Technische Universität Berlin

Faculty VII (Economics & Management)

Workgroup for Infrastructure Policy (WIP)

New Ventures in Fusion: Statistical Analysis

The Role of Top Management on the Funding Success of Fusion Ventures

Authors (Matr. Nr.):

Leander, Hérault (509295)

Tobias, Konkel (509255)

Jakub Adam, Manczak (388286)

Arwed, Straub (469056)

Julian Lukas Wiersich (506177)

Filename-core (with version no. 00): term_paper_v00_group_1_15-01-2025

File location (fixed):

Current file location (temporary): https://ittuberlin-my.sharepoint.com/personal/172831517021978084853076638l6_msopseudo_tu-berlin_de/Documents/Fusion_Ventures_Paper/term_paper_v01_group_1_15-01-2025.docx

Date: 31.03.2025 22:32

Supervisor(s):

Prof. Dr., Astrid, Cullmann

Björn, Steigerwald

Berlin, 31.03.2025

Statutory declaration

I hereby declare that I have produced the present work independently and with my own hands without the permission of outside help and exclusively using the listed sources and resources.

Berlin, 31.03.2025

Leander, Hérault (509295)

T. Konkel

Tobias, Konkel (509255)

Manczak Jakub

Jakub Adam, Manczak (388286)

Arwed E. Straub

Arwed, Straub (469056)

J. Wiersich

Julian Lukas Wiersich (506177)

List of Figures

List of Tables

1 Introduction

Nuclear power was once considered the most promising source of electricity. Various types of nuclear fission reactors were developed and built, offering the prospect of a clean and almost inexhaustible energy supply. This led to a record high of 227 new reactor startups in the 1980s (Schneider and Froggatt 2022). Following various safety and environmental incidents, financial instabilities surrounding nuclear fission reactors, and the abundant availability of traditional energy sources such as coal, gas, and oil - alongside the falling costs of renewables - nuclear power, once a beacon of hope, saw more reactor closures than new constructions worldwide between 2002 and 2021(Schneider and Froggatt 2022).

With the turn of the millennium an old concept in nuclear science has resurfaced as a potential energy breakthrough: nuclear fusion. Unlike nuclear fission, fusion seeks to generate power by fusing atomic nuclei, releasing vast amounts of energy – similar to the reactions that power the sun. Even though the concept has been scientifically proven and atoms have been successfully fused, no fusion design has yet been able to stably generate energy. In order to solve this crucial challenge and compete in highly competitive energy markets, numerous ventures have been founded with the ultimate goal of achieving the fusion breakthrough. To advance towards commercialization, those new fusion ventures need to secure sufficient funding – primarily venture capital - for their foundational and applied research, as well as the construction of prototypes, first-of-a-kind facilities (FOAK) and demonstration power plants.

The purpose of this paper is to analyse the influence of the characteristics of the Top Management Team (TMT) on the success of funding for fusion ventures. We define the TMT as consisting of the Chief Executive Officer (CEO), the Chief Financial Officer (CFO) and the Chief Technology Officer (CTO). Since fusion ventures can be classified as *Deep Tech* - “disruptive solutions built around unique, protected or hard-to-reproduce technological or scientific advances” (de la Tour et al. 2017) - or as technology-based ventures, we draw upon the findings of Nuscheler et al. (2019) in their paper *The role of top management teams in transforming technology-based new ventures’ introductions into growth* to support the formulation of our hypothesis.

We hypothesize that our variables for the educational background and work experience of the Top Management Team have a positive impact on the funding success of fusion ventures.

2 Theoretical Framework

The relationship between the experience and education of top executives, such as Chief Executive Officers (CEOs), Chief Technology Officers (CTOs), and Chief Financial Officers (CFOs), and the financing of firms, has been an area of growing academic interest, namely in the nuclear energy industry. Prior studies have explored how the background of executives influences various aspects of business strategy, performance, and innovation. While prior studies have explored how executive backgrounds influence business strategy, performance, and innovation, there remains a noticeable gap in the literature specifically concerning the nuclear energy sector. Existing research has primarily focused on broader industries, and, to our knowledge, no studies have specifically examined the impact of executive experience and education on financing within nuclear energy companies.

We have identified one publication, very closely related to this topic, which is "The Role of Top Management Teams in Transforming Technology-Based New Ventures' Product Introductions into Growth" (Nuscheler, Engelen, and Zahra 2019). It explores how the composition of top management teams influences the growth trajectories of technology-based ventures. This study offers valuable insights but does not address the role of executive background in securing financing. This leaves a research gap. Due to the fact that the nuclear energy sector is capital-intensive, understanding how the experience and education of top management affects financing is essential.

According to the study, "The number of new products is positively related to growth when the TMT's startup experience is strong, and the TMT's functional diversity is low" (Nuscheler, Engelen, and Zahra 2019). Furthermore, "when the TMT faces a task that requires flexibility, speed, and consistency (such as transforming new products into growth), non-diverse TMTs are beneficial"(Nuscheler, Engelen, and Zahra 2019). These findings highlight the importance of management experience in facilitating firm growth, a principle that may be relevant in the nuclear energy industry, where executive leadership plays a vital role in securing long-term financing and investment confidence. However, the energy industry differs significantly in this regard, as new products are not frequently introduced. Energy is transported in standardized units, making it indistinguishable between different firms and sole tracking of research successes is difficult. As a result, measuring a startup's progress in this sector becomes a challenge. One can try to measure progress through employee growth, or other indicators .

Further study results indicate that in the Deep Tech sector, "on average, […] companies have a TMT of 2.3 members, which is consistent with the literature that indicates that more than one person is needed to handle the complexity of technology ventures" (Kristinsson et al. 2016, 78). Additionally, these results align with suggestions that TMTs should not be too large in the context of high innovation to ensure frequent and open interactions (Amason, Shrader, and Tompson 2006).

This suggest that good structured executive teams combine diverse skills with clear decision making structure. In the nuclear energy context, where large-scale investments and compliance are key factors, the organization of executive teams could play a crucial role in managing financial challenges.

An analysis of the available scientific literature indicates a significant and positive correlation between the number of years of work experience and the length of time spent on education by top management members and the likelihood of success for technology startups (Colombo and Grilli 2010). The research suggests that both the accumulated capital of theoretical knowledge and practical managerial skills derived from work experience can play a key role in building a sustainable competitive advantage. They can also increase the chances of long-term stability and growth of the company. These findings may also be relevant to nuclear energy companies, where both technical expertise and strategic financial management are critical to success.

New ventures are young institutions that have limited knowledge bases, which increases the value of TMT members' human capital gained prior to working for the new venture (Colombo and Grilli 2010).

Without this human capital, new ventures might be better off sticking to one or a few products and growing from them, thereby avoiding the complexities and additional demands associated with adding new products. However, this raises an important question: what happens when only one product is available? Existing research has yet to provide a clear answer to this issue.

Moreover, the nuclear energy industry presents unique financial challenges, due to high capital requirements, long project timelines, and regulatory constraints (Joskow and Parsons 2009). These constraints affect not only large-scale nuclear fission companies but also emerging nuclear fusion start-ups. Consequently, executives with extensive industry-specific education and experience may be better positioned to secure financing through strategic partnerships, government grants, or institutional investors. This perspective aligns with the broader management literature, which emphasizes the role of human capital in shaping firm outcomes (Beckman and Burton 2008).

3 Data and Methods

3.1 Data Set

Our dataset comprises information on 82 fusion ventures, covering both characteristics of the companies and of their top management team (CEO, CFO, CTO). Data on company names, total funding amounts, and locations were sourced from the Traxcn database[1]. To ensure comparability, funding amounts were inflation-adjusted to 2020 levels. Information on top management team members was collected manually, primarily via LinkedIn[2]. If LinkedIn profiles were unavailable, additional data was retrieved through Google searches and other publicly accessible sources, such as company websites. All available data up to and including 2024 was included in the data set.

