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ORIGINAL CONTRIBUTION

Entrepreneurship and Digital Innovation: Adoption of Artificial Intelligence (AI) in French Family Business Firms

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Abstract— The study examines a major emphasis on investigating how training contributes to the growth of digital innovation in family businesses. The goals and prerequisites for entrepreneurial education need to be reevaluated in light of the significantly changed entrepreneurial landscape brought about by the dynamic character of the digital age and the ongoing digitization of business models. This change is necessary to bring educational strategies into line with the burgeoning digital reality of entrepreneurship. The main objective of the study is to investigate the impact of entrepreneurial passion on digital innovation within family-owned enterprises, with a unique focus on modifying the adoption of Artificial Intelligence (AI) and examining the mediating role of perceived family support. Data were collected from 150 owners/CEOs of family business firms located around Paris through an online survey employing a longitudinal study design. The study spans three-time points: Time 1 data, collected in June 2023, captures demographics, entrepreneurship education, and entrepreneurial passion. Time 2 data, gathered in July 2023, explores perceived family support and the adoption of AI. Finally, time 3 data, collected in August 2023, centres on digital innovation within family businesses. The Smart PLS method is employed for data analysis, with a comprehensive questionnaire administered through online surveys. The findings from this study offer valuable insights into the nuanced relationships between entrepreneurial passion, AI adoption, perceived family support, and digital innovation, contributing to the growing body of knowledge in the field of family business research.

Index Terms— Entrepreneurial education, Entrepreneurial passion, Digital innovation in family business, AI adoption, Perceived family support, Theory of planned behavior, Innovation diffusion theory

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Introduction

In less than 20 years, digital innovation has triggered a crucial upheaval for economies worldwide. At present, the largest global firms are no longer operating in industrial sectors but belong to digital innovations. Surprisingly, despite the prevalence of family businesses around the world, research on their contribution to digital innovation is lacking. Yet, recently, a survey by KPMG (2017) suggests that digitalization and innovation are two of the top three concerns keeping family businesses awake at night. This fact is more important since family firms represent more than two-thirds of all firms in Western countries. They represent 90 per cent of firms in the USA, 93 per

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cent in Italy, 80 per cent in Greece, 79 per cent in Sweden, 75 per cent in Spain, 70 per cent in Belgium, more than 60 per cent in France and 60 per cent in Germany (IFERA, 2003).

Companies, especially family-run ones, face enormous strategic hurdles when they decide to become global (Meier & Thelisson, 2021). A thorough analysis of the variables influencing family businesses' worldwide growth is necessary because they are an essential part of the world's economy. Family businesses have unique traits that show themselves as strengths and weaknesses and influence their strategic behaviour (Basly & Saunier, 2020). Their goals go beyond corporate concerns to encompass affective, emotional, and familial aspects. Family businesses are the source of significant study efforts and ongoing attention among practitioners because they are positioned at the intersection of economic and emotional justifications. Given their importance on a national and international level, it is imperative to conduct a thorough investigation into the internal dynamics of these companies and how they may affect internationalization, particularly about France and the larger global scene (Chatterjee, Chaudhuri, Vrontis, & Basile, 2022; Jneid, 2023).

Based on a comprehensive analysis, an unlisted family business with 8,500 employees, and a wealth of research on family business dynamics, the paper makes its conclusions (Basly & Saunier, 2020; Setyowati & Hakim, 2022). With a revenue of 112 million euros as of 2016, Chatterjee et al. (2022) has made a name for itself as a highly diversified company in the cleaning industry, focusing on hygiene and cleaning solutions for professional and residential use. The example focuses on a voluntary succession scenario, in which a family member takes over the company, highlighting the difficulties that arise during this crucial period of transition. Numerous technical advancements continue to hasten the world's rapid progress. This forces businesses to face a strategic imperative, as noted by Saleem, Hoque, Tashfeen, and Weller (2023), which is the effective adoption of cutting-edge new technology.

