industry experience based on past work experience.

3.2.2.6 Cultural diversity

Cultural diversity refers to whether the original founding team of a USO consists of only local founders (i.e., those that are Dutch or have been in the Netherlands for a substantial time to be considered local). This variable is measured as a binary value, representing only local (0) or founding teams with at least non-local person (1).

3.2.2.7 Experience diversity

This variable refers to the diversity in experience of the founding team. Founding teams may be composed of PhDs, industry veterans, or experienced entrepreneurs. Each of these founder type brings a different set of skills and expertise to the USO. The experience diversity variable measures the degree to which the founding team is diverse in experience with a value ranging from 0 to 4, with 0 being the lowest. A value of (0) represents no PhD, industry veteran, or entrepreneur. A value of (1) represents one of these types present in the founding team. A value of (2) represent two of the four types of founders present in the founding team, whereas a value of (3) represents all three types being present in the founding team, i.e., PhD, industry veteran, and entrepreneur.

3.2.2.8 Patent ownership

This variable denotes whether the company is in possession of patents (1) or not (0). It is measured as a binary variable, capturing the presence or absence of patents within the company. The presence of patents within an USO serves as an indicator of distinctive technology or innovation.

3.2.3 Control variables

3.2.3.1 Company age at first funding

This control variable denotes the age of the USO at the time of its first external funding acquisition. It is measured as a continuous numerical value, representing the number of years since the company’s inception until the first funding round. By controlling for company age at first funding, the analysis aims to account for potential variations in funding patterns that may be related to the timing of initial external investments.

3.2.3.2 Number of publications

This variable denotes the number of publications of the PhD founder with the most publications. This variable is measured as a continuous numerical value. The maximum number of publications is taken as measurement under the assumption that the most active/impactful academic is the largest predictor of funding among the academics in the founding team.

3.3 Data collection

This study builds on an extensive dataset to conduct comprehensive analysis and test the established

hypotheses in Section 2 of this paper. The dataset has been collected specifically for this study and was constructed using a variety of sources. Data collection has been an integral part of this study as the data was not readily available in a single database. To construct the dataset, a multi-step iterative process has been followed.

The *first step* involved creating an extensive list of USOs. This list of USOs was compiled using a variety of sources, including websites of universities and/or associated (university) incubators, annual reports of universities listing their respective USO ownership. Moreover, the list was further populated by reaching out to the TTOs of the respective universities (of which very few replied). Though, the first iteration resulted in a total number of 460 USOs founded between 2000 and 2022.

The *second step* involved populating the dataset of USOs with information on the USO and the founding team, including but not limited to the industry, headquarter location, founding year, team size, funding status, number of founders. Information was manually collected primarily from the company website and professional networking site LinkedIn. Additional and/or complimentary data was gathered from other sources, such as, but not limited to, Crunchbase, Pitchbook, Drimble (for data from the Chamber of Commerce), Web of Science (for data on researcher profiles), news websites (for e.g., company interviews). Through an iterative process the database was populated with publicly accessible information. Some information was not publicly available and as such was not included in the database.

The Additional and/or complimentary data was gathered from other sources, such as, but not limited to, Crunchbase (for data on funding), Drimble (for data from the Chamber of Commerce), Web of Science (for data on researcher profiles).

The *third step* included assessing the dataset and labelling each entry in the dataset as either fit or unfit for further analysis. Qualification was based on several grounds, and as such, each entry was labelled as follows:

1. Sufficient data is available for the company and founding team (fit for further analysis);
2. Insufficient data is available for the company (unfit for further analysis);
3. Insufficient data is available on the founding team and/or its composition (unfit for further analysis);
4. The company is considered too old (founded before 2000 (unfit for further analysis)¹;
5. The company is not considered relevant in the sample (e.g., it is a foundation with no profit goal, has corporate founders, or still part of the university) (unfit for further analysis);

6. The company was acquired by another company (as this may not be directly indicative of a successful exit, but may also indicate a bankruptcy or management buyout in distressed situations, unfit for further analysis);
7. The company is out of business (unfit for further analysis).

