

**Impact of CEO Education and Age on IT Capabilities of Private Family
Firms: Moderating Role of CEO Family Status and Moderated-Moderation
of CEO Perception**

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Abstract

Information Technology (IT) capabilities are the foundation or cornerstone for firms' ability to adapt to technological changes in this rapidly changing business environment. Drawing upon the Upper Echelon Theory (UET), this study investigates the impact of CEO characteristics—specifically education and age—on IT capabilities in private family firms, considering the moderating effects of CEO family status (non-family CEO) and the moderated-moderation of CEO perception of the business. Using survey data from 608 private family firms in Belgium, our findings indicate that CEO education positively and CEO age negatively affect IT capability development. These effects are significantly moderated by CEO family status, with non-family CEOs showing a stronger positive relationship between education and IT capabilities. Furthermore, this moderated relationship is amplified when CEOs perceive their business as a non-family firm. Our results suggest that family CEOs face a "mixed gamble" in IT capability decisions, balancing economic performance against non-economic goals tied to social emotional wealth (SEW). This study advances the literature by integrating the mixed-gamble perspective into the upper echelons theory. It offers novel insights into how leadership and their perception influence the development of IT capabilities in family firms.

1. Introduction

Digitalization rapidly transforms organizations, impacting firms of all sizes and sectors (Teece, 2018; Verhoef et al., 2021). It has emerged as a source of competitive advantage (Nambisan et al., 2017). Nwankpa and Roumani (2016) argue that Information Technology (IT) capability is a fundamental factor in an organization's ability to undergo this digital transformation successfully. IT capability, defined as the ability to assemble and deploy IT-based resources in combination with other firms' resources (Bharadwaj, 2000), gained significant importance in the increasingly digitalizing business environment. IT capability enables firms to transform processes, adapt to technological changes, and leverage technology for improved performance (Chen et al., 2014). Research has empirically confirmed that firms with well-developed IT capabilities can effectively navigate rapid technological advancements, adapt more effectively to changing environments, and achieve better performance (Bharadwaj et al., 2013; Felipe et al., 2020; Mithas et al., 2011). Consequently, IT capability has become a foundation in the digitalization efforts of organizations, reinforcing its essential role as a driver of competitive advantage and long-term success.

Developing IT capabilities is equally important for family firms to remain competitive in the rapidly changing business environment (Soluk & Kammerlander, 2021). However, developing IT capabilities may be challenging in private family firms due to the interplay between family and business decisions (Gomez-Mejia et al., 2014). For instance, family firms might be more reluctant to invest in IT capabilities because they may focus on non-economic and family goals instead of financial goals (Gomez-Mejia et al., 2011). This is supported by Ceipek et al. (2020), who found that family-managed firms avoid exploring new Internet of Things (IoT) innovations due to family-centric non-economic goals and rigid mindsets. Additionally, family identity and communication styles can hinder cross-generational knowledge sharing, a critical factor for successful digital transformation (Prügl & Spitzley, 2021), while resource constraints further

limit their ability to adopt digital technologies for business model innovation (Garzoni et al., 2020). Moreover, family businesses often prioritize symbolic descriptions of digital transformation rather than making substantial investments due to high costs, uncertainties, and the need for specialized human capital (Liu et al., 2023). Conversely, some studies also found the opposite results. For instance, Soluk et al. (2021) revealed that family influence positively affects digital business model innovation. Similarly, Nieto et al. (2023) indicated that digitalization enhances open innovation activities in family firms by facilitating collaboration with broader technology partners. Moreover, Ano and Bent (2022) further endorse the positive impact of the unique characteristics of family businesses on digital transformation. Likewise, De Groote et al. (2023) advocated the role of family managers in digitalization, showing how they can leverage the family's collaborative culture, historical legacy, and venture capital to drive successful change.

As the literature on the digitalization of family businesses is still in its early stages and yields mixed findings, there remains a high need to investigate the factors that influence the development of IT capabilities in private family firms. The upper echelon theory (UET) (Hambrick & Mason, 1984) posits that a firm's strategic decisions and outcomes are significantly influenced by its top executives' characteristics. This is particularly relevant in private family firms, where CEOs often exert greater influence on strategic decision-making than their publicly traded counterparts (Quigley et al., 2022). UET suggests that executives' cognitive bases and values shape their interpretation of strategic situations and subsequent decisions through two primary mechanisms: cognitive capacity and values/preferences (Hambrick, 2007). Cognitive bases are made of knowledge and assumptions about future events, alternatives, and consequences attached to alternatives, while values guide the prioritization of these alternatives. Together, these mechanisms shape executives' interpretation

of a situation and their subsequent strategic choices, thereby influencing the development of IT capabilities for digital transformation.

This study focuses on CEO education and age as fundamental UET characteristics that operate through these mechanisms to influence IT capability development. Education enhances an individual's cognitive ability and understanding, making it a potential critical factor in IT adoption and use (Aleml et al., 2018). Age, operating primarily through the values/preferences mechanism of UET, shapes how CEOs perceive and respond to technological change. Younger individuals are considered more adaptable to change, risk-tolerant, and technologically savvy, given their exposure to IT throughout their lives, and have grown up with IT (Müller & Neck, 2010). As a result, CEO education is expected to positively influence the development of IT capabilities, whereas CEO age is anticipated to have a negative impact.

However, the influence of these UET-derived characteristics (education and age) on IT capabilities likely operates differently within the unique context of family firms, where business decisions are filtered through business and family-oriented goals (König et al., 2013). Therefore, we propose that family status (family CEO vs. non-family CEO) of the CEO moderates the relationship between CEO characteristics and IT capabilities through distinct theoretical mechanisms. Family CEOs operate under the dual influence of business and family institutional logic (Miller et al., 2011), which can either amplify or weaken the effects of their education and age. For instance, while higher education might generally promote IT investment, family CEOs might filter this cognitive predisposition through concerns about preserving socioemotional wealth and family control (Gomez-Mejia et al., 2011). Family CEOs may view the investment in IT capabilities as a more complex decision involving weighing the perceived business benefits (e.g., improved efficiency) with potentially family-related tradeoffs (e.g., loss of control since IT capabilities development requires external expertise). Hence, it might be a mixed gamble for family CEOs, and they may not always prioritize investing in IT capabilities

according to their individual cognitive or value-based inclination. However, non-family CEOs, guided more exclusively by business logic, may more freely pursue IT capability development aligned with their cognitive characteristics, unhindered by legacy constraints or family obligations (Sun et al., 2023). Therefore, we propose that the family status of the CEO moderates the direct relationship between CEO characteristics (education and age) and IT capabilities, such that the positive effect of education and the negative effect of age are amplified for non-family CEOs.