Chatterjee et al. (2022), Sitaridis and Kitsios (2023) and Upadhyay, Upadhyay, Al-Debei, Baabdullah, and Dwivedi (2023) . Digital technologies are having an increasing impact on businesses of all sizes and in a variety of industries. These technologies, which include methods, procedures, instruments, and processes that use binary digits, such as data analytics and cloud computing (Bornhausen & Wulf, 2023), (Ferraro & Cristiano, 2021), are essential. Prior studies highlight how implementing digital technologies can give a company a competitive advantage (Soluk, 2022; Upadhyay et al., 2023) and greatly increase its long-term success (Ferraro & Cristiano, 2021; Sitaridis & Kitsios, 2023). One example of this is when a company uses digital distribution channels to expand into new markets.

Family businesses are important drivers of economic growth and development in many nations; they have an impact on demand patterns, employment levels, portfolio decisions, and educational initiatives, among other things (Bornhausen & Wulf, 2023; Ferraro & Cristiano, 2021; Soluk, Miroshnychenko, Kammerlander, & De Massis, 2021; Upadhyay et al., 2023). Specific characteristics set family businesses apart from other kinds of businesses, as noted by Baluku, Kikooma, Otto, König, and Bajwa (2020) and Jneid (2023). These traits include a familial connection to the business and variations between family members and outside managers' time horizons, goals, motives, and stakes in the company's success. Other differentiating factors include the process of making strategic decisions, an organizational structure, specifically the degree of centralization and vigour of control activities, interactions between family members and other stakeholders, internal family dynamics, and the critical component of succession (Bose & Pal, 2020; Parrado-González & León-Jariego, 2020).

Understanding the importance of these critical distal variables can be critical to improving the efficacy of entrepreneurship education initiatives. The availability of information that is essential for spotting opportunities and activating cognitive processes to assess them using available data is made possible by entrepreneurship education (Sitaridis & Kitsios, 2023; Yi & Duval-Couetil, 2022). Because of the easy access to international markets offered by the development of digital technologies, entrepreneurial processes have evolved. This has made IT capabilities investors more competitive and opened up new business prospects (Munawar, Yousaf, Ahmed, & Rehman, 2023), (Wang et al., 2023). Sitaridis and Kitsios (2023) note that while digital communication technology has made information more accessible to a larger audience, it has also expanded the pool of potential competitors beyond traditional brick-and-mortar business ownership. The requirement for human capital is growing due to rising competition, which emphasizes the importance capabilities play in fostering digital innovation and entry-level digital entrepreneurship (Liao, Nguyen, Yeong, Hong Vu, & Trinh, 2023; Munawar et al., 2023). Enthusiasm is often linked to entrepreneurs, and it is thought that this enthusiasm increases their efficacy in starting and maintaining successful businesses (Anjum, Heidler, Amoozegar, & Anees, 2021; Hubner, Baum, & Frese, 2020). Consciously accessible, intense positive feelings experienced by engagement in entrepreneurial activities associated with roles that are meaningful and salient to the self-identity of the entrepreneur (Syed, Butler, Smith, & Cao, 2020), (Zollo, Rialti, Tron, & Ciappei, 2021) are one way to conceptualize entrepreneurial passion . The entrepreneurial process is often characterized by enthusiasm, and it's critical to comprehend the driving forces behind both novice and seasoned company owners (Hubner et al., 2020; Lex, Gielnik, Spitzmuller, Jacob, & Frese, 2022; Santos & Cardon, 2019). But when it comes to the specific mechanisms and conditions under which entrepreneurs' excitement improves employee outcomes, there is a severe lack of theoretical frameworks and empirical data (Chiengkul, Tantipanichkul, Boonchom, Phuangpornpitak, & Suphan, 2023; Jneid, 2023).