The *fourth step* included cleaning and verifying the data for accuracy before proceeding to analyse the data. To ensure data accuracy and additional cross-checks were performed in cases with uncertainty. Any discrepancies and/or inconsistencies were resolved through additional research and verification. For instance, for each USO, if available, team size was retrieved from both LinkedIn and company website. Any large discrepancies were further investigated and adjusted accordingly. Moreover, in some instances a cross-check was performed on the completeness of the founding team using information from the Chamber of Commerce (via Drimble), Crunchbase, and Pitchbook. From the initial list of 460 USOs, 260 entries were considered unfit for further analysis and as such 200 entries remained.

3.4 Analysis methods

The research utilizes Microsoft Excel for data collection and organization, followed by IBM SPSS Statistics (version 27) for conducting the statistical analysis. The primary method of analysis in this research is binary logistic regression (or BLR). This technique allows for the examination of the relationships between the binary dependent variable and independent variables. By employing BLR, the research aims to identify any significant associations or patterns between these variables, while also controlling for potential confounding factors such as industry, company age, and company age at first funding.

4. RESULTS

This section presents the findings from the study. First the descriptive statistics are presented, including the mean, standard deviations, and distribution of the variables. The descriptive statistics are followed by the correlation matrix, which highlights the bivariate relationships among the independent, dependent, and control variables. Finally, the results of the binary logistic regression are presented.

4.1 Descriptive statistics

The descriptive statistics for the key variables of the study provide a comprehensive overview of the dataset and provide an understanding of the distribution and central tendencies of the included

¹ For older companies, it becomes increasingly difficult to collect sufficient data on the founding team, and as such, relatively fewer older (i.e., older than >10 year) are included in the dataset.

variables. The average founding year in the dataset is 2015 with a standard deviation of 6.87 years. The minimum and maximum founding years are 2000 and 2022, respectively. This indicates that the companies in the sample were founded over a range of 22 years. For the patent variable, 45% of the companies in the dataset have ownership of at least one patent.

In terms of the founding team composition, the average number of founders in the majority (i.e., 69%) of the founding teams are founded by more than one founder. While more USOs are founded by founders all possessing PhD or advanced degrees, (i.e., 40% of the founding teams in the dataset), less founding teams seemed to possess entrepreneurial experience (i.e., 26% of the founding teams in the dataset).

Concerning the variables related to the founding team's research impact, the average maximum *h*-index of PhD founders is 22.91 with a standard deviation of 23.06. The minimum and maximum *h*-index values are 1 and 133, respectively. The average median *h*-index of the PhD founders is 18.64 with a standard deviation of 19.26, and the minimum and maximum median *h*-index values are 0.00 and 109.00, respectively.

4.2 Correlations

Before performing the regression analyses, the bivariate relationships between the independent, dependent, and control variables using Spearman's correlation coefficient is examined. Spearman's rho is a non-parametric measure of the strength and direction of the association between two variables. It is particularly useful when dealing with ordinal variables or when the relationship between variables is not linear (Field, 2013). Given the nature of the variables in this study and the possibility of non-normal distributions or non-linear relationships, the Spearman's correlation coefficient was chosen. The Spearman's correlation matrix is presented in Table 1. Several significant correlations were observed. The correlations demonstrate a statistically significant but weak positive correlation between founding teams with entrepreneurial experience and all PhD founders ($r_s = -.213$, $p < 0.01$). Patent ownership and ability to find raise external funding shows a moderate positive relationship ($r_s = .343$, $p < 0.01$).

Finally, the correlation matrix revealed that the 'multiple founder' variable revealed evidence of multi-collinearity. Therefore, this variable has been excluded from the total binary logistic regression model (Model 8). The correlation matrix revealed that none of the other pairwise correlations showed evidence of multi-collinearity.

4.3 Binary Logistic Regression

A binary logistic regression was performed to investigate the relationships between the independent variables and the dependent variable (USO Funding). Before performing the binary logistic regression, it is

important to check whether the main assumption were fulfilled. The Binary Dependent Variable assumption states that the dependent variable must be binary. The dependent variable of this study, USO funding, is measured as either no funding raised (0) or funding raised (1). Thus, this assumption is met. Each observation (i.e., USO) in the dataset is unique and there is no reason to suspect any dependencies in the dataset. As such, the Independent Observations assumption is met. The Boxwell-Tidwell test was performed to test the Linearity Assumption.