Furthermore, it is argued that the influence of CEO family status is not absolute—it is further conditioned by how CEOs perceive the identity of the firm (CEO perception of the business). A non-family CEO who strongly identifies the firm as a family business may internalize family-centric logics and act more conservatively, similar to family CEOs. Conversely, a family CEO who views the firm as a professionalized enterprise may adopt a more rational, innovation-oriented approach. Thus, the CEO's perception of the business moderates the moderating role of family status, forming a moderated moderation structure in which the effects of CEO education and age on IT capabilities are shaped by both the CEO's family status and how they perceive the business.

To summarize, this study examines the impact of CEO education and age on IT capabilities in private family businesses, considering the moderating effects of CEO family status and the moderated moderation of CEO perception of the business. This research contributes to the family business and Information Systems literature by investigating CEO characteristics as antecedents of IT capabilities in the unique context of family firms. Specifically, it underscores the significance of individuals in developing IT capabilities in the digital transformation era, emphasizing the upper echelons theory and contributing to the literature that examines individual-level drivers of digital transformation in family business research (Bornhausen & Wulf, 2023; Soluk & Kammerlander, 2021). Additionally, the study adopts a holistic approach

by incorporating the mixed gamble concept, which acknowledges the complexities inherent in decision-making processes within family businesses due to the crucial role of the CEO's family status (family CEO vs. non-family CEO) (He et al., 2024). Finally, it introduces a novel theoretical lens by incorporating identity perception (CEO's perception of the business), demonstrating that CEO interpretation – not just structural roles- changes the approaches to decision-making in family firms, consequently forming a complex moderated moderation between CEO characteristics and the IT capabilities of private family firms.

2. Literature review and hypothesis development

2.1 IT Capabilities in Family Firms

Digitalization is rapidly transforming businesses, and adopting new technologies has emerged as a significant source of competitive advantage (Kraus et al., 2022; Nambisan et al., 2017; Verhoef et al., 2021). According to Soluk and Kammerlander (2021), developing IT capabilities is also crucial for family firms to remain competitive in the rapidly changing business environment. IT capabilities – the ability to effectively integrate and leverage IT resources with other company assets (Bharadwaj et al., 2013) – emerge as a fundamental factor and a vital driver of organizational agility, driving digitalization (Nwankpa & Roumani, 2016). While IT capabilities are essential for family businesses, their development can be challenging due to unique governance structures, values, and strategic preferences that distinguish them from non-family counterparts. Family firms might be more reluctant to invest in IT capabilities due to their focus on non-economic and family goals such as preserving family legacy, identity, and control (Gomez-Mejia et al., 2014). This is also confirmed by the study of Ceipek et al. (2020), as family-managed firms are found to be less inclined to pursue exploratory IoT innovations outside their existing technology due to their focus on family-centered non-economic goals.

In addition to strategic conservatism, family firms often face organizational constraints that hinder digital transformation. Prögl and Spitzley (2021) argue that internal communication styles and a strong orientation towards family identity could hinder knowledge sharing and digitalization. Additionally, resource constraints (Del Vecchio et al., 2020) and a focus on symbolic adoption rather than actual investment (Liu et al., 2023) can further hinder the development of IT.

Nonetheless, the literature also points to enabling conditions supporting digital transformation within a family firm. For instance, family influence can also positively impact digital transformation through dynamic capabilities (Soluk & Kammerlander, 2021). Moreover, unique family determinants, such as intergenerational commitment and a stewardship mindset, may accelerate digital transformation under certain conditions (Ano & Bent, 2022). These contrasting findings underscore the need to delve deeper and explore the fundamental factors that drive successful digitalization in family businesses. Further supporting this enabling perspective, De Groote et al. (2023) highlight the active role of family managers in driving digital innovation. Their study reveals how family leaders can harness the firm's collaborative culture, historical legacy, and family-financed venture capital to promote and institutionalize technological change. Rather than viewing family control as a barrier, this research suggests that, under the right circumstances, family-centric leadership can become a catalyst for digital renewal. Collectively, these findings challenge traditional assumptions of technological conservatism in family firms and emphasize the need to examine the mechanisms that shape IT capability development.

Despite the growing interest, the digitalization of family businesses has predominantly been studied from the organizational and family level perspective, focusing on factors such as family influence and resource constraints. Little is known about the individual-level drivers, particularly the role of top executives, which remains underexplored. To address this oversight,

the upper-echelon perspective provides a theoretical lens that posits that CEOs' attributes and characteristics may influence organizational outcomes (Buyl et al., 2011; Carpenter et al., 2004; Hambrick & Mason, 1984). This is even more evident in private family firms, where the CEO is generally the head of the family and the firm, concentrating the power, making it the ultimate decision-maker (De Massis et al., 2021; Hsu et al., 2013). Therefore, their attributes can significantly impact IT capability. This is evidenced by Kammerlander and Ganter (2015), who highlighted how CEOs' non-economic goals influence their perception of new technologies. Their qualitative study indicates that prioritizing "family power and control" led the CEO to view technology as crucial for maintaining influence. Moreover, Bornhausen and Wulf (2023) studied digital innovation in family firms, suggesting that family firms with lower transgenerational control intentions and a higher presence of non-family managers in the top management team (TMT) are more likely to engage in digital innovation. This underscores the importance of individuals within the family firm, notably the CEO, in IT-related decision-making.

Building upon the upper echelons theory (UET), which posits that a firm's strategic decisions are shaped by the characteristics of its top executives, mainly the CEO (Hambrick & Mason, 1984). These decisions are guided by two key mechanisms: cognitive capacity (knowledge and assumptions about events and outcomes) and values/preferences (prioritization of alternatives) (Hambrick, 2007). These mechanisms shape how executives interpret situations and make strategic choices, impacting IT capability development for digital transformation. Therefore, this study examines CEO education, representing cognitive capacity, and CEO age, reflecting values and preferences, as key UET characteristics that impact the IT capabilities of private family firms.

Furthermore, the study considers two key contextual moderators. First, it explores the moderating role of CEO family status—whether the CEO is a family member or not—as this

may influence the alignment of personal and organizational goals. Second, it incorporates the conditional effect of CEO perception of the business, conceptualized as whether the CEO subjectively views the firm as a *family business* or not, regardless of its formal structure. This perception serves as a cognitive lens through which executives interpret strategic challenges, influencing the degree to which family-related goals and identity concerns are prioritized in IT investment decisions. By examining this moderated moderation effect, the study offers a more nuanced understanding of how individual CEO traits and subjective interpretations interact with firm context to shape IT capability development.