Within the ever-changing realm of entrepreneurship, family support plays a crucial and complex role that profoundly affects a person's entrepreneurial journey. Employees' work lives are greatly impacted by their families, and vice versa. Family obligations have frequently been identified as a key factor influencing career preferences and choices. However, family responsibilities change depending

on a person's stage of life. A person's time, effort, and energy are required for a variety of duties that arise from different life events. It can be difficult at times to strike a balance between the competing demands of job and family (Baluku et al., 2020; Parrado-González & León-Jariego, 2020). Employees usually deal with constraints, challenges, and struggles in trying to find a balance between these two aspects of their lives; they frequently make compromises in one of these areas and manage seemingly incongruous but important aspects of their lives (Mayrhofer, Meyer, Schiffinger, & Schmidt, 2008). According to Chatterjee, Chaudhuri, and Vrontis (2023), "The roles of work and family are increasingly at odds with one another." Family responsibility, according to Ferraro and Cristiano (2021), is having a sense of duty and accountability to one's family members and considering their needs and desires while making decisions (Jneid, 2023; Schnettler et al., 2018; Uddin, Ali, & Khan, 2020).

With notable advancements made in the last ten years, artificial intelligence is a disruptive innovation that is positioned to lead the next wave of corporate digital transformation Chatterjee, Chaudhuri, Kamble, Gupta, and Sivarajah (2023); Pan, Froese, Liu, Hu, and Ye (2022); Upadhyay et al. (2023). The development of AI technology has revolutionized the way businesses manage their human resources by bringing new functions to the field (Baluku et al., 2020; Nam, Dutt, Chathoth, Daghfous, & Khan, 2021) . Globally, investment in AI and cognitive solutions is growing at a strong 50.1% Cumulative Annual Growth Rate (CAGR), and estimates suggest that by Nam et al. (2021), it will probably reach USD 57.6 billion (Upadhyay et al., 2023). However, in France, the adoption of AI is very slow and restricted; according to research conducted in 2019, only 26% of enterprises used AI for any business processes (Baluku et al., 2020) . The present study determines the relationship between entrepreneurship education, entrepreneurship passion for digital innovation in the family business, and the mediating role of perceived family support and adoption of AI as moderators, as well as innovation diffusion theory and planned behaviour theory involved.

Literature Review

Due to the disruptive nature of technologies, the undertaking of digital entrepreneurial activities is becoming a necessity rather than a choice (Leong, Pan, & Liu, 2016). However, while technology-based firms are inherently more positive about the future possibilities of IT, traditional firms and industries often face contradictory tendencies when it comes to digital entrepreneurship (Leong et al., 2016). Hu, Huang, Zeng, and Zhang (2016) find that contradiction arises from the staff's preference for stability extended from the past as opposed to the potential of an uncertain future. While this contradiction might apply to the case of many family firms, entrepreneurship, in general, and innovation are crucial to ensure their sustainability and their ultimate goal—succession (Chua, Chrisman, & Sharma, 1999; Jam et al., 2011). Therefore, researching innovation and entrepreneurship for family firms in the digital era is necessary for enhancing their competitive advantage and their resistance to economic downturns. Furthermore, size is not an inhibitor factor of digital entrepreneurship as small businesses can be just as successful as, if not more successful than, their larger competitors because, with the right technology, they can easily cause positive disruption in the market (Christensen & Mcdonald, 2015). Within the thriving digital economy, small businesses have the power to reshape their markets and industries (Deloitte, 2013)