The interaction terms were found to be non-significant (> 0.05) and thus the linearity assumption was not violated. Finally, the Condition Index showed values below 30, which showed no evidence of multicollinearity in the dataset, and thus, the Multicollinearity Assumption was not violated. The dataset was therefore regarded fit for performing binary logistic regression. Models 1 through 7 each focus on a single independent variable, with the intention of examining consistency and stability of the observed effects. Model 8 incorporates all variables and is used to interpret the results in this section. The results are depicted in Table 2.

The first (sub-)hypothesis (H1a) proposed that founding teams composed of exclusively PhD or advanced degree holders has a positive effect on USO funding. All PhD or advanced degree holders was found to be not statistically significant predictor of funding ability ($p = .524$). The odds ratio of 0.688 indicates that the presence of exclusively PhD and advanced degree holders was associated with a 31.2% decrease in odds of receiving funding. H1a can therefore not be confirmed ($\text{Exp}(B) = 0.688$, $p = .524$). The second (sub-)hypothesis (H1b) proposed that founding teams with high-impact academic have a positive effect on USO funding. The variable "academic impact" was not found to be a statistically significant predictor of funding ability ($p = .168$). For each one-unit increase in academic impact (i.e., increase in *h*-index score), the odds of receiving funding increased by factor 1.036. H1b can therefore not be confirmed ($\text{Exp}(B) = 1.036$, $p = .168$). The third hypothesis (H2) proposed that founding teams with past entrepreneurial experience have a positive effect on USO funding. Based on the results in Table 2 in the model for this independent variable, the effect of entrepreneurial experience is positive but non-significant ($\text{Exp}(B) = 1.159$, $p = 0.863$). The odds ratio of 1.148 indicates that the presence of entrepreneurial experience increases the odds of receiving funding. H2 can therefore not be confirmed. The third hypothesis (H3) proposed that multiple founders have a positive effect on USO funding. Based on the results in Table 2 in the model for this independent variable, the effect of having multiple founders is positive but non-significant ($\text{Exp}(B) = 1.430$, $p = 0.626$). H3 can therefore not be confirmed. The fourth hypothesis (H4) proposed that cultural diversity within the founding team has a negative

Table1
Minimum. Maximum. Mean. Standard Deviation. And Correlations of the Variables

Variable	N	Min.	Max.	M.	Sd.	1	2	3	4	5	6	7	8	9	10
1. USO funding	200	0	1	.510	.501	--									
2. All PhD founders	200	0	1	.400	.491	-.008	--								
3. Academic impact	119	1.0	109.0	22.445	20.912	-.207*	.012	--							
4. Multiple founders	200	0	1	.690	.464	-.015	-.380**	.200*	--						
5. Entrepreneurial experience	200	0	1	.260	.442	.073	-.213**	.125	.133	--					
6. Industry experience	200	0	1	.200	.434	-.167*	-.94	-.073	.262**	.020	--				
7. Cultural diversity	200	0	3	.390	.775	-.152*	.081	-.066	.272**	.026	.990**	--			
8. Age of USO	200	0	22	6.870	4.805	.298**	-.001	-.039	-.272**	-.088	-.267**	-.275**	--		
9. Maximum publications	200	1	548	83.840	102.483	.210*	-.057	.925**	.228*	.156	-.084	-.058	.002	--	
10. Patent ownership	119	0	1	.450	.498	.343**	-.012	-.014	.035	.078	-.029	-.025	-.318**	.000	--

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

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

	Model 1				Model 2				Model 3				Model 4			
	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)
All PhD founders	-.316	.405	.435	.729												
Academic impact					.035	.023	.119	1.036								
Multiple founder									.719	.502	.152	2.052				
Entrepreneurial experience													.422	.468	.367	1.525
Cultural diversity																
Experience diversity (low)																
Experience diversity (med)																
Experience diversity (high)																
Patent ownership																
Age of USO	.177	.051	<.001	1.194	.182	.052	<.001	1.200	.200	.055	<.001	1.221	.179	.052	<.001	1.196
Publications	.003	.002	.115	1.003	-.003	.004	.547	.997	.003	.002	.151	1.003	.003	.002	.138	1.003
Constant	-1.152	.513	<.001	.142	-2.415	.461	<.001	.179	-2.078	.625	<.001	.125	-1.539	.420	<.001	.215
-2 Log likelihood	146.522				144.459				144.459				147.134			
Nagelkerke R Square	.188				.207				.207				.182			