The dataset includes variables capturing both entrepreneurial and executive experience, as well as educational and technical backgrounds of the TMT members. Entrepreneurial experience is measured through prior start-up involvement, distinguishing between individuals who have previously founded companies and the number of start-ups they founded. Executive experience is measured through prior C-level positions. Technical expertise is assessed by considering whether an individual has a technical work background, the total years of work experience, and whether they pursued studies in technical fields such as physics or engineering. Educational background is further analyzed by considering whether they studied in the US, EU or other countries (Table 1). Of the 3,198 total data points across our 13 TMT variables, 1,653 are missing. Regarding the main reactor category, of the 82 companies, 45 can be grouped to use *magnetic confinement* (“*Tech_Magnetic”*), while 15 use *inertial confinement* (*“Tech_InterConf”*) to establish fusion reactions. The residual 22 companies use other techniques[3].

[1] https://tracxn.com
[2] https://www.linkedin.com
[3] An in-depth explanation of fusion reactor concepts can be found in (Freidberg 2007).

Table 1: Overview of variables

Variable	Technical Name	Abbreviation	Type	Description
Serial founder	serial_founder	SF	Binary	prior start-up experience
Number of companies founded	number_founded_companies	NCF	Integer	Count of prior start-ups founded
C-level experience	experience_c level	CLE	Binary	experience in “chief” positions
Technical work background	tech_work_background	TWB	Binary	1 if technical work background
Work experience in years	experience_years	WEY	Integer	Interval of work experience
Study Background	/	SB	Text	Names of study programs (for later interpretation)
Technical educational background	tech_edu_background	TEB	Binary	1 if study background in physics, engineering etc.
PhD	phd	PHD	Binary	1 if PhD
Education	/	ED	Text	Names of universities studied on (for later interpretation)
Education USA	education_usa	EDUS	Binary	1 if studied in the US
Education EU	education_eu	EDEU	Binary	1 if studied in the EU
Education Other	/	EDOT	Binary	1 if other
Top University	top25_uni	TOP	Binary	1 if studies at a Top 25 University (Times Higher Education World University Rankings 2025)
Technology magnetic confinement	Tech_Magnetic	TM	Binary	Reactor uses magnetic confinement
Technology inertial confinement	Tech_InerConf	TI	Binary	Reactor uses inertial confinement

3.2 Descriptive Variable Analysis

In this section, we provide a descriptive analysis of the distribution of variables in our dataset. We begin with funding data, followed by entrepreneurial and executive variables, and conclude with educational variables related to TMT members. Note that in the following figures, we only use the available data and not the missing data.

3.2.1 Funding distribution & development

Figure 1 shows the proportion of companies who received certain amounts of funding. Approximately one-third (33.06%) of companies have received no funding at all, while only a small fraction (1.65%) have received over $1 billion in total funding. Most ventures fall within lower funding brackets, with just

10.74% receiving between $10 million and $100 million. These figures suggest that large-scale funding is rare and not evenly distributed across the sector.

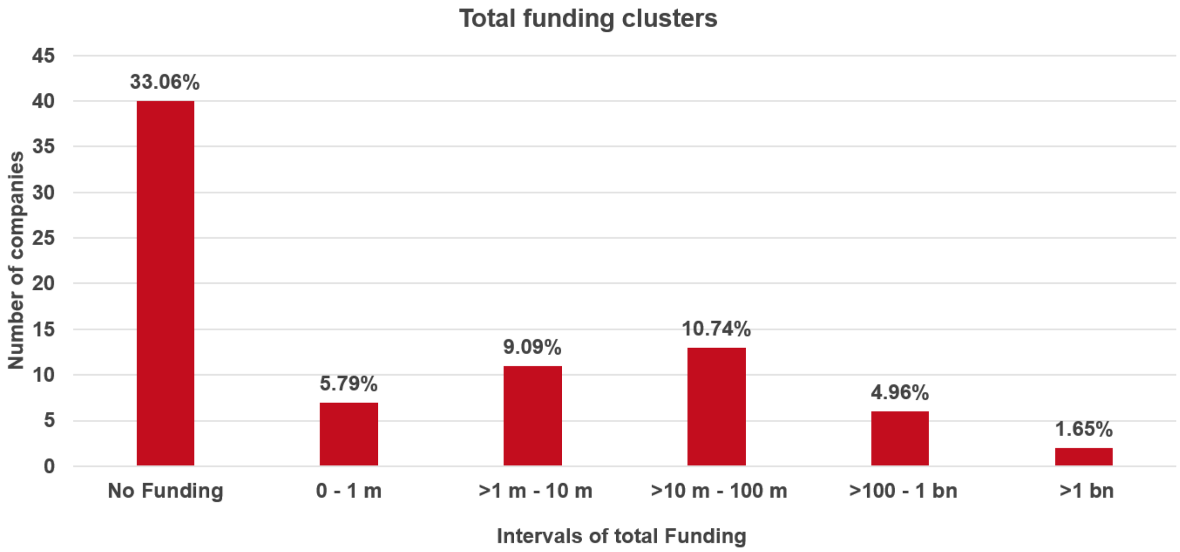


Figure 1: Funding clusters of nuclear fusion ventures

The cumulative growth of both the number of fusion ventures and amount of total funding over time is displayed in Figure 2. From 1989 to around 2010, growth in both metrics remained modest. However, starting in the early 2010s there is a sharp increase in the number of ventures, followed by a rapid acceleration in funding from around 2018 onward. By 2023, over $7 billion of funding had been raised across all ventures in our dataset. This trend reflects a significant interest in the sector of fusion energy in the past decade. Figure 2 also underlines the uneven distribution of funding in this sector as the curve of the cumulative founded ventures lies above the curve of cumulative total funding and is steeper, suggesting that other factors than funding, e.g., TMTs, might determine the sectors´ development as well.

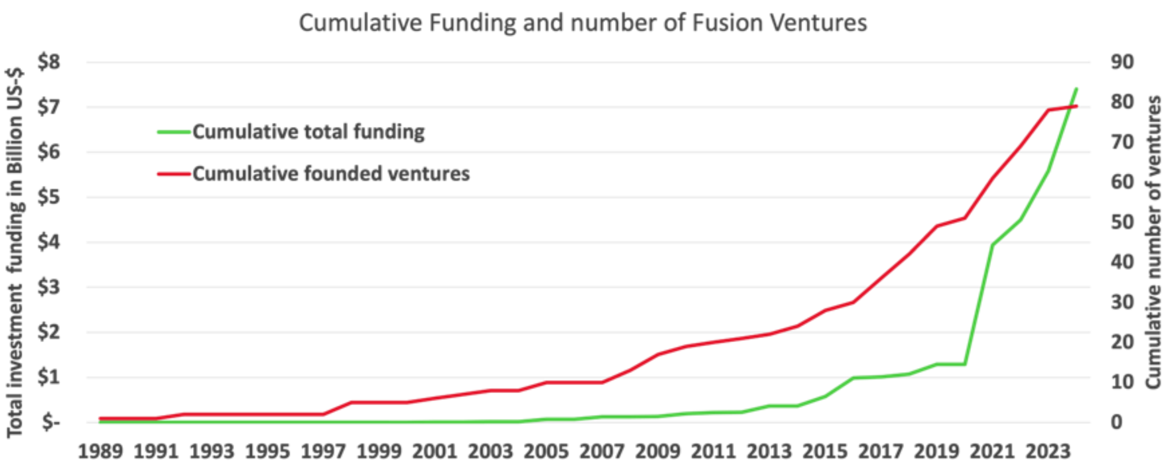


Figure 2: Cumulative funding and number of fusion ventures over time

3.2.2 Work background

3.2.2.1 Serial Founder and Number of Companies Founded

Figure 3 shows the number of companies founded for the three TMT roles. Most TMT members, irrespective of their role, have founded zero companies, indicated by the red bars reaching approximately 60-90%. As shown by the green, blue and purple bars, Chief Executive Officers (CEOs) are more likely to have founded at least one company compared to Chief Financial Officers (CFOs) and Chief Technology Officers (CTOs). This suggests that CEOs are more likely than CFOs or CTOs to have entrepreneurial experience.