2.1.1 Impact of CEO Education on IT Capabilities

According to UET, a CEO's educational background is expected to be a critical factor in determining a family firm's adoption and use of IT. Education is an important characteristic that helps form an individual's knowledge base, abilities, and preferences (Herrmann & Datta, 2002; Hsu et al., 2013). Studies suggest that CEOs with higher education levels possess greater cognitive complexity (Herrmann & Datta, 2002; Tihanyi et al., 2000), making them better equipped to assess the strategic value of IT. This aligns with UET, as education enables CEOs to interpret strategic opportunities more effectively and prioritize IT as a tool for operational efficiency and competitive advantage. Consequently, it is expected that highly educated CEOs are more likely to drive IT adoption, leveraging it to enhance the firm's technological capabilities.

Several studies have shown a positive correlation between education level and information technology (IT) adoption in various non-business contexts, particularly within higher education. These findings suggest that individuals with higher education levels are more likely to possess the necessary skills and knowledge to embrace and utilize IT in their activities. For instance, Eynon and Malmberg (2011) found that people with higher levels of education were more likely to use the Internet for educational purposes, which suggests that higher education

facilitates the development of the skills and competencies necessary to utilize IT tools for productive purposes. Likewise, Van Deursen and Van Dijk (2014) suggest that individuals with higher levels of education tend to use the Internet for more diverse and complex activities, indicating that higher education levels may enhance individuals' ability to handle complex information and technologies. According to Xie (2003), adults with higher levels of education were more likely to use computers and the internet for a broader range of activities, such as online banking and health information seeking, indicating that higher education levels may also enhance individuals' ability to use technology for practical purposes. Individuals with higher education are also more inclined to adopt and utilize new technologies, understanding their benefits (Alemi et al., 2018; Goldfarb & Prince, 2008).

Thus, it can be argued that higher education levels facilitate the development of IT capabilities, enabling individuals to navigate and utilize technology effectively. Therefore, a CEO's education level is expected to enhance an organization's IT capability, as an educated CEO is more likely to understand the importance and usage of IT. Hence, it is assumed that the CEO's education level will positively impact the IT capabilities of private family firms.

Hypothesis 1: The CEO's education level positively impacts the IT capabilities of a private family firm.

2.1.2 Impact of CEO's Age on IT Capabilities

In addition to the CEO's education, we expect that the CEO's age can be essential in driving the firm's development of IT capabilities. Younger individuals are generally considered more adaptable to change and willing to take risks (Müller & Neck, 2010). Their familiarity with technology, having grown up with IT, makes them more likely to invest in IT. Moreover, individuals who experience similar events during their formative years develop shared collective memories, which shape their values, behaviors, and social identities (Guerrero et al.,

2019; Yu & Miller, 2005). Thus, this age-related trait might influence how CEOs perceive and implement IT strategies (Hung et al., 2007; Micelotta et al., 2017; Yusoff et al., 2019).

Different generations exhibit distinct characteristics that influence their approach to IT. For instance, Gen Y-ers have a strong digital orientation, and Gen Z-ers are more receptive to technology (Gibson et al., 2009; Puiu et al., 2022; Wey Smola & Sutton, 2002). Generation Y, also known as the millennials, is often associated with a strong digital orientation and a desire for skill development, innovation, and new opportunities (Wong et al., 2008). According to Müller and Neck (2010), millennials are more prone to taking risks and exhibit higher adaptability than previous generations. Moreover, they have grown up in an era of rapid technological advancements and are typically more comfortable with technology, making them open to embracing new IT capabilities (Chou, 2012). Furthermore, Gen Z, the latest generation in a tech-driven environment, exhibits intelligence, fearlessness towards challenges, proactive decision-making, and a welcoming attitude toward new technology (Seemiller & Grace, 2016; Singh, 2014).

Therefore, younger CEOs, who belong to the later generations, are more likely to invest in IT capabilities. Their familiarity with technology and digital trends enables them to recognize the potential strategic advantages that IT can provide for their firms. Additionally, the inclination of younger CEOs towards risk-taking and adaptability makes them more open to exploring innovative solutions and seizing new opportunities. They are more receptive to changing circumstances and are willing to take calculated risks in implementing IT capabilities to drive organizational growth and transformation. They are expected to recognize the importance of investing in IT capabilities for their organizations' long-term success and competitiveness.

Hence, younger CEOs are assumed to be more likely to invest in IT capabilities.

Hypothesis 2: The CEO's age negatively impacts the IT capabilities of a private family firm.

2.1.3 The moderating role of CEO family status

While we expect highly educated and younger CEOs to invest more in IT capabilities, the relationship between age and education on IT capabilities will not be uniform for all CEOs. For non-family CEOs, investing in IT is a straightforward decision based on their business logic and its value for the firm. However, for family CEOs, the decision becomes more complex due to the influence of family dynamics on their priorities. The moderating effect arises from the unique priorities of family businesses, emphasizing non-economic and family goals alongside financial ones (Gomez-Mejia et al., 2011).

The socio-emotional wealth (SEW) perspective highlights these non-financial objectives, such as preserving family control, providing family jobs, and safeguarding the family legacy (Gómez-Mejía et al., 2007). These goals introduce a complex layer for family CEOs when evaluating IT investments. On the one hand, there is the potential for uncertain financial gains from advanced IT. On the other hand, they might perceive IT as a risk to SEW, potentially disrupting family control (e.g., requiring external expertise that could threaten family control or dilute the family's influence over the firm). This situation creates a "mixed gamble" (Bromiley, 2009) where family CEOs carefully weigh potential benefits and drawbacks, and this perspective positions IT investment as a trade-off for family decision-makers. Research indicates that family firms led by family CEOs tend to invest less in R&D and prefer less risky strategies (Gomez-Mejia et al., 2003). Similarly, investing in IT capability for family CEOs involves a trade-off similar to investing in R&D. This cautious approach is often attributed to their desire to maintain family control (Duran et al., 2016). Through a qualitative study, Kammerlander and Ganter (2015) indicated that a CEO's non-economic goals influence whether they view emerging technology as relevant enough to necessitate a response. Consequently, family CEOs, due to their prioritization of SEW and focus on non-economic goals, may perceive IT as more of a threat than an opportunity.