Table 2. Continued

Logistic Binary Regression Model for Dependent Variable USO Funding

	Model 5				Model 6				Model 7				Model 8			
	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)	B	S.E.	Sig.	Exp(B)
All PhD founders													-.374	.586	.524	.688
Academic impact													.035	.025	.168	1.036
Multiple founders													.358	.734	.626	1.430
Entrepreneurial experience													.148	.859	.863	1.159
Cultural diversity	-.006	.223	.977	1.006									-.009	.328	.977	.991
Experience diversity (low)					.456	1.1230	.711	1.577					.795	1.850	.667	2.215
Experience diversity (med)					.128	1.216	.916	1.136					-.011	1.582	.994	.989
Experience diversity (high)					.671	1.275	.599	1.957					.172	1.424	.904	1.188
Patent ownership									1.946	.455	<.001	7.004	1.928	.511	<.001	6.879
Age of USO	.173	.052	<.001	1.188	.167	.057	.002	1.182	.123	.053	.020	1.131	.129	.063	.041	1.137
Publications	.003	.002	.109	1.003	.003	.002	.132	1.003	.005	.002	.034	1.005	-.002	.005	.745	.998
Constant	-1.420	.446	.001	.242	-1.688	1.180	.153	.185	-2.082	.470	<.001	.125	-2.775	1.969	.159	.062
-2 Log likelihood	146.374				144.649				126.931				121.384			
Nagelkerke R Square	.189				.206				.362				.406			

effect on USO funding. Based on the results in Table 2 in the model for this independent variable, the effect of cultural diversity is positive but non-significant ($\text{Exp}(B) = 0.991$, $p = 0.977$). H4 can therefore not be confirmed.

The fifth hypothesis (H5) proposed that founding teams with high experience diversity have a positive effect on USO funding. Based on the results in Table 2 in the model for this categorical independent variable, the effects are non-significant for all categories of experience diversity: low experience diversity ($\text{Exp}(B) = 2.215$, $p = 0.667$), medium experience diversity ($\text{Exp}(B) = 0.989$, $p = 0.994$), and high experience diversity ($\text{Exp}(B) = .1.188$, $p = 0.904$). H5 can therefore not be confirmed. The sixth and final hypothesis proposed that technological innovation (through patent ownership) has a positive effect on funding. Patent ownership was found to be a statistically significant predictor of funding ability ($p < 0.001$). The odds ratio of 6.879 indicates that patent ownership exhibits a six-fold increase in odds of obtaining funding ($\text{Exp}(B) = 6.879$, $p < 0.001$).

5. DISCUSSION & CONCLUSION

The study aimed to investigate the effects of various factors on USO funding, including founding teams' composition, academic impact, entrepreneurial experience, the number of founders, and cultural diversity. Moreover, the effect of presence of technological innovation was also investigated to provide an opposing angle. This section discusses the key findings, implications for academia and policymakers and practitioners, and limitations and areas for future research.

5.1 Key findings

Despite the theoretical foundation and previous research suggesting the potential influence of these characteristics, the analyses conducted in this study did not reveal any statistically significant effects for the tested hypotheses related to the founding team composition. However, it is important to consider these non-significant outcomes in the context of the existing literature and explore possible explanations for these findings. For one, the dynamics of USO funding are more complex and multifaceted than initially anticipated, with numerous interrelated factors influencing funding decisions, as the research suggested by Franke et al. (2008) and Siegel (2006). While the present study focused on specific characteristic of USO founding teams, such as cultural diversity and education of founders, other factors related to the founders may be more influential in determining funding decisions. In particular, (intrinsic) motivation, commitment, and dedication of founding team members could play a more important role in securing funding. These factors may play a more important role in running the business, communicating with (potential) investors, and

overcoming challenges. Though these traits are less tangible than the characteristics in this study, they might appear to increase the potential of securing funding as opposed to the past achievements or experience of founders. Moreover, Ewens & Marx (2017) found evidence that replacing founders may lead to better performance. This might indicate that external investors do not see the qualification of the founders as an important indicator for their decision to invest. Next to the motivation, commitment, and dedication of the founding team members, not founder related factors may also play a role. As this study found, patent ownership has a significant positive effect on USO funding – indicating towards the importance of non-founder related factors and more towards technological innovation. While it was established in past research that the founding team plays an important role, and which might be true in the broader context of start-ups in general, this notion might not hold true for USOs. USOs generally are established with the purpose to commercialize university research and the transfer of knowledge from an academic setting to industry. In the context of USOs and their purpose, technology may hold a relatively more important role than the founding team (and other factors). The outcome of this study confirms this belief.