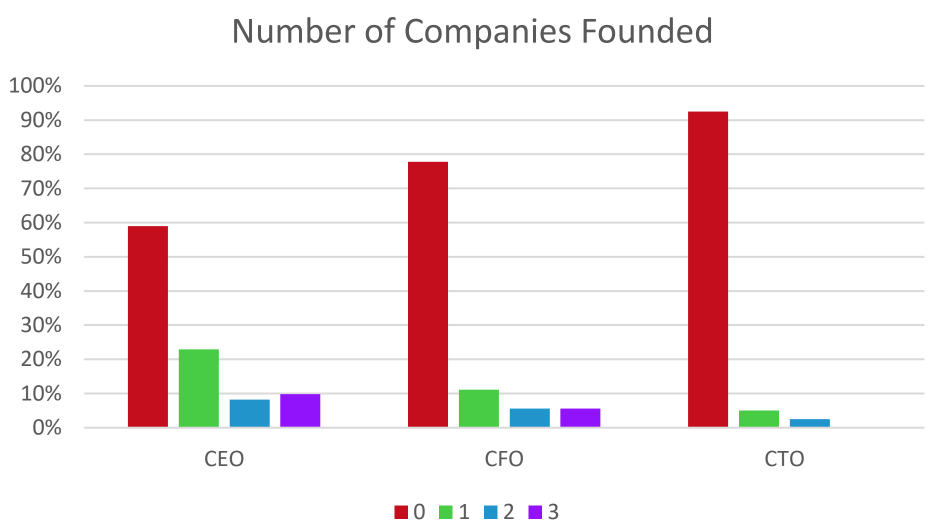


Figure 33: Distribution of the number of founded companies in the TMT

3.2.2.2 C-Level Experience

The percentage of TMT members with and without C-level experience is displayed in Figure 4. Both categories CEO and CTO show a higher proportion of individuals without C-level experience compared to those with C-level experience. Among CTOs, the proportion of those with experience is about twice as high as among those without experience. In contrast, a reverse distribution is observed among the CFOs, of which 66% are experienced in the C-level.

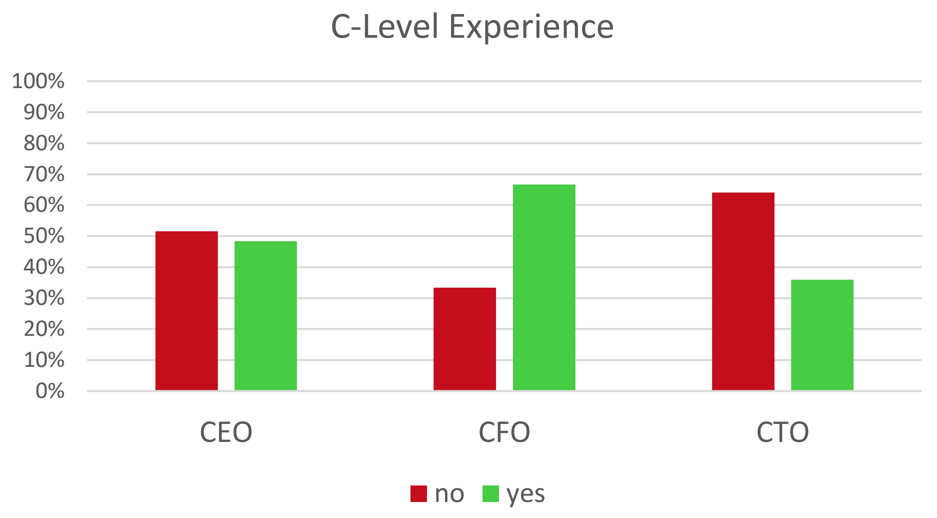


Figure 4: Distribution of C-level experience in the TMT

3.2.2.3 Technical work background

Whether the TMT members have a technical work background or not is depicted in Figure 5. While a majority of CEOs (~70%) have a technical work background, this is the case for nearly all CTOs (~98%), which reflects the importance of technical knowledge in the leadership of fusion ventures. Among CFOs, the distribution of having or not having a technical work background is evenly split, suggesting technical expertise is less central, but still relevant, in financial leadership roles.

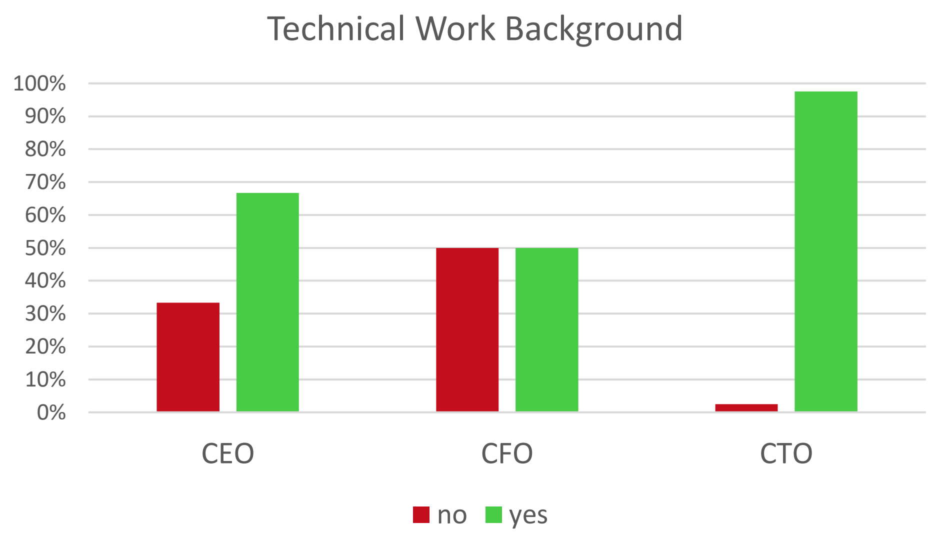


Figure 5: Distribution of technical work background in the TMT

3.2.2.4 Work experience

Figure 6 presents the years of work experience across the three TMT roles. Most CEOs (~31%) have a work experience between 11 and 20 years, while 21 to 30 years of work experience is the most prominent range for CFOs and CTOs. Few TMT members have worked for more than 41 years (less than 10% in all three roles) but CFOs have a minimum work experience of 21 years. This indicates that leadership roles in fusion ventures are typically held by highly experienced individuals, emphasizing the importance of extensive career backgrounds in this field.

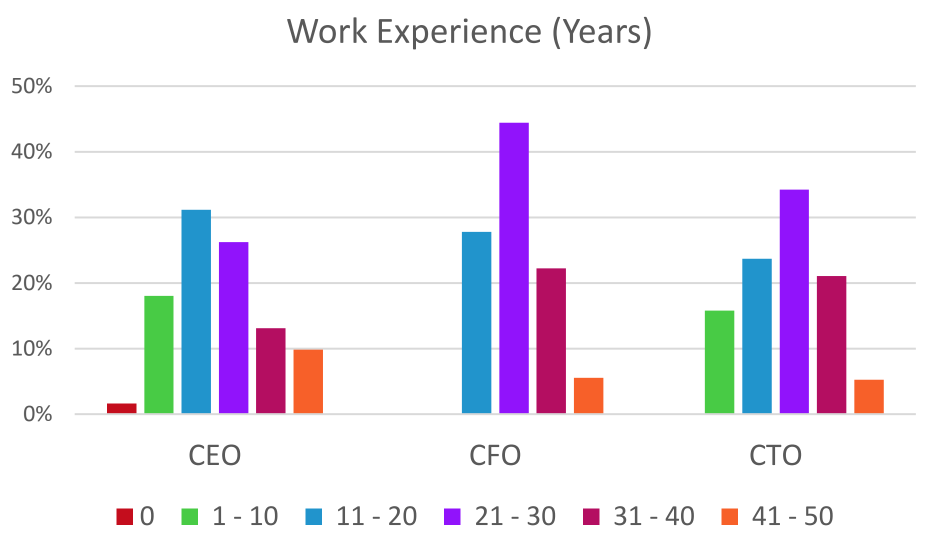


Figure 6: Distribution of the work experience in the TMT

3.2.3 Educational Background

3.2.3.1 Technical Educational Background

Figure 7 illustrates the distribution of technical education among top management team (TMT) members in the analysed dataset. Specifically, the data shows that 83% of Fusion Venture CEOs possess a technical educational background, while the remaining 17% do not. This suggests that while technical expertise is common among CEOs, it is not a strict requirement for the role. In contrast, a reversed trend is exhibited by CFOs. 68% of CFOs do not possess a technical educational background, in contrast to the approximately 32% who do. As expected, CTOs predominantly possess a technical educational background. The chart indicates that almost all CTOs in our data set have a technical education, with only a negligible percentage lacking such a background. This finding is consistent with the technical and innovation-driven responsibilities typically associated with the CTO position. The results highlight significant differences in the educational backgrounds associated with different executive positions