Underpinning theory

Innovation diffusion theory was created to explain why people decide, depending on their beliefs, to accept or reject an invention. The fundamental idea behind innovation diffusion theory is that adopting a new idea involves five stages: persuasion, knowledge, decision, implementation, and confirmation (McMullen, Brownell, & Adams, 2021). The innovation's features or traits, which can be measured by five aspects: relative advantage, compatibility, complexity, experimental, and observability, are related to the innovation's acceptance and the decision-making process, according to the author (Soluk et al., 2021; Yi & Duval-Couetil, 2022). McMullen et al. (2021) developed entrepreneurship education to investigate potential adopters' perceptions of utilizing an innovation, drawing on innovation diffusion theory (Yi & Duval-Couetil, 2022). They further changed innovation diffusion theory in the following ways, arguing that it emphasizes the important quality of innovation rather than the adopters' PCI. First, the advantage is composed of two elements: image and relative advantage. Studies revealed that image could be quantified as a different construct and was distinct from relative advantage (McMullen et al., 2021). Consequently, an image which highlights raising one's social status was separated from relative advantage. Second, the observability feature in innovation diffusion theory is comprised of two concepts: visibility, which focuses on the ease of facilitating social learning through observation, and results in demonstrability, which focuses on the outcomes and communicability of applying innovation. The family's belief in the individual's ability to succeed as an entrepreneur and their encouragement and support can have a significant impact on the development of entrepreneurial ambitions. The ambition to engage in entrepreneurial activities and entrepreneurship education and passion are mediated, according to Sitaridis and Kitsios (2023), Ferraro and Cristiano (2021) and Hubner et al. (2020).

According to Meier and Thelisson (2021), "innovations that give advantages would have a more widespread and quick pace of diffusion." These advantages include perceived compatibility with existing practices and beliefs, minimal complexity, potential liability, and observability. To explain how an attitude toward a behaviour forms, the TPB uses an expectancy-value framework. In particular, attitudes

toward the conduct are thought to be a product of easily obtainable ideas about the anticipated outcomes of the behaviour—behavioural beliefs. A behavioural belief is an individual's subjective likelihood that engaging in an activity of interest will result in a particular experience or outcome. An example of this would be the belief that wearing a heart monitor is inconvenient or that it can detect heart arrhythmias. McMullen et al. (2021) assumed that most acts of interest to social and behavioural scientists are likely to be under volitional control and that perceptions of control are correspondingly strong when they developed the theory of reasoned action . We also proposed that people who were naturally inclined to participate in a behaviour that piqued the investigator's attention could really do so and could easily cease if they so desired. Therefore, there should be a direct correlation between behavioural intentions and behaviour performance. We also proposed that intentions are influenced by attitudes toward the activity and by subjective norms. The trajectory of adoption is largely determined by aspects like suitability for existing family business operations, complexity or ease of use of AI integration, potential for trial-based AI experimentation, and visibility of successful AI deployments. By acting as a bridge between the inherent characteristics of digital innovation and the unique attributes of family businesses, artificial intelligence makes it possible for cutting-edge technology to be integrated more smoothly. The use of artificial intelligence is a key moderating factor in the evolution of digital innovation in family businesses, which is a dynamic and transformational landscape (Lex et al., 2022). This behaviour can be better understood by applying the innovation diffusion theory to it. This theory sheds light on how new technologies, like artificial intelligence, are incorporated into social systems. The perceived relative benefit, compatibility, complexity, trialability, and observability of AI applications are some of the characteristics that impact the proliferation of digital innovation in the setting of family companies (Soluk et al., 2021; Yi & Duval-Couetil, 2022)