While higher CEO education might be associated with better IT capabilities, the SEW perspective suggests that this relationship may be weaker for family CEOs. The perceived risk of disrupting family control or jeopardizing the legacy can outweigh the potential benefits of IT capability, even if the CEO understands them. Consequently, even with a high level of education, a family CEO might hesitate due to potential threats to SEW to invest in the firm's IT capabilities. However, for a non-family CEO, it will be a straightforward decision based on business logic; therefore, they may more freely pursue IT capability development aligned with their cognitive characteristics, without having any legacy constraints or family obligations.

Hence, it is hypothesized:

Hypothesis 3a: Family status moderates the positive effect of CEO education level on the IT capabilities of a private family firm in such a way that for non-family CEOs, the effect is stronger than for family CEOs.

Similarly, for age, even if a family CEO is young and potentially more open to IT investments, the influence of family interests and traditions may constrain their decision-making process. The responsibility to preserve family control and legacy often outweighs their inclination to take risks and IT capabilities. In contrast, it will be a straightforward decision for a non-family CEO. As a result, the expected negative link between the CEO's age and IT capabilities is stronger in non-family firm CEOs than in family CEOs.

Hence, it is hypothesized:

Hypothesis 3b: Family status moderates the negative effect of the CEO's age on the IT capabilities of a private family firm in such a way that for non-family CEOs, the effect is stronger than for family CEOs.

2.1.4 The moderated moderation of CEO Perception

While we expect the non-family CEO to positively moderate the relationship between CEO education level and IT capabilities, this effect is not uniform across all contexts. A critical contingent factor is the CEO's perception of the firm's identity, particularly whether they view it as a family business. CEOs who perceive the firm as a traditional family business may be more conservative in adopting technology, due to the tendency of family firms to prioritize socioemotional wealth and long-term stability over innovation (Gómez-Mejía et al., 2007). Consequently, even a non-family CEO might demonstrate greater resistance to technologies despite their generally positive predisposition toward IT capabilities. In contrast, if the non-family CEO sees the business through a non-familial or professionally managed lens, they are not bound to family-related constraints (Sun et al., 2023). Consequently, they may feel more empowered to implement IT advancements, leveraging their educational background to enhance IT capabilities.

Hypothesis 4: The positive moderating effect of a non-family CEO on the relationship between CEO education level and IT capabilities is stronger when the CEO does not perceive the firm as a family business.

2.2 Theoretical Framework

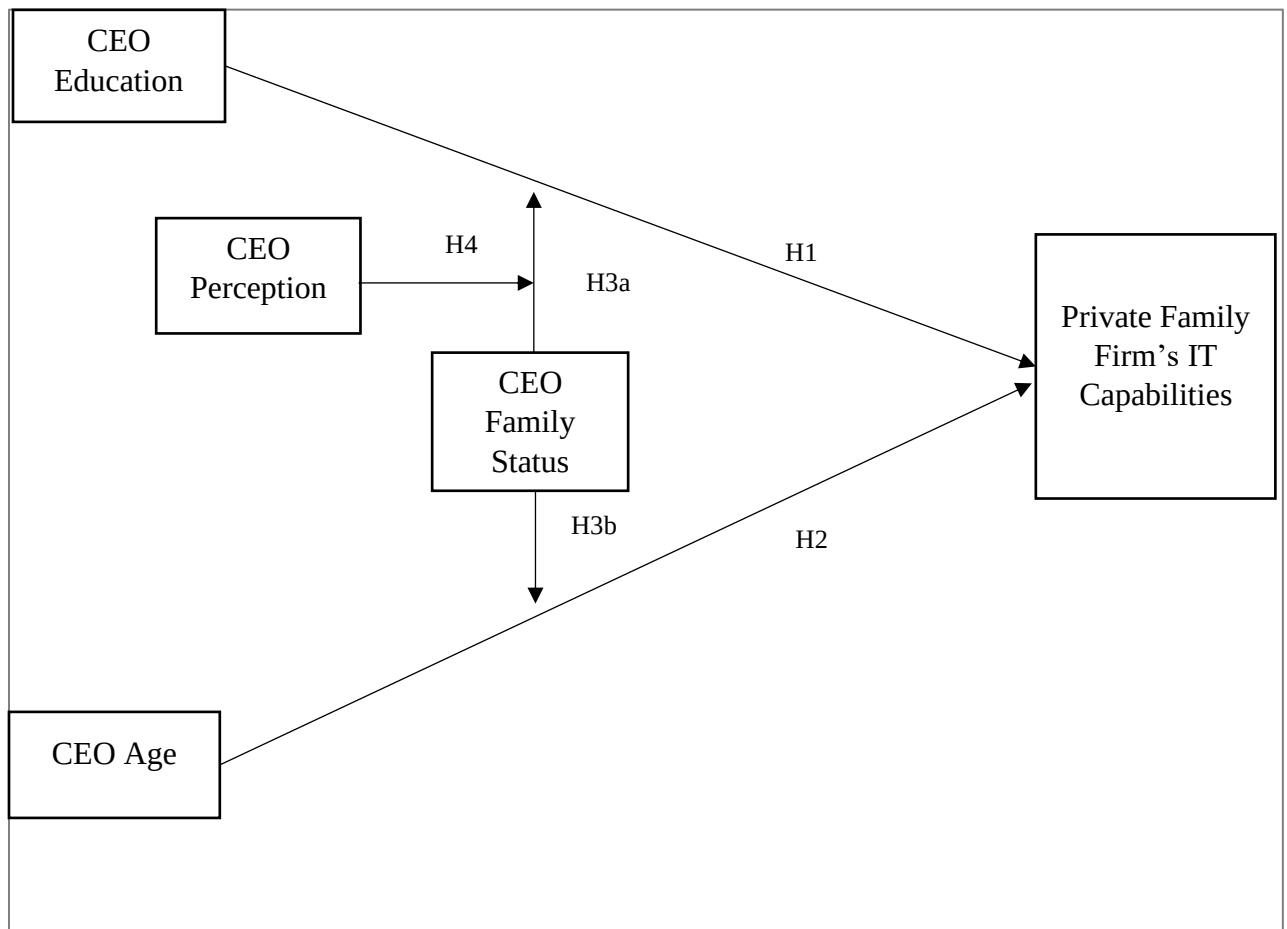


Figure 1. The theoretical framework

3. Methodology

3.1 Research Sample

This study employed a survey-based approach to collect data from CEOs of family businesses in Belgium. The survey was distributed anonymously through a third-party network, Xerius, and received over 1,900 responses. For this study, we selected only those firms in which a family owns more than 50% of the shares. Furthermore, we refined the sample by including only small and medium-sized family firms with no more than 250 employees. This resulted in a final sample of 608 firms for further analysis.