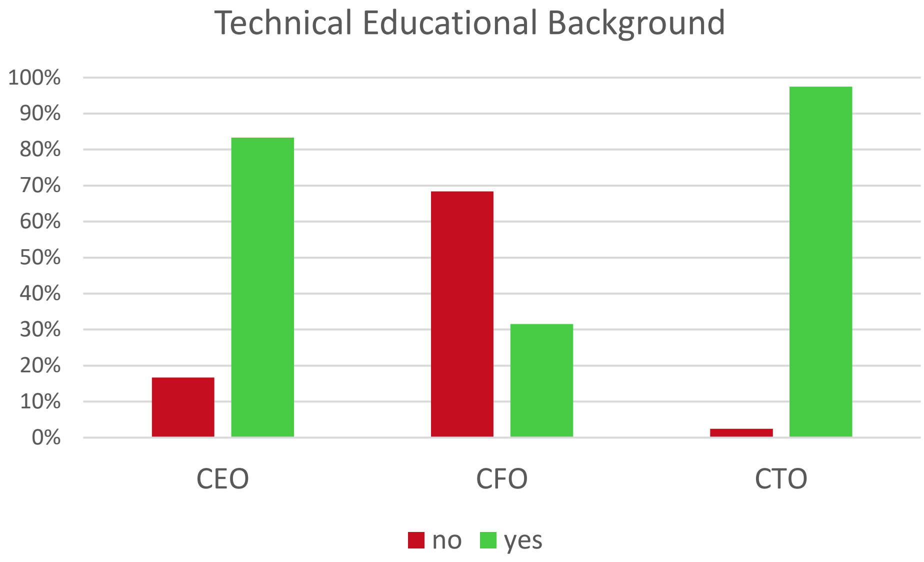


Figure 7: Distribution of Technical Educational Backgrounds in the TMT

3.2.3.2 PhD Holder

Figure 8 illustrates the proportion of CEOs, CFOs, and CTOs with and without a doctoral degree. Among CEOs, the distribution is relatively balanced, with around 48% holding a PhD and 52% not. This suggests that while a PhD is not a prerequisite for the role, it is not uncommon either.

In contrast, CFOs rarely hold a PhD, with 95% lacking one. This aligns with the nature of the CFO position, which prioritizes financial expertise over academic research credentials. CTOs, however, exhibit the highest percentage of PhD holders, with 70% having completed a doctorate. This reflects the technical and research-intensive nature of the CTO role, particularly in fields like fusion research, where deep subject-matter expertise is highly valued. While technical leadership (CTO) benefits most from doctoral qualifications, financial leadership (CFO) relies more on professional experience. The CEO role, positioned between strategy and technical expertise, shows a more balanced distribution.

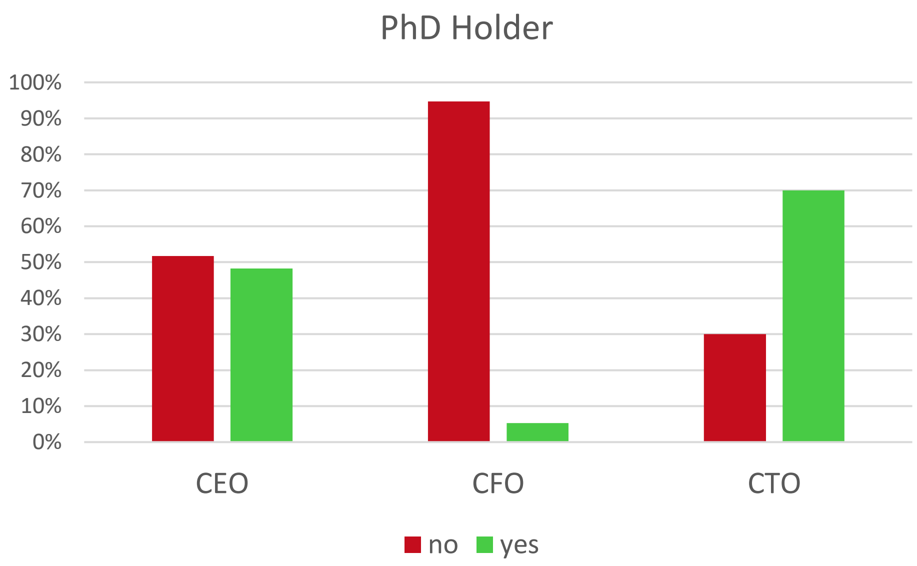


Figure 8: Distribution of PhD Holders in the TMT

3.2.3.3 University Country

Depicting the distribution of top management team (TMT) members by the country of their university education, Figure 9 classifies graduates into the USA (red), the EU (blue), and other countries (green).

Among CEOs, the majority - around 60% - graduated from U.S. universities, while the remaining are fairly evenly split between the EU and other regions. CFOs follow a similar pattern, though with a slightly

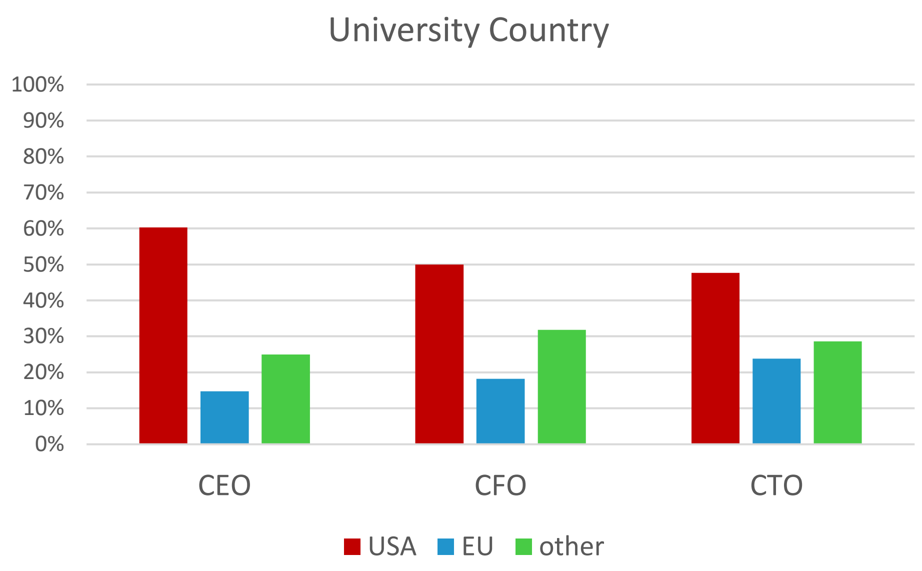


Figure 9: Geographical Distribution of Universities Attended by the TMT

lower share of U.S. graduates and a higher proportion from other countries. This suggests that financial executives may have more geographically diverse educational backgrounds. For CTOs, U.S. universities remain the most common, but their dominance is less pronounced compared to CEOs and CFOs. The share of EU and other-countries graduates is slightly higher. Overall, the data highlights the prominence of U.S. universities in shaping top executives, while also showing notable representation from EU and other international institutions, particularly among CTOs and CFOs.

3.2.3.4 Top University

The analysis of our last educational variable “Top University” shows the proportion of top management team (TMT) members who attended a top university, defined as one of the top 25 institutions in the 2025 Times Higher Education World University Rankings[4]. The data distinguish between CEOs, CFOs, and CTOs, showing notable differences across roles.