Entrepreneurship education and digital innovation in family business

According to Sitaridis and Kitsios (2023), Wang et al. (2023) and Yi and Duval-Couetil (2022), entrepreneurship education is also important in providing the necessary knowledge to enable opportunity identification and in exercising the cognitive mechanisms for opportunity evaluation through the available information. In addition to providing competitive advantages to those investing in IT capabilities, the transformation of entrepreneurial processes through the use of emerging digital technologies opened up new opportunities for entrepreneurs by providing them with simple access to international markets (El-Den, Adikhari, Adikhari, et al., 2017; Munawar et al., 2023). While the use of digital communication technology has made information more accessible to a wider range of stakeholders Liao et al. (2023), it has also expanded the pool of potential competitors in comparison to traditional brick-and-mortar enterprises. The heightened competitiveness exacerbated the need for human capital in terms of competencies, which in turn served as a major catalyst for digital innovation and the emergence of digital entrepreneurship (Sitaridis & Kitsios, 2023; Wang et al., 2023; Yi & Duval-Couetil, 2022). Bornhausen and Wulf (2023) are an example of how the advancement of digital technology can open up new doors and provide businesses a competitive edge using smart automobiles. Additionally, digital innovation helps businesses contact a wider range of clients, frequently in previously untapped markets. Sitaridis and Kitsios (2023) show how companies can employ digital innovation to make enhancements available to customers quickly and grow their user base. The testing of new technologies broadens the range of instructional resources available to enhance the efficacy of creative learning. For instance, instructors throughout the world are starting to notice three technologies that are referred to as "emergent education technologies." These consist of game-based learning, individualized learning, and massively open online courses. Particularly among institutions with an emphasis on entrepreneurship, case technology has grown in popularity (Wang et al., 2023; Yi & Duval-Couetil, 2022). Teaching entrepreneurship is one of the most important aspects of implementing innovative education successfully. Providing students with the knowledge and skills necessary to cultivate their entrepreneurial potential and increase their employability is the aim of entrepreneurship education programs (Soluk et al., 2021). The main objective of entrepreneurship education is to develop all the entrepreneurial competencies needed to identify the performance traits of big, medium, and small enterprises that will generate the projected yearly profit and be essentially risk-averse (Saleem et al., 2023; Soluk, 2022; Soluk et al., 2021). Interactive learning connected to company and community efforts is a hallmark of entrepreneurship education (Munawar et al., 2023). This indicates that because entrepreneurship education uses an experience-based learning approach, there is a sense of industry linkage. Since teaching techniques are dynamic and subject to change with the rising use of social media in the learning process, guest speakers and case studies are frequently included in entrepreneurship education programs (Sitaridis & Kitsios, 2023). Accordingly, it's critical to focus educational efforts on creating pertinent, practice-based courses that are informed by research Munawar et al. (2023). The two main schools of thought on entrepreneurship have been the causal and effectuation approaches (Yi & Duval-Couetil, 2022). According to the causal approach, entrepreneurship is more strongly associated with economic objectives and tactics and focuses on the impact of education on business development rates. The effectuation approach advises business leaders to maximize their resources in order to account for uncertain conditions. Students can better understand how ideas are developed and then brought to market by using effectuation as a teaching tool (Sitaridis & Kitsios, 2023; Wang et al., 2023; Yi & Duval-Couetil, 2022). Hence,

H1: Entrepreneurship education has a significant direct impact on digital innovation in family businesses.

Entrepreneurship passion and digital innovation in family business

Due to the demanding nature of entrepreneurial undertakings, which call for more tenacity and constant effort in uncertain and sometimes challenging settings, this idea is especially important in the field of entrepreneurship (Anjum et al., 2021; Zollo et al., 2021). Described as a strong, positive emotional response to participating in entrepreneurial activities, entrepreneurial passion is distinct because it is closely related to important entrepreneurial activities like creating, starting, or growing a business (Chen, Zhang, Tian, & Bu, 2022; Hussain, Rafiq, Mahmood, Nasir, & Zahid, 2023; Zainuddin, Tasnim, & Mukhtar, 2022). The idea behind the term "passion" in entrepreneurship aligns with the definition provided by Chiengkul et al. (2023) of a "strong inclination toward an activity that people like, find important, and in which they invest time and energy." In the context of entrepreneurship, it specifically refers to extremely joyful feelings that are intentionally attained while engaging in endeavours that hold personal meaning and worth for the entrepreneur's identity (Jneid, 2023). The perspective of harmonious passion—a component of work passion that is driven by a person's free will and compatible with other aspects of life—is adopted by the study. Positive engagement is encouraged by harmonious passion both while and after participating in connected activities (Flores Pérez & Guevara, 2023; Santos & Cardon, 2019).