3.2 Measures

3.2.1 Dependent Variable: The measurement of the dependent variable was adopted from prior literature. A seven-point Likert scale was used to measure the items, giving respondents greater flexibility in expressing their opinions and reducing range restriction (Allen & Seaman, 2007). Compared to the five-point scale, the seven-point Likert scale allows for increased variability and skewness in responses (de Winter & Dodou, 2010). This study employs a survey-based approach to assess IT capabilities, utilizing the three-dimensional construct developed by Lu and Ramamurthy (2011). The construct includes three dimensions: IT infrastructure capability, IT business spanning capability, and IT proactive stance. The items used to measure each dimension are presented below.

IT Infrastructure Capability	• IIC1: Data management services & architectures (e.g., databases, data warehousing, data availability, storage, accessibility, sharing, etc.) • IIC2: Network communication services (e.g., connectivity, reliability, availability, LAN, WAN, etc.) • IIC3: Application portfolio & services (e.g., ERP, ASP, reusable software modules/components, emerging technologies, etc.) • IIC4: IT facilities' operations/services (e.g., servers, large-scale processors, performance monitors, etc.)
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IT Business Spanning Capability	• IBC1: Developing a clear vision regarding how IT contributes to business value • IBC2: Integrating business strategic planning and IT planning • IBC3: Enabling functional area and general management's ability to understand the value of IT investments • IBC4: Establishing an effective and flexible IT planning process and developing a robust IT plan
IT Proactive Stance	• IPS1: We constantly keep current with new information technology innovations • IPS2: We are capable of and continue to experiment with new IT as necessary • IPS3: We have a climate that is supportive of trying out new ways of using IT • IPS4: We constantly seek new ways to enhance the effectiveness of IT use

3.2.2 Independent Variable: To measure the education level of the CEO, this study uses the measurement approach used by Herrmann and Datta (2005), based on the highest degree earned: 1 = Primary or secondary education, 2 = Bachelor's degree, 3 = Master's degree, 4 = Ph.D. Moreover, CEO age is measured as the number of years from birth (Belenzon et al., 2019; Herrmann & Datta, 2002).

3.2.3 Moderating Variable: In line with the previous research (Banalieva & Eddleston, 2011; Bauweraerts et al., 2024), this research uses a dummy variable for family status and scores 1 if the non-family CEO; otherwise, 0.

3.2.4 Moderated Moderator: To measure CEO perception, this study uses a dummy variable. A value of 1 is assigned if the CEO perceives the business to be a family firm; otherwise, 0.

3.2.5 Control Variables: In line with previous research, this study uses some control variables. Firstly, CEO tenure is measured as the number of years the individual has served as CEO within the firm (He et al., 2024). Secondly, firm age is measured as the number of years since incorporation, and leverage is calculated as the debt-to-asset ratio (Ceipek et al., 2020). Furthermore, firm size is calculated using total annual sales (Maqsood et al., 2025). To reduce skewness, firm age and firm size are both measured in a natural logarithm transformation. Moreover, industry dummies are also created for retail and production.

4. Results

4.1.Descriptive statistics

Table 1 presents descriptive statistics for 608 firms. IT capabilities average 3.86 on a 7-point scale (SD = 1.35), indicating moderate adoption with considerable variation. The average CEO is 53 years old with 15 years of tenure, reflecting experienced leadership. CEO education averages 2.27 on a 4-point scale, suggesting that most hold at least an undergraduate degree. Firm characteristics display substantial heterogeneity. Firm size (log of total annual sales) averages 12.24 (SD = 2.39), while firm age, also log-transformed, averages 2.56 (SD = 1.01), reflecting a wide range from startups to mature firms. Leverage shows enormous dispersion, averaging 12% but ranging from 0% to 100% (SD = 19.93), indicating diverse capital structures. Only 5% of firms are in production and 5% in retail, suggesting that other sectors dominate the sample.

Table 1: Descriptive statistics

	Mean	SD	Min	Max
IT Capabilities	3.86	1.3502	1	7
CEO education level	2.27	0.84	1	4
CEO Age	53.37	10.38	25	80
Firm Size	12.239	2.3864	2.08	17.88
Firm Age	2.556	1.0144	0	4.96
Firm Leverage	12.03	19.93	0	100
CEO Tenure	15	11.4	1	57
Industry Production	0.05	0.22	0	1
Industry Retail	0.05	0.22	0	1

N=608

Table 2 presents the pairwise correlations among the study variables. The results indicate that IT capabilities are positively associated with firm size and negatively associated with CEO age.

This suggests that larger firms and younger CEOs are more inclined toward technological development. The strongest relationships observed are between CEO tenure and firm age. Additionally, firm size correlates with CEO and firm age, indicating that larger firms tend to have more experienced leadership. Firms led by older CEOs tend to have lower leverage, which may reflect more conservative financial strategies. Industry variables show weak associations with other attributes, suggesting that sectoral differences have a limited impact on the observed relationships. While some variables display moderate correlations, there is no evidence of strong multicollinearity among the independent variables, indicating that multicollinearity is unlikely to affect subsequent regression analyses.

Table 2: Correlations

	1	2	3	4	5	6	7	8	9
1. IT Capabilities	—								
2. CEO Education Level	.079 (.052)	—							
3. CEO Age	-.120** (.003)	.115** (.004)	—						
4. Firm Size	.127** (.002)	-.085* (.036)	-.030 (.454)	—					
5. Firm Age	-.018 (.664)	-.031 (.438)	.349*** ($<.001$)	.352*** ($<.001$)	—				
6. Firm Leverage	.025 (.541)	-.070 (.084)	— .249*** ($<.001$)	.115** (.005)	.030 (.457)	—			
7. CEO Tenure	-.032 (.430)	-.042 (.299)	.501*** ($<.001$)	.133*** (.001)	.689*** ($<.001$)	-.067 (.100)	—		
8. Industry Production	.023 (.564)	-.033 (.421)	.087* (.032)	.151*** ($<.001$)	.064 (.114)	.026 (.518)	.032 (.434)	—	
9. Industry Retail	-.057 (.163)	-.038 (.352)	.007 (.857)	.036 (.380)	.087* (.031)	-.018 (.666)	.094* (.020)	-.054 (.186)	—

*** $P < 0.001$; ** $p < 0.01$; * $p < 0.05$; $N = 608$

4.2. Linear Regression

The effects of CEO education level and CEO age on IT capabilities are examined using a linear regression model in SPSS software. This analysis also accounted for several control variables, including CEO tenure, firm age, firm size, leverage, and industry sector. The

regression model yielded statistically significant results, $F 3.64, p < .001$, indicating that the predictors collectively explain a meaningful portion of the variance in IT capabilities. The model accounted for approximately 4.6% of the variance in ITC ($R^2 = 0.046$; Adjusted $R^2 = 0.034$).