Among Fusion Venture CEOs, approximately 37% attended a top university, while the majority (63%) did not. The share of CFOs with a top university background is even lower, at only 26%, indicating that elite university education is less common in financial leadership roles. In contrast, CTOs have the highest proportion of top university graduates, with around 42% having attended one of these institutions.

---

[4] Times Higher Education, World University Rankings 2025, available at: https://www.timeshighereducation.com/world-university-rankings/latest/world-ranking

This pattern suggests that technical leadership roles may place a higher value on degrees from prestigious institutions, potentially due to the emphasis on cutting-edge research and innovation. Meanwhile, financial executives appear to rely more on professional experience than on elite academic credentials. Overall, the data highlights a clear variation in educational backgrounds across different leadership roles.

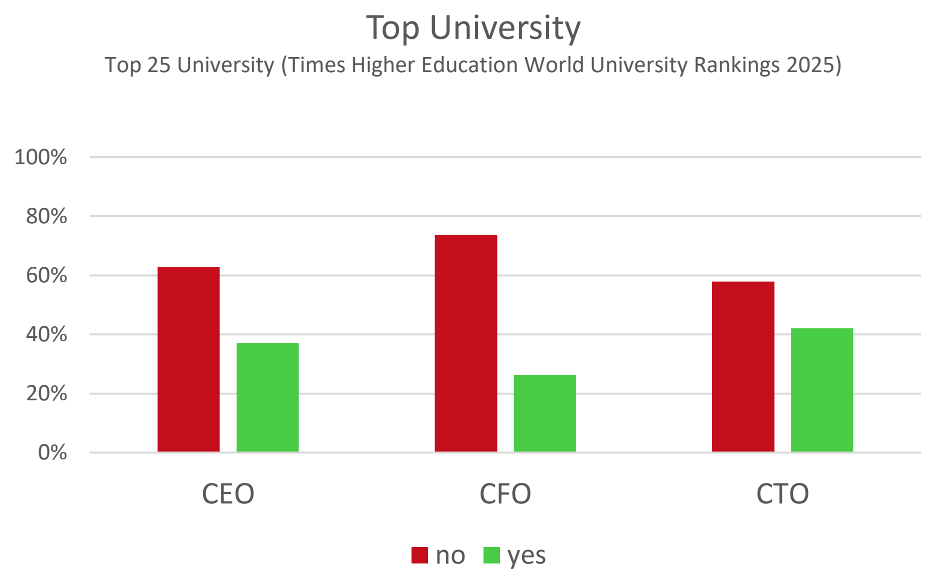


Figure 10: Top vs. Non-Top University Attendance Among the TMT

3.4 Regression analyses

To test our research hypothesis of the influence of the top management team on the funding success of fusion ventures, we employed multivariate logistic regression models, that were stratified by the top management team members. We decided to include only fundings granted in the last five years (between 2019 and 2024), because otherwise the date of funding would not align with the time interval where the TMT members could have had an impact on the funding probability. The selection on five years is done by our judgement of average employment times in the companies. We included the used technology (inertial confinement, magnetic confinement, cold fusion) of the ventures as control variables in all our models, as they might have a confounding effect on the link of characteristics of top management and the funding outcomes.

To investigate the likeliness of funding in general, logistic regression models are suitable, as they regress one or multiple independent variables on a binary dependent variable (Cameron and Trivedi 2005). Logistic regression is particularly useful in this context, because it ensures that the estimated probabilities of receiving funding lie between 0 and 1, which is a requirement for modeling such binary outcomes. We used the variable on the funding amount in our data to code a binary variable (*0* for no funding received, *1* for any funding received). We calculated multivariate logistic regression models stratified by the three top management team members in our dataset (CEO, CFO, CTO), which contained variables on characteristics of the top management team members. By stratifying, we want to investigate whether certain team members of top management have a larger influence on the funding success. The model equation of our multivariate logistic regression model *(1)* can be denoted in an abbreviated way exemplary for the CEOs as the following,

$$\boldsymbol{P(Y=1 \mid \bullet_{CEO}) = L\,(b_0 + b_1\,SF_{CEO} + b_2\,NCF_{CEO} + b_3\,CLE_{CEO} + \ldots + b_k\ \bullet_{CEO})} \quad \textbf{\textit{(1)}}$$

where $P(Y = 1 \mid \bullet)$ represents the probability of receiving funding (i.e., $Y = 1$) conditional on the independent variables of our model, L is the logistic function, b_0 denotes the intercept coefficient and b_1, $b_2, \ldots, b_k$ describe the regression coefficients for the respective independent variable.

Lastly, we calculated one large multivariate model, that includes observations for CFO and CTO, handling CEO as the left-out baseline, as well as control variables. The calculation is handled by interaction terms, estimating all three roles ($Role_{i:j}$) with their respective variables.

$$\boldsymbol{P(Y=1 \mid \bullet_{Role_{i:j}}) = L\,(b_0 + Role_i * (b_1\,SF_{Role_i} + b_2\,NCF_{Role_i} + b_3\,CLE_{Role_i} + \ldots + b_k\ \bullet_{Role_i})} \quad \textbf{\textit{(2)}}$$

For our descriptive data analysis and regression analyses we used Microsoft Excel and RStudio (Version 2024.09.0+375), respectively. Significant results were predefined at a 5%-level.

3.4.1 Methodological requirements

This chapter deals with key aspects the data must inherit, to comply with the assumptions of logistic regression. More specifically, it will deal with conditions enabling significance in the variables. Following (Cameron and Trivedi 2005), the necessary assumptions for logistic regression are 1) correct model specification, meaning the logit function needs to be linear in the parameters, there are neither relevant variables omitted, or irrelevant variables included and the data (binary) fits the specification 2) there is no strong or perfect multicollinearity in the estimators, 3) observations are independently drawn, meaning one does not influence the other, 4) no influential observations, meaning there are no strongly influential outliers which can distort outcome and accuracy of the model and 5) sufficient sample size. In the following, we will report our assessments of the 2) multicollinearity and 5) sample size requirements. The other assumptions were assessed to be fulfilled without further discussion here.

To assess multicollinearity, we decided to use variance inflation factors (VIF). VIF's are obtained by taking an explanatory variable as dependent variable and regressing it on the other independent variables. By comparing the fraction of the complement of the R^2, an interpretation about the extent of interdependence within the explanatory variables can be drawn (3) (Kutner 2005). Above values of five to ten, an indication for multicollinearity is assumed. Figure 11 shows the VIF values for each variable of the three role specific models (role as dependent variable).

$$\boldsymbol{VIF_i = \frac{1}{1 - Ri^2{}_i}} \; \textbf{(3)}$$

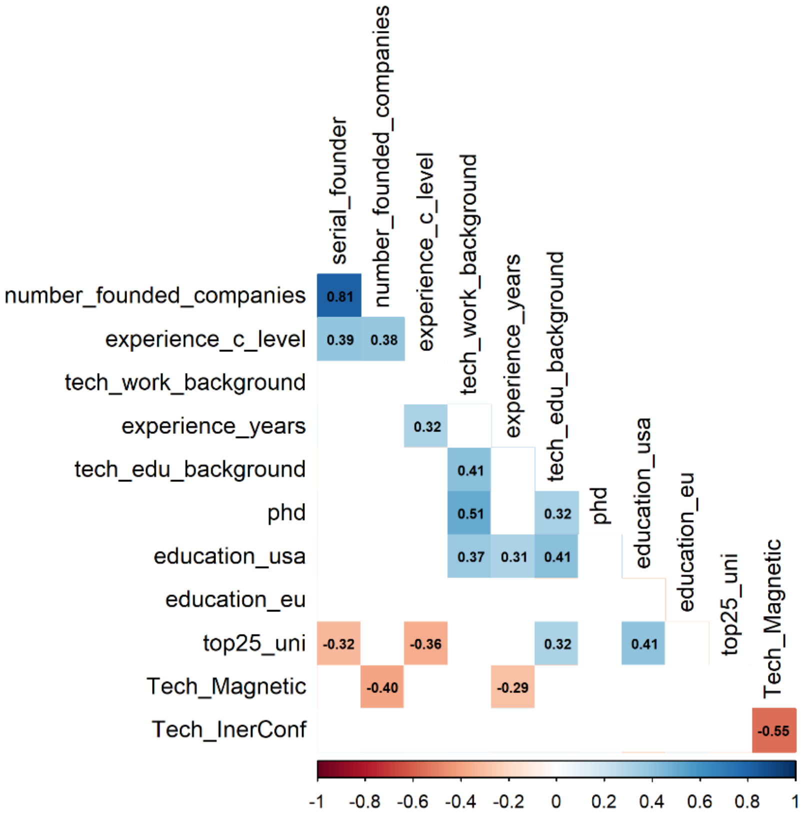
Variable \ VIF Value	Model 1: CEO	Model 2: CFO	Model 3: CTO
serial_founder	3.52	21.31	3.06
number_founded_companies	3.86	20.19	3.21
experience_c_level	1.57	12.97	2.46
tech_work_background	1.71	33.59	1.15
experience_years	1.53	16.08	1.08
tech_edu_background	1.77	13.65	1.00
phd	1.64	13.09	1.91
education_usa	1.69	9.84	1.48
education_eu	1.44	5.30	1.27
top25_uni	1.51	14.34	1.58