Entrepreneurial passion is in line with earlier research that supports Lex et al. (2022) conceptualization as appropriate for comprehending the dynamics of generic entrepreneurial passion that passion is acknowledged as a positive and influential factor in entrepreneurship (Zainuddin et al., 2022). Fundamentally, the harmonic dimension of entrepreneurial passion makes it appear as a constructive and powerful force associated with successful entrepreneurial endeavours.

Long-term success in organizations, including those affected by family dynamics, requires ongoing renewal via innovation (Bornhausen & Wulf, 2023). Prior studies on family businesses have shown that they have particular traits when it comes to their innovation efforts, especially when it comes to product and process innovation activities. These efforts differ greatly from comparable efforts in non-family businesses because family businesses have special resources and frequently have nonfinancial goals (Bornhausen & Wulf, 2023; Saleem et al., 2023; Soluk, 2022; Soluk et al., 2021). "Designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" Chatterjee et al. (2022) is one way that digital innovation in family business can help achieve continuous renewal in addition to traditional forms of innovation. Academic research emphasizes how important business model innovation is to ensuring businesses' survival and long-term competitive advantage. The innovation model, which is essentially a depiction of the business's fundamental operations and innovation processes, includes a company's value creation, delivery, and capture methodologies (Chatterjee et al., 2022; Ferraro & Cristiano, 2021). Research on digital innovation indicates that businesses have been particularly compelled to reevaluate and reinvent their business models as a result of the advent of digital technology (Soluk et al., 2021; Upadhyay et al., 2023). Notably, digital technologies are seen as enablers of new business prospects, such as expanding into new markets via innovative functions and potentially lowering costs, including those brought about by automation (Sitaridis & Kitsios, 2023). Essentially, in the always-changing business environment, incorporating digital innovation into family businesses becomes a strategic necessity for ongoing renewal and long-term survival. Hence,

H2: Entrepreneurial passion has a significant direct impact on digital innovation in family business.

Mediating role of perceived family support

Family support plays a critical part in influencing an individual's total life successes by acting as a bridge between their job and home lives (Baluku et al., 2020). The degree to which family members respect and are prepared to accommodate an individual's work-related duties is reflected in the perceived level of support from family members. According to Bose and Pal (2020), a caring and compassionate family structure plays a major role in helping employees improve their resilience. Meier and Thelisson (2021), to be a strong predictor of work-to-family enrichment, highlighting its significance for the harmonious coexistence of work and family life, have found family support. Furthermore, having the impression that one's family is there to assist one helps one deal with obstacles at work. In addition to intangible forms like emotional connectedness, compassion, and inspiration that people look forward to from their families, this assistance can also take on real forms like sharing the load of work and financial obligations (Upadhyay et al., 2023). Family support is a complex idea that not only aids people in overcoming obstacles in the workplace but also develops resilience and a sense of enrichment, all of which lead to a happier and more satisfying existence (Schnettler et al., 2018). Emotional support from family may help young entrepreneurs start their enterprises and be linked to showing acceptance, which is vital for people in collectivistic communities. Giving counsel may also serve as a means of assistance (Uddin et al., 2020). It is acknowledged that parents, particularly those of recent graduates, have a big influence on their children's employment decisions (He, Wongpakaran, Wongpakaran, & Wedding, 2022). As such, family support plays a significant role in influencing the transition from entrepreneurial objectives to entrepreneurial behaviour. Therefore,

H3: Perceived family support has a mediating impact between entrepreneurship education and digital innovation in family business.

H4: Perceived family support has a mediating impact between entrepreneurial passion and digital innovation in family business.