The research question for this study was formulated as follows: “*How does founding team composition affect a USOs ability to raise external funding?*”. While the various hypotheses did not result in significant findings, the findings do suggest that the composition of the founding team does not appear to have a significant effect on its ability to raise external funding. However, it is still crucial to recognize that the non-significant results should not be interpreted as definitive evidence that the investigated characteristics are irrelevant to USO funding.

5.2 Implications

5.2.1 Implications for Academia

The findings of this study contribute to the existing body of literature on USOs and their funding ability by offering new insights into the role of founding team characteristics. While previous research has often focused on the formal qualifications and experience of founders, this study emphasizes that non-significant results for the tested hypotheses suggest the need for further exploration of other factors that may impact funding success. In particular, the importance of motivation, commitment, and dedication among founding team members could be explored in future research. Ewens & Marx (2017) found that USOs of which the founders have been replaced show better performance. This area can be explored in more depth by studying the background and qualification of founder that have or have not been replaced by external investors.

5.1.2 Implications for Policymakers & Practitioners

Several implications for policymakers who aim to drive growth of USOs have been identified. First, the non-significant findings suggest that focusing solely on the formal qualifications or characteristics of founders may not be sufficient to ensure USO funding success. Policymakers should consider the importance of other factors, such as motivation, commitment, and dedication, when designing support programs and/or initiatives for USOs. Support and attention toward these other factors may be found more effective than finding outside founders from outside the university or finding founders with entrepreneurial experience. Policymakers should regularly evaluate the effectiveness of their support programs and policies to support USOs. By understanding the role of industry dynamics, regional characteristics, and investor preferences, policymakers can better tailor their efforts to support the growth and development of USOs in their specific contexts.

5.3 Limitations & Future Research

In writing of this paper, the complex and multifaceted nature of USOs and their ability to secure funding has become increasingly clear, and the data-driven approach to this study posed some limitations. First, the sample size in this study was relatively small, which may limit the statistical power to detect significant effects. Future research could benefit from larger sample sizes to increase the robustness and generalizability of the findings. This limitation also highlights another critical limitation: the availability of sufficient and robust data. The study relied on information on private companies from (mostly) public sources. Given the private nature of such companies, not all information was publicly available, greatly reducing the sample size. Moreover, the data-driven approach relied on mostly quantitative data whereas funding decisions may be less theoretical and more driven by non-quantitative factors. Future research should thereby focus more on these non-quantitative factors. Future studies with more resources can create prediction models with vast more variables to come to more accurate results. Another limitation of this study is the potential for selection bias in the sample of university spinoff companies.

The database was compiled using a variety of sources, including university websites, university incubators, and from TTOs. It is possible that some companies may have been missed or excluded due to incomplete or inaccurate information, which could affect the representativeness of the sample. Despite these limitations, this study provides valuable insights into the composition of the founding teams and the impact of PhD founders on the success of university spinoff companies. Further research is needed to confirm and expand upon these findings, and to explore other factors that may influence the success of university spinoff companies.

In conclusion, acknowledging these limitations is essential for interpreting the findings of this study and for guiding future research. By addressing these limitations, future studies can contribute to a more comprehensive and nuanced understanding of the factors that influence USO funding. Furthermore, overcoming these limitations may help in developing more effective strategies for policymakers, universities, and founders to enhance the potential of USOs to secure funding and achieve long-term success.

Acknowledgements

I would like to express my sincere gratitude towards Dr. Igors Skute for his supervision and guidance during my master thesis. His insights and guidance have been instrumental in helping to push my thinking in new and productive directions.

With this thesis also comes an end to my time at the University of Twente. I thereby also sincerely like to thank Mrs. Charlotte Röring for her encouragement and support during my studies. Her support was essential as I was juggling a full-time job next to my studies and she enabled me to make the right decisions during this journey. Finally, I would like to express thanks to the people who contributed data to this study. Your contributions are greatly appreciated.

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