Figure 11: Variance Inflation Factors per Model

The values of the CEO- and CTO model are not elevated. At the CFO model in comparison, all variables apart from *education_eu*, have values violating the above stated thresholds, indicating interdependent variables.

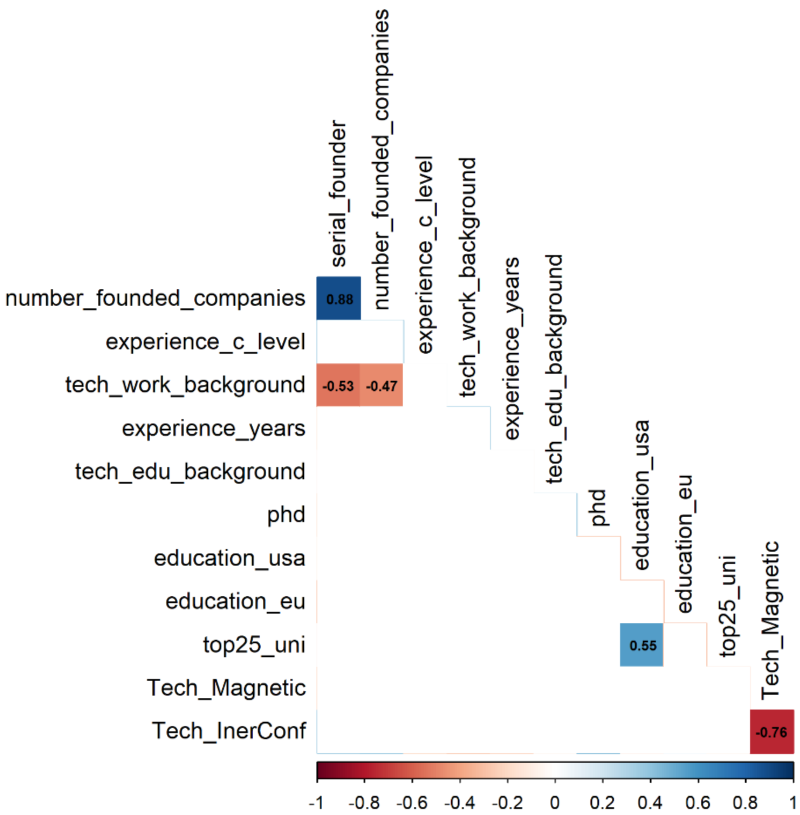
To further investigate potential multicollinearity, we established Pearson-correlation matrices. We decided to evaluate the correlations at the five percent significance level, since the reason behind the investigation was to find variables which inhibit interdependence, limiting the ability to make a ceteris paribus statement. As also correlations are not prone to random effects, such conclusions can only be made after accounting for randomness. Starting with the CEO model in figure 12, red values denote a negative- and blue values a positive correlation. The stronger each color is, the stronger the relationship. Only significant values are shown.

Figure 12: Correlation Matrix CEO Model



Most correlations are in acceptable ranges, with the relationship of *phd – technical work background* and the controls for the *confinement technology*, being in the medium area of 0.5. As for the controls, a high correlation would be tolerable because it is immanent that only one can be positive (not interfering with a ceteris paribus statement). The only strong correlation is shown for the number of founded companies and the characteristic of being a serial founder. This relationship is also immanent, as one's *number of founded companies* will be positive with being a *serial founder* and vice versa. Interpretating it's effects requires attention. Next, figure 13 shows the correlation matrix for the CFO model.

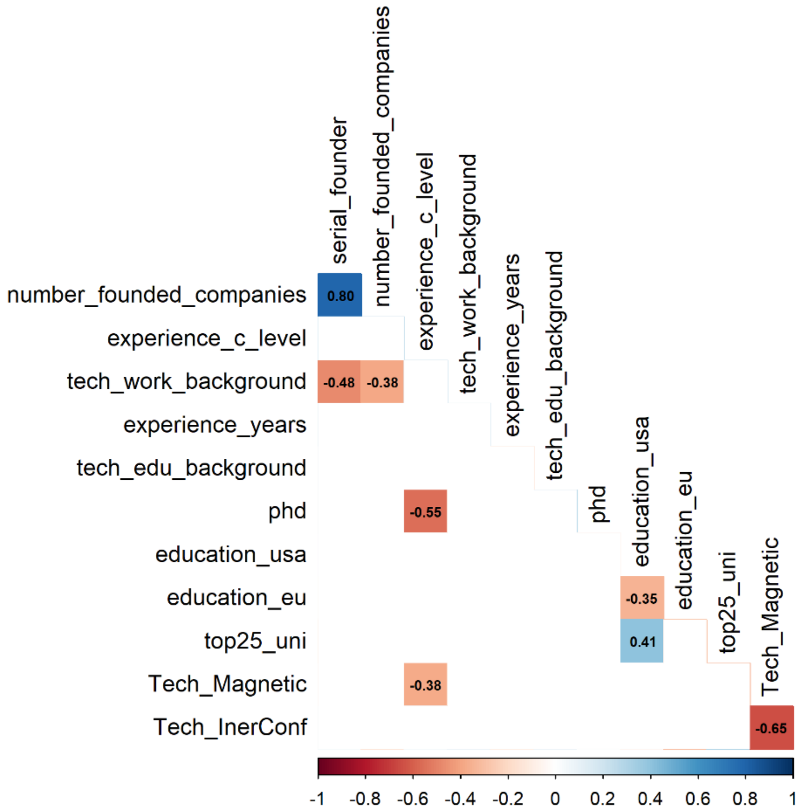
Figure 13: Correlation Matrix CFO Model



Contrasting the high VIF values of the CFO model obtained before, the correlation matrix does not show strong relationships, apart from the prior mentioned immanent dependences. We assume that that the underlying reason for high VIF values, but an imperceptible correlation matrix lies in the small number of full rank observations for the CFO role. This will be mentioned again in the following pages.

Lastly, figure 14 denotes the correlaton matrix of the CTO model. Here, also no strong relationships seem to be present. A potentially interesting finding of the three matrices is that the CEOs who obtained a *PhD*, correlate to having a *technical work background*, while those CTOs correlate to having *experience in c-level positions*. Also, *technical work backgrounds* in CFO and CTO positions negatively correlate to having *founding experience*. Concluding, the correlation matrices do not suggest that multicollinearity is a problem, but some model inherent relationships require attention interpretating. Regarding the fourth model which estimates the effects of all roles at once (2), showing its correlation matrix would be beyond the scope of this paper. The requirement of 4) no influential observations is fulfilled as the fundings are converted in a binary outcome variable. Therefore, the large variance in funding amounts has no effect.