In support of Hypothesis 1, CEO education was positively associated with IT capabilities ($B = 0.171, p = 0.009$). This finding suggests that firms led by more highly educated CEOs tend to show greater development in their IT capabilities. Conversely, CEO age had a significant negative impact on ITC ($B = -0.019, p = 0.002$), indicating that older CEOs may be less likely to prioritize or invest in IT capabilities, thereby confirming hypothesis 2. Among the control variables, only firm size was a significant predictor ($B = 0.081, p = 0.001$), suggesting that larger private family firms are more inclined to develop stronger IT capabilities. Other control variables, including CEO tenure, firm age, firm leverage, and industry sector, did not show significant relationships with ITC.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.215a	0.046	0.034	1.327342
a. Predictors: (Constant), DebtR, IndRe, IndP, EDU, Firm_Age, FirmSS, Age, CEOTenure				

Table: 3a

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.312	8	6.414	3.64	<.001b
	Residual	1055.34	599	1.762		
	Total	1106.652	607			
a. Dependent Variable: ITC						
b. Predictors: (Constant), DebtR, IndRe, IndP, EDU, Firm_Age, FirmSS, Age, CEOTenure						

Table:3b

		Coefficients ^a			t	Sig.
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta		
1	(Constant)	3.606	0.452		7.982	<.001
	CEO Education	0.171	0.065	0.107	2.624	0.009
	CEO Age	-0.019	0.006	-0.148	-3.047	0.002
	CEO Tenure	0.008	0.007	0.071	1.179	0.239
	Firm Age	-0.076	0.079	-0.057	-0.967	0.334
	Firm Size	0.081	0.025	0.143	3.248	0.001
	Firm Leverage	-0.001	0.003	-0.016	-0.384	0.701
	Industry Production	0.102	0.246	0.017	0.414	0.679
	Industry Retail	-0.359	0.251	-0.058	-1.434	0.152

a. Dependent Variable: ITC

Table:3c

4.2.2 Moderation

The moderation of non-family CEOs on the direct relationship between CEO education level and IT capabilities in private family firms is measured using moderation analysis through Hayes' PROCESS macro (Model 1). The analysis revealed a significant moderating effect of non-family CEO status on the relationship between CEO education level and IT capabilities in private family firms. The interaction between CEO education and non-family CEO status was positive and statistically significant ($b = 0.5871$, $SE = 0.2664$, $t = 2.2043$, $p = .0279$), indicating that the positive association between CEO education and IT capabilities is stronger when the CEO is a non-family member. Conditional effects analysis showed that for family CEOs (NFCEO = 0), CEO education had a modest but significant positive effect on IT capabilities ($b = 0.1351$, $p = .0444$). In contrast, the effect was significantly stronger for non-family CEOs (NFCEO = 1) ($b = 0.7223$, $p = .0053$). The interaction accounted for a significant increment in explained variance ($\Delta R^2 = .0077$, $p = .0279$). These findings suggest that the positive impact of CEO education on IT capability is amplified in the presence of a non-family CEO, providing statistical evidence for Hypothesis 3a.

Predictor	Coefficient (B)	SE	t	p	LLCI	ULCI
Constant	3.709	0.454	8.178	< .001	2.818	4.600
CEO Education (EDU)	0.135	0.067	2.015	0.044	0.003	0.267
Non-Family CEO (NFCEO)	-1.198	0.599	-2.001	0.046	-2.374	-0.022
EDU × NFCEO (Interaction)	0.587	0.266	2.204	0.028	0.064	1.110
CEO Age	-0.019	0.006	-3.051	0.002	-0.032	-0.007
Firm Age	-0.096	0.080	-1.203	0.229	-0.254	0.061
Firm Size	0.082	0.025	3.276	0.001	0.033	0.131
Firm Leverage	-0.001	0.003	-0.304	0.761	-0.006	0.005
CEO Tenure	0.010	0.007	1.326	0.186	-0.005	0.024
Industry Production	0.085	0.245	0.347	0.728	-0.397	0.567
Industry Retail	-0.340	0.250	-1.357	0.175	-0.831	0.152

N=608

Table:4a

Model Summary
R = 0.2325, R ² = 0.0541, F(10, 597) = 3.41, p = .0002
Interaction Effect
Change in R ² (ΔR^2) = 0.0077, F(1, 597) = 4.86, p = .0279

Table:4b

Conditional Effects of CEO Education on IT Capabilities by Non-Family CEO Status						
NFCEO Status	Effect of EDU on ITC	SE	t	p	LLCI	ULCI
0 = Family CEO	0.1351	0.0671	2.0149	0.0444	0.0034	0.2668
1 = Non- Family CEO	0.7223	0.2583	2.7957	0.0053	0.2149	1.2297

Table:4c

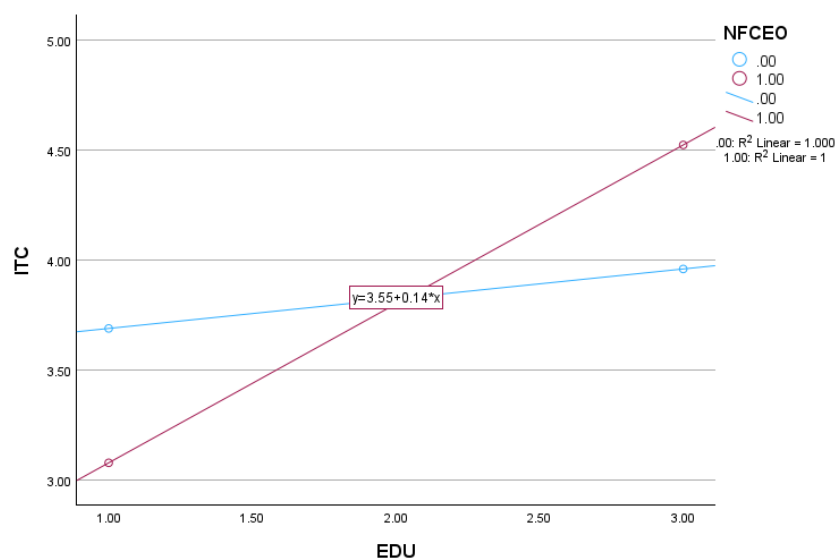


Figure 2. Moderation of NFCEO (Non-Family CEO)

Furthermore, the moderation impact of non-family CEOs is checked on the direct relationship between CEO age and ITC through Hayes' PROCESS macro (Model 1). The interaction term between CEO age and Non-Family CEO (NFCEO) is statistically non-significant ($B = 0.0025$, $p = .9049$). Moreover, the change in explained variance due to the interaction was negligible ($\Delta R^2 = .0000$), indicating no meaningful moderating effect. This result implies that CEO family status—whether family or non-family—does not significantly change the influence of CEO age on IT capabilities. Hence, there is no statistical evidence for hypothesis 3b.