Moderating the role of adoption of AI

Optimization, accuracy enhancement, and algorithmic innovation are the three main areas of ongoing AI research (Pillai & Sivathanu, 2020; Zainuddin et al., 2022). These initiatives demonstrate the benefits of applying AI at the corporate level since less than 10% of businesses are now adopting AI successfully. Regretfully, several businesses are either not using AI at all or are confusing it with IoT methods (Kinkel, Baumgartner, & Cherubini, 2022; Syed et al., 2020). Employee experiences have improved at companies that have effectively implemented AI, as seen by a discernible change from a traditional to an adaptive work environment. Even with AI's revolutionary potential, it is unclear what exactly influences workers' attitudes toward its adoption and use. This knowledge gap results from a paucity of research aimed at understanding workers' choices for the adoption of AI. Although studies of organizational preparedness have been undertaken before AI adoption Hussain et al. (2023), there is a conspicuous lack of study devoted to elucidating the variables influencing workers' viewpoints toward AI adoption at work. Proceed with its adoption. Moreover, firms may lack the necessary information about the various threats and opportunities provided by AI, limiting their decision-making process to adopt AI. Interestingly, what AI is and what it does is still not well understood even among top managers. Based on a survey of 1,500 senior executives in the United States, only about 15% of the executives who responded noted that they were familiar with AI and its application in their companies (Walsh & Volini, 2017). Digital technologies have an impact on the operations, digital capabilities, value chains, and business models of all kinds of organizations (Pan et al., 2022; Pillai & Sivathanu, 2020; Upadhyay et al., 2023). According to Wang et al. (2023) and Zainuddin et al. (2022), all businesses—including family businesses—must recognize, investigate, and reevaluate their business practices comprehend the novel approaches to developing, capturing, and delivering business values through the use of digital technology. Scholars and practitioners contend that Artificial Intelligence (AI) is a revolutionary technology with unprecedented potential to revolutionize business, the marketplace, and entrepreneurial endeavours, among other emerging and disruptive technologies (Pillai & Sivathanu, 2020; Upadhyay et al., 2023). The impact of AI on the corporate and personal spheres is clear. Neural AI systems, on the other hand, rely on algorithms and data to produce meaningful patterns through self-learning processes. AI even plays a part in the strategic implications of the organization by changing and (re)creating (new) business models. **?** note that AI influences business models of businesses at all levels by assisting, supporting, and driving functionality. While AI-driven functionality creates brand-new business models, AI-support and AI-assist functionality has an impact on operational tasks and business model elements. According to Wang et al. (2023) and Zainuddin et al. (2022), family businesses are interested in the appropriate use of AI and are utilizing it to explore new business opportunities and expand their entrepreneurial endeavours.

H5: The adoption of AI has a moderating impact on perceived family support and digital innovation in the family business.

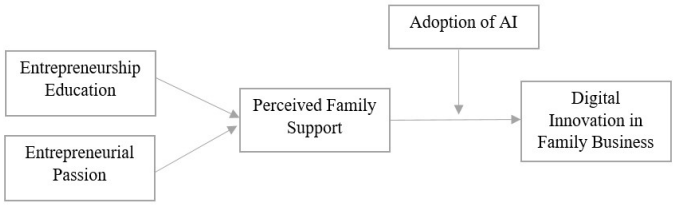

Fig. 1 *Conceptual framework*

Methodology

To accommodate the geographical dispersion of family businesses around Paris. To justify why family businesses were selected as a context of the study, the reasons were divided into three major facts.

Relevance

Family businesses were chosen as the focus due to their unique dynamics, where family ties often play a crucial role in decision-making and business continuity.

Practical significance

Understanding the impact of family support and digital innovation on AI adoption was particularly relevant for family businesses, as these factors can influence long-term sustainability and success.

Contextualization

Focusing on family businesses in the Paris region provides a localized perspective, allowing for context-specific insights that may be valuable for regional policymakers and business stakeholders.