Figure 14: Correlation Matrix CTO Model



Looking at the 5) requirement of sample size, we identify the findings in (Hosmer, Lemeshow, and Sturdivant 2013), suggesting that the number of parameters should not be greater than the number of positive outcome events divided by ten ("one in ten rule"). Still acceptable at minimum would be a division by five. Our dataset has **82** observations, from which **32** have a positive outcome variable (=being funded). Following the above presented rule, the number of parameters should therefore not exceed **three** or at maximum **six**. We use 11 parameters, exceeding the rule-recommended thresholds. To assess the potential detrimental effects on significance, we estimated also univariate models for each parameter to observe if the number of predictors introduces a problem. Only using the data in an averaged way, not controlling for the roles, would have allowed us to use an increased number of nine to 19 predictors (96 positive outcomes as each of the three roles has one, divided by ten or five), theoretically. As this would have introduced an omitted variable bias by not controlling for the roles, we decided to continue with our prior model specification. However, due to missing data, the number of full rank observations regarding our set of predictors is even smaller. Of **53** full rank observations for the role CEO, **26** are with positive outcome. For the role CFO it is **18** to **13** positive outcomes and for CTO it is **34** to **20** positive outcomes. It is likely that this is a challenge to significance.

4 Results

This chapter deals with the results we obtained from estimating the four models. Unfortunately, almost all variables were not significant. Following table 2 shows the estimates and p-values for model one, two and three (full results of all four models in the appendix). The column "*Pr(>|z|)*" denotes the p-value for the null-hypothesis being correct.

Table 2: Selected results of logistic regression analyses

	Model 1: CEO		**Model 2: CFO**		**Model 3: CTO**	
	Estimate	**Pr(>|z|)**	**Estimate**	**Pr(>|z|)**	**Estimate**	**Pr(>|z|)**
(Intercept)	-2.60	0.1016	-33.24	1	18.52	0.9990
serial_founder	-0.07	0.9591	-65.6	1	-21.75	0.9970
number_founded_companies	-0.28	0.6741	29.6	1	39.79	0.9950
experience_c_level	0.64	0.4245	10.6	1	1.69	0.2480
tech_work_background	-0.07	0.9380	53.27	1	-1.53	1.0000
experience_years	-0.03	0.3963	-2.238	1	0.00	0.9020
tech_edu_background	2.09	0.1223	-80.53	1	-19.76	0.9990
phd	0.27	0.7415	23.16	1	0.99	0.4610
education_usa	0.55	0.5717	-23.26	1	0.07	0.9460
education_eu	3.14	0.0231*	-28.74	1	-0.97	0.3420
top25_uni	-0.74	0.3593	71.86	1	0.95	0.3850
Tech_Magnetic	0.62	0.4948	112.7	1	1.86	0.2070
Tech_InerConf	1.11	0.2479	121.8	1	2.74	0.1230

Of all three models, only the education_eu variable of Model 1: CEO is significant to the 5 % level. The confidence interval of the odds-ratio of *education_eu* at this significance level, would be [2.45; 798.23]. The interpretation would be that having studied in the EU, increases the likelihood of being funded between 2.45 and 798 times against not having studied in the EU. Since this confidence interval is extremely large, no interpretation can be drawn from the variable. Therefore, all variables are deemed to be without interpretation due to statistical reasons. Similar results were obtained at **model four,** estimating the specific effects of the three roles combined using an interaction term. Apart from the *education_eu* predictor, no other variable was significant. With respect to chapter 3.3.1, we rule out multicollinearity to be the reason for missing significance. Regarding the interplay of sample-size and number of parameters although, it is very likely that this could be the reason for missing significance. However also univariate model specifications tested by us, did not yield significant coefficients. Therefore, we must conclude that we cannot draw any conclusions from the procedures done, since we cannot be sure that randomness is the underlying reason behind the effects.

5 Discussion

We have found no effects that the top management team has on the funding success in fusion ventures. Our logistic multivariate regression models revealed no significant results for any of our models.

This contrasts the findings other studies have made in the context of the role top management team on company success. Several studies have investigated the role of the top management on different performance parameters of firms. Nuscheler, Engelen, and Zahra (2019) looked at the role of top management in the context of new ventures considering the impact of product introductions on growth. The authors showed in their study comprising 374 US new technology ventures, that new product introductions only help with growth of the venture if the TMT has prior startup experience and is not functionally diverse. Many studies do not cover startups or ventures in specific, but companies in general. Pham and Lo (2023) investigated what influence the diversity of the TMT has on company performance using a causal complexity analysis. They found that cultural diversity and gender diversity in TMT has a positive effect on company performance. A study by Zhou et al. (2022) looked at a sample of 228 firms and was able to show that the characteristics of the TMT substantially impact changes in patent strategy, which is seen as an increasingly important factor for company success. An older study from 1989 looked at TMT in the banking sector and also found significant results - more innovative banks were managed by more functionally diverse and higher educated teams (Bantel and Jackson 1989). One paper by Aboramadan (2021), that did a literature review on top management teams characteristics and firms performance, is more in line with our results. They do not come to a clear result and state that the relationship of the two dimensions is not as straightforward as it might seem at first and needs further investigation.

However, in summary, prior studies oftentimes showed that the composition and characteristics of the top management team has an influence on companies’ performance parameters. From our work, we cannot make a statement about the impact on the funding outcomes of ventures in the field of nuclear fusion.

5.1 Limitations

When interpreting our results, several limitations of our approach must be considered, that might influence the outcomes of our analysis. Starting with our dataset, the initial sample size of our study is relatively small, as the number of ventures operating in the field of nuclear fusion, is limited. This sample was further reduced, when we included top management team variables. Reasons include missing or incomplete LinkedIn profiles or ventures that have not (yet) announced key position such as CFOs or CTOs. A small sample size might be responsible for seeing no significant effects in our regression models. Furthermore, due to our data collection method, we cannot guarantee that we collected the latest data for all ventures. Both LinkedIn profiles as well as the Tracxn database, that was used to collect information on the ventures and their fundings, might not always be up to date. Concerning the causal structure of the link of the top management team characteristics and funding outcomes, we cannot prove with our cross-sectional approach, if the proposed direction of top management affecting funding is correct. It would also be conceivable that the received funding influences the composition and characteristics of the top management team. We tried to address this problem by only including fundings, that were granted in the last five years, however, that cannot rule out this problem completely. To prove this, longitudinal data, which documents the dates of the receipt of funding and the entry of the top management team member, are needed. This is information not available in our data.

6 Conclusion

This paper examined whether characteristics of the TMT (CEO, CFO, CTO) influence the funding success of nuclear fusion ventures. Drawing from prior literature, it was hypothesized that a TMT´s educational and professional background would positively impact both the likelihood of receiving funding and the total amount received.

The descriptive variable analysis confirmed that TMTs are often composed of highly experienced individuals, especially in technical roles. Almost all CTOs, for example, possess technical educational backgrounds and often holds PhDs, while CEOs and CFOs demonstrate varying levels of entrepreneurial and C-level experience. Furthermore, US universities–particularly top-ranking institutions–appear to play an important role in the TMTs of nuclear fusion ventures.

Despite these trends, the logistics regression analyses did not identify any significant relationships between TMT variables and funding outcomes. Neither model showed statistical evidence that factors like prior startup experience, technical expertise, education location, or PhD-level qualifications were associated with higher funding success or larger funding amounts.

There are plausible explanations for these results. Considering our data analysis, the small sample size as well as missing TMT data, may be responsible for not detecting significant results. However, more generally, the complexity and long-term horizon of nuclear fusion projects may reduce the influence of managerial characteristic. In an environment with immense capital requirements, slow technological progress, and significant regulatory oversight, factors beyond the scope of the TMT–such as macroeconomic trends, policy incentives, or technological breakthroughs–may exert stronger influence on funding outcomes.

Future research should consider panel studies to address the causal link between funding and TMT composition or shift toward in-depth case studies that explore the qualitative aspects of decision-making, leadership, and funding negotiations in fusion ventures. While this study could not confirm a significant influence of TMT characteristics on funding outcomes, it helps narrow the scope for future investigations.