Predictor	Coefficient (B)	SE	t	p	LLCI	ULCI
Constant	3.6174	0.4596	7.8711	< .001	2.7148	4.52
CEO Age	-0.0195	0.0065	-3.0007	0.0028	-0.0322	-0.0067
Non-Family CEO (NFCEO)	-0.1169	1.1762	-0.0994	0.9209	-2.4268	2.1931
Age $\times$ NFCEO Interaction	0.0025	0.0213	0.1195	0.9049	-0.0393	0.0443
CEO EDU	0.171	0.0653	2.6188	0.009	0.0428	0.2993
Firm Age	-0.0779	0.0801	-0.9728	0.3311	-0.2351	0.0794
Firm Size	0.0811	0.0251	3.2335	0.0013	0.0318	0.1303
Firm Leverage	-0.0011	0.0028	-0.3836	0.7014	-0.0066	0.0045
CEO Tenure	0.0085	0.0072	1.1819	0.2377	-0.0056	0.0227
Industry Production	0.1022	0.2463	0.4147	0.6785	-0.3816	0.5859
Industry Retail	-0.3575	0.2514	-1.4219	0.1556	-0.8512	0.1363

N=608
Table:5a

Summary of Interaction					
Interaction Term	ΔR^2	F	df1	df2	p-value
Age $\times$ NFCEO	0	0.0143	1	597	0.9049

Table:5b

4.2.3 Moderated Moderation

The conditional effect of CEO perception of the business (whether the firm is considered a family business or not) on the moderating impact of non-family CEO on the direct relationship between CEO education and ITC is measured using the process Hayes macros model 3.

The three-way interaction ($\text{EDU} \times \text{NFCEO} \times \text{CEOPcp}$) is statistically significant ($b = -1.5235$, $p = .0136$), indicating a moderated moderation effect. Specifically, the positive moderating effect of a non-family CEO on the relationship between CEO education (EDU) and IT capabilities is stronger when the CEO does not perceive the firm as a family business ($\text{CEOPcp} = 0$). When the CEO does view the firm as a family business ($\text{CEOPcp} = 1$), this moderating effect disappears or reverses.

At $\text{CEOPcp} = 0$, the interaction between education and non-family CEO is positive and significant ($b = 1.0604$, $p = .0008$), suggesting that education leads to higher IT capabilities in firms led by non-family CEOs only when they do not identify the firm as a family business. In contrast, at $\text{CEOPcp} = 1$, the conditional effect becomes non-significant ($b = -0.2623$, $p = .6024$), confirming hypothesis 4. These findings underscore that the effectiveness of CEO education in enhancing IT capabilities through non-family CEOs depends on whether the CEO perceives the firm as a family business, emphasizing the complexities of the family business.

Predictor	b	SE	t	p	LLCI	ULCI
Intercept	4.142	0.541	7.65	< .001	3.08	5.205
CEO Education (EDU)	-0.023	0.138	-0.17	0.868	-0.293	0.247
Non-family CEO (NFCEO)	-2.396	0.746	-3.21	0.001	-3.861	-0.932
EDU $\times$ NFCEO	1.083	0.345	3.14	0.002	0.407	1.76
CEO Perception (CEOPcp)	-0.606	0.393	-1.54	0.124	-1.378	0.166
EDU $\times$ CEOPcp	0.201	0.157	1.28	0.201	-0.107	0.509
NFCEO $\times$ CEOPcp	3.877	1.493	2.6	0.01	0.944	6.81
EDU $\times$ NFCEO $\times$ CEOPcp	-1.524	0.615	-2.48	0.014	-2.732	-0.315
Control Variables						
CEO Age	-0.019	0.006	-3.05	0.002	-0.032	-0.007
Firm Age	-0.105	0.081	-1.3	0.193	-0.263	0.053
Firm Size (Sales)	0.084	0.025	3.32	0.001	0.035	0.134
Firm Leverage	-0.0003	0.003	-0.1	0.92	-0.006	0.005
CEO Tenure	0.011	0.007	1.54	0.125	-0.003	0.025
Industry Production	0.059	0.246	0.24	0.812	-0.425	0.542
Industry Retail	-0.3	0.251	-1.2	0.232	-0.793	0.193