To maintain the ethical aspect, it was taken into consideration that the data should be collected using this approach and that the participants should be fully informed about the study's purpose, procedures, and potential outcomes before providing consent. All the data collected was treated with utmost confidentiality, with identifiers removed to ensure participant anonymity. The respondents of the study were entirely voluntary, and participants had the right to withdraw at any stage without facing consequences. After completion of the data collection process, the Smart PLS was used for data analysis due to its suitability for structural equation modelling. Statistical techniques for this study included structural equation modelling, which was employed to analyze the relationships among the variables. Findings may be specific to family businesses in the Paris region and may not be fully generalizable to other contexts.

Research instrument

Data was collected using the survey approach in three different phases. A structured questionnaire was designed to capture relevant data for each time point. This questionnaire was based on adapted items against each variable of the study. The survey is administered using an online platform for ease of data collection and participant convenience. To measure the variables, all the items were items adapted, and they were based on 5-point Likert scale. To measure entrepreneurial education as an independent variable, 4 items were adapted from the scale (Sitaridis & Kitsios, 2023). The other predictor variable was entrepreneurship passion, and it was measured by using the 3-item scale Jneid (2023). The perceived family support was the mediating variable in this study, and it was measured by adapting 5 items from the scale (Bose & Pal, 2020). The adoption of AI was measured by using the scale developed by Chatterjee, Chaudhuri, Kamble, et al. (2023), and a total of 3 items were adapted for this moderating variable. The outcome variable digital innovation in family business was measured by adapting the 6 items by using the scale (Ferraro & Cristiano, 2021).

Data collection process

To guarantee representation across a range of industries and sizes, a stratified random sampling approach served as the foundation for the sampling strategy. The requirements for being included as respondents in a longitudinal survey were family businesses that were willing to engage willingly. To obtain consent for participation, a cover letter and email outlining the goal of the research were sent to the chosen businesses. The data collection timeline was divided into three phases, where time 1 (June 1-30, 2023) contains demographics and entrepreneurial traits. The information from the respondents was collected on participant demographics, entrepreneurship education, and entrepreneurial passion. In the second phase of data collection, which was declared as time 2 (July 1-30, 2023) and during perceived family support and adoption of AI, data was collected. This phase examines the perceived level of family support and the extent of AI adoption within the family businesses. The third and last phase of longitudinal data collection was declared as time 3 (August 1-30, 2023), and data related to digital innovation in family businesses was collected. Focuses on the digital innovation practices within family businesses. The online platform was used for collecting the primary data. To gather the data, 230 family businesses were contacted, and after the consented participants, 160 family businesses agreed to participate. Out of these, 10 participants were excluded due to non-response in either time 2 or time 3, resulting in a final sample size of 150.

Table 1 provides an overview of the demographic details and descriptive statistics for the sample in the current study, consisting of 150 participants. The preliminary analysis of respondent data forms the basis of this information. The study was carried out in Paris, with a specific focus on family business owners and CEOs in the region.

Table I
Demographic profile

Gender	Description	No. of Responses	%
	Male	90	60
Age	Female	60	40
	22-33	56	37
	33-44	40	27
Qualification	Above 45	54	36
	Masters	66	44
	Bachelors'	32	21
Job Experience	Diploma	52	35
	Less than 3 Years	71	47
	4-5 Years	40	27
	More than 6 Years	39	26

Data Analysis

SmartPLS 3.0 was used to conduct the two-stage data analysis procedure. First, the suggested research model was evaluated using the measurement model. The proposed research model was then assessed using the structural model. The sections that follow provide a detailed explanation of the study's results and analysis.

Results

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used in the conceptual model analysis. Because PLS-SEM can handle both small and large sample sizes and is compatible with non-normal data, it is frequently used in social science research (Hair, Risher, Sarstedt, & Ringle, 2019; Hair Jr, Howard, & Nitzl, 2020). Hair et al. (2021) Smart PLS 3.0 program was used for primary data analysis.