References

Aboramadan, Mohammed. 2021. 'Top Management Teams Characteristics and Firms Performance: Literature Review and Avenues for Future Research'. *International Journal of Organizational Analysis* 29 (3): 603–28. https://doi.org/10.1108/IJOA-02-2020-2046.

Amason, Allen C., Rodney C. Shrader, and George H. Tompson. 2006. 'Newness and Novelty: Relating Top Management Team Composition to New Venture Performance'. *Journal of Business Venturing* 21 (1): 125–48. https://doi.org/10.1016/j.jbusvent.2005.04.008.

Bantel, Karen A., and Susan E. Jackson. 1989. 'Top Management and Innovations in Banking: Does the Composition of the Top Team Make a Difference?' *Strategic Management Journal* 10 (S1): 107–24. https://doi.org/10.1002/smj.4250100709.

Beckman, Christine M., and M. Diane Burton. 2008. 'Founding the Future: Path Dependence in the Evolution of Top Management Teams from Founding to IPO'. *Organization Science* 19 (1): 3–24. https://doi.org/10.1287/orsc.1070.0311.

Cameron, A Colin, and P K. Trivedi. 2005. *Microeconometrics: Methods and Applications*. New York, NY: Cambridge University Press.

Colombo, Massimo G., and Luca Grilli. 2010. 'On Growth Drivers of High-Tech Start-Ups: Exploring the Role of Founders' Human Capital and Venture Capital'. *Journal of Business Venturing* 25 (6): 610–26. https://doi.org/10.1016/j.jbusvent.2009.01.005.

Freidberg, Jeffrey P. 2007. *Plasma Physics and Fusion Energy*. Cambridge: Cambridge University Press.

Hosmer, David W., Stanley Lemeshow, and Rodney X. Sturdivant. 2013. *Applied Logistic Regression*. 3. Aufl. Wiley Series in Probability and Statistics. Hoboken, N.J: Wiley.

Joskow, Paul L., and John E. Parsons. 2009. 'The Economic Future of Nuclear Power'. *Daedalus* 138 (4): 45–59. https://doi.org/10.1162/daed.2009.138.4.45.

Kutner, Michael H., ed. 2005. *Applied Linear Statistical Models*. 5th ed. The McGraw-Hill/Irwin Series Operations and Decision Sciences. Boston: McGraw-Hill Irwin.

Nuscheler, Daniela, Andreas Engelen, and Shaker A. Zahra. 2019. 'The Role of Top Management Teams in Transforming Technology-Based New Ventures' Product Introductions into Growth'. *Journal of Business Venturing* 34 (1): 122–40. https://doi.org/10.1016/j.jbusvent.2018.05.009.

Pham, Thuy-Dzung T., and Fang-Yi Lo. 2023. 'How Does Top Management Team Diversity Influence Firm Performance? A Causal Complexity Analysis'. *Technological Forecasting and Social Change* 186 (January):122162. https://doi.org/10.1016/j.techfore.2022.122162.

Schneider, Mycle, and Antony Froggatt. 2022. 'The World Nuclear Industry Status Report 2022', 203–9. https://doi.org/10.1142/9789811213953_0021.

Tour, Arnaud de la, Philippe Soussan, Nicolas Harlé, Rodolphe Chevalier, and Xavier Duportet. 2017. 'From Tech to Deep Tech: Fostering Collaboration between Corporates and Startups'. *The Boston Consulting Group (BCG), Hello Tomorrow*. https://media-publications.bcg.com/from-tech-to-deep-tech.pdf.

Zhou, Yongtao, Yi Zhou, Li Zhang, Xu Zhao, and Weijing Chen. 2022. 'Effects of Top Management Team Characteristics on Patent Strategic Change and Firm Performance'. *Frontiers in Psychology* 12 (January):762499. https://doi.org/10.3389/fpsyg.2021.762499.

Appendix

Appendix 1: Results of logistic regression analyses (complete)

	CEO	CFO	CTO	All TMT members
	Model 1	**Model 2**	**Model 3**	**Model 4**
Serial Founder (yes)	-0.07	-65.6	-21.75	-0.07
	(1.28)	$(5.25 \times 10^{5}.)$	(5.64×10^{3})	(1.28)
Numb. of founded companies	-0.28	29.6	39.79	-0.28
	(0.67)	(3.58×10^{5})	(7.04×10^{3})	(0.67)
C-level experience (yes)	0.64	10.6	1.69	0.64
	(0.80)	(4.57×10^{5})	(1.74)	(0.80)
Technical Work Background (yes)	-0.07	53.27	-1.53	-0.07
	(0.92)	(5.85×10^{5})	(1.16×10^{4})	(0.92)
Work Experience in Years	-0.03	-2.238	0.00	-0.03
	(0.03)	(1.98×10^{4})	(0.04)	(0.03)
Technical Educ. Background (yes)	2.09	-80.53	-19.76	2.09
	(1.35)	(3.71×10^{5})	(1.08×10^{4})	(1.35)
PhD (yes)	0.27	23.16	0.99	0.27
	(0.82)	(1.30×10^{6})	(1.34)	(0.82)
Education USA (yes)	0.55	-23.26	0.07	0.55
	(0.96)	(3.16×10^{5})	(1.03)	(0.96)
Education EU (yes)	3.14 *	-28.74	-0.97	3.14 *
	(1.38)	(3.12×10^{5})	(1.02)	(1.38)
Top 25 University (yes)	-0.74	71.86	0.95	-0.74
	(0.81)	(3.88×10^{5})	(1.09)	(0.81)
Technology (control)				
Magnetic	0.62	112.7	1.86	0.62
	(0.91)	(5.16×10^{5})	(1.47)	(0.91)
Inertial	1.11	121.8	2.74	1.11
	(0.96)	(5.15×10^{5})	(1.77)	(0.96)
Cold (ref.)	ref.	ref.	ref.	ref.
Role				
CFO				- 20.60
				(2.62×10^{4})
CTO				21.12
				(1.58×10^{4})
CEO (ref.)				ref.
CFO:Serial Founder (yes)				-47.27
				(1.57×10^{4})
CTO:Serial Founder (yes)				-21.68
				(5.64×10^{3})
CFO:Numb. of founded companies				21.97
				(1.08×10^{4})
CTO:Numb. of founded companies				40.07
				(7.04×10^{3})
CFO:C-level experience (yes)				6.91
				(1.38×10^{4})
CTO:C-level experience (yes)				1.05
				(1.67)
CFO:Technical Work Background (yes)				38.74
				(1.77×10^{4})

CTO:Technical Work Background (yes)				-1.46
				(1.16 x 10^4)
CFO:Work Experience in Years				-1.60
				(596.5)
CTO:Work Experience in Years				0.021
				(0.050)
CFO:Technical Educ. Background (yes)				-59.50
				(1.12 x 10^4)
CTO:Technical Educ. Background (yes)				-21.86
				(1.08 x 10^4)
CFO:PhD (yes)				15.58
				(3.930 x 10^4)
CTO:PhD (yes)				0.715
				(1.57)
CFO:Education USA (yes)				-17.11
				(9.54 x 10^3)
CTO:Education USA (yes)				-0.48
				(1.41)
CFO:Education EU (yes)				-23.36
				(9.39 x 10^3)
CTO:Education EU (yes)				-4.11*
				(1.72)
CFO:Top 25 University (yes)				51.91
				(1.17 x 10^4)
CTO:Top 25 University (yes)				1.70
				(1.36)
Technology (control)				
CFO:Magnetic				79.81
				(1.56 x 10^4)
CTO:Magnetic				1.24
				(1.73)
CFO:Inertial				85.95
				(1.55 x 10^4)
CTO:Inertial				1.63
				(2.02)
CFO:Cold (ref.)				ref.
CTO:Cold (ref.)				ref.
Constant	-2.60	-33.24	18.52	-2.60
	(1.59)	(8.67 x 10^5)	(1.58 x 10^4)	(1.59)
AIC	83.75	26.00	59.16	168.91
N	53	18	34	31

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Dependent variable: Funding within the last 5 years yes / no (binary)
b: Coefficient; standard errors are given in parentheses
: denotes interaction terms
Source: Own dataset, own calculations