N=608

Table:6a

Model Summary						
R	R ²	MSE	F	df1	df2	p
0.258	0.067	1.742	3.02	14	593	< .001

Table:6b

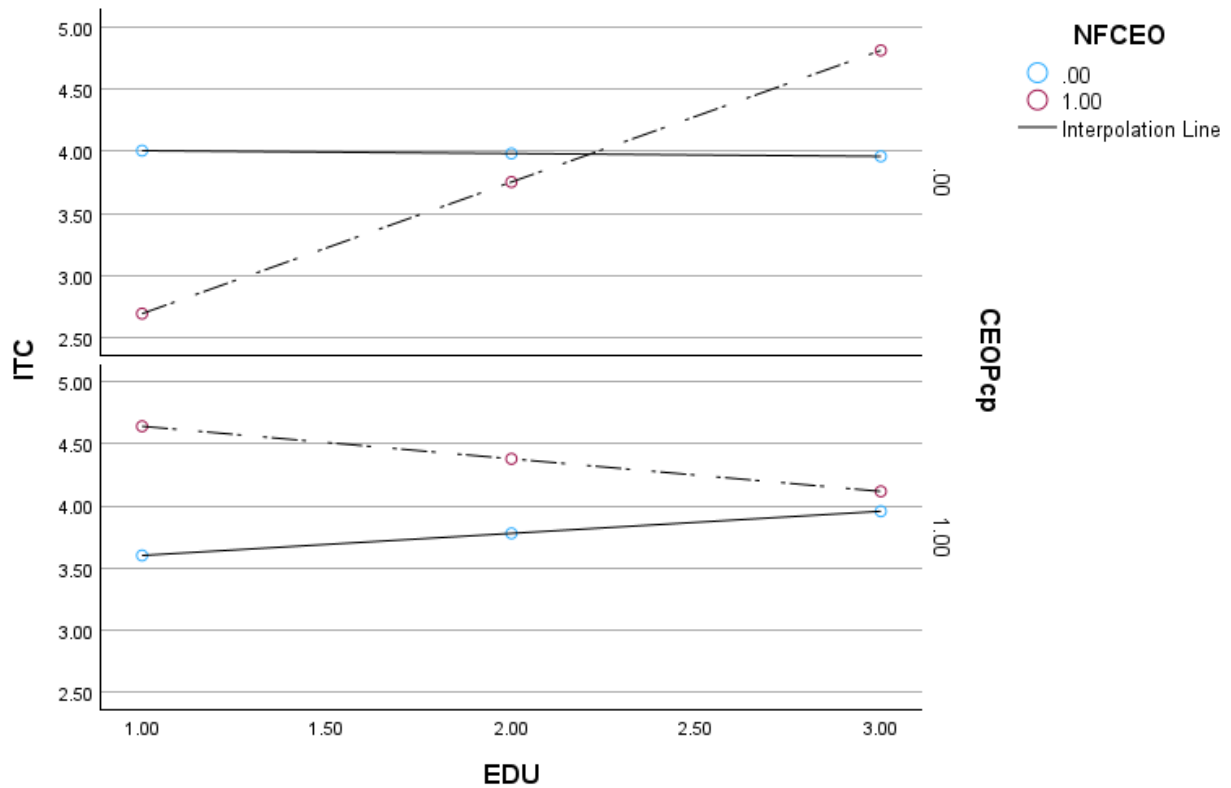


Figure 3. Moderation-Moderation of CEO Perception

The upper portion of the graph illustrates the scenario where the CEO does not perceive the firm as a family business. Here, the red circles (non-family CEOs) show a strong positive relationship between CEO education and IT capabilities, while the blue dots (family CEOs) reveal little to no association. In the lower portion, where CEOs perceive the firm as a family business, the blue dots indicate a slightly positive relationship between education and IT capabilities. In contrast, the red dots show a negative relationship, suggesting that higher education levels are linked to lower IT capability development for non-family CEOs in a family business context. This pattern emphasizes the CEO's perception of the firm's identity as a crucial factor affecting the relationship between education and strategic outcomes, highlighting that the positive impact of CEO education on IT capabilities is strongest when non-family CEOs do not frame the firm as a family business.

Hypothesis	Statement	Supported	Remarks
H1	CEO Education (EDU) is positively related to IT Capabilities (ITC)	Yes	Significant positive relationship ($B = 0.171, p < 0.01$)
H2	CEO Age is negatively related to IT Capabilities (ITC)	Yes	Significant negative relationship ($B \approx -0.019, p < 0.01$)
H3a	NFCEO moderates the relationship between CEO Education and ITC	Yes	EDU $\times$ NFCEO interaction significant ($B = 0.587, p < 0.05$)
H3b	NFCEO moderates the relationship between CEO Age and ITC	No	Results not significant
H4	CEO perception (CEOPcp) moderates the moderating impact of NFCEO - CEO Education and ITC (3-way interaction)	Yes	EDU $\times$ NFCEO $\times$ CEOPcp significant ($B = -1.524, p < 0.05$)

Table 7: Summary of Hypothesis Testing

5.0 Discussion and conclusion

This study explored the influence of CEO characteristics—specifically education and age—on the development of IT capabilities in private family firms, while considering the moderating impact of CEO family status and the moderated moderation of CEO perception of the business. Consistent with upper echelon theory (UET), our findings demonstrate that CEO education positively impacts IT capability development, while CEO age has a negative effect. These results confirm that cognitive bases (education) and values/preferences (age) significantly shape strategic decisions regarding IT capabilities, which is the foundation of digital transformation in family firms.

The positive impact of CEO education reinforces prior research suggesting that educational attainment enhances cognitive capacity and openness to innovation (Alemi et al., 2018). Educated CEOs are likely better equipped to recognize the strategic value of IT and manage the complexities of digital transformation. In contrast, the negative association between CEO age and IT capabilities supports literature highlighting that younger leaders are more technologically adept and adaptive to change (Müller & Neck, 2010).

The moderation analysis revealed that the positive effect of CEO education on IT capabilities is significantly stronger when the CEO is a non-family member. This finding suggests that non-family CEOs may operate with fewer constraints from family-centered goals and

socioemotional wealth considerations. This allows them to leverage their educational background more freely in pursuing IT capability development. In contrast, family CEOs may weigh the benefits of IT investments against family-related tradeoffs, such as potential loss of control or risks inconsistent with family values, which can dilute the effect of education on IT capability development (Gomez-Mejia et al., 2011; He et al., 2024). Interestingly, family status did not moderate the negative relationship between CEO age and IT capabilities, indicating that the effect of CEO age operates similarly regardless of whether the CEO is a family member or not.

The moderated-moderation analysis further highlighted that CEO perceptions of the firm as a family business shape the strength of these interactions. Non-family CEOs who do not identify the firm as a family business demonstrate the strongest education-ITC link, suggesting fewer psychological or cultural constraints. Conversely, family CEOs who perceive the firm as professionalized show a stronger positive link between education and IT capabilities.

These findings underscore the importance of both structural (e.g., family status) and perceptual (e.g., firm identity perception) factors in shaping CEO influence. In line with the mixed gamble concept, the study demonstrates how family business leaders navigate the dual pressures of business rationality and socioemotional considerations.

This study enriches the family business literature by integrating UET and the mixed gamble perspective. It highlights that CEO education and age are not standalone predictors of digital advancement. However, their effects are conditioned by the CEO's family affiliation and their subjective interpretation of the business. By bringing CEO perception, the study offers a more nuanced view of how individual leaders and their perception change the development of IT capabilities in family firms.

6.0 Limitations and future research

Despite these findings, this study has several limitations. First, the cross-sectional design limits causal inferences; future longitudinal research could better capture dynamic changes in CEO influence and IT capability development over time. Second, the sample focuses on private family firms within a particular geographic context, which may limit generalizability.. Expanding the sample across countries or continents could provide a more comprehensive understanding of CEO effects in varying family firm ecosystems. Lastly, the study focuses on only two CEO characteristics—education and age. While these are central to upper echelons theory, other psychological and behavioral traits, such as risk tolerance or innovativeness, may offer additional explanatory power. Future research should explore a broader range of CEO attributes and their interactions with family business dynamics.

Disclaimer:

This is a work-in-progress paper submitted for presentation at the IFERA conference 2025. The purpose of this submission is to receive constructive feedback from experts and fellow researchers to improve the quality of the research.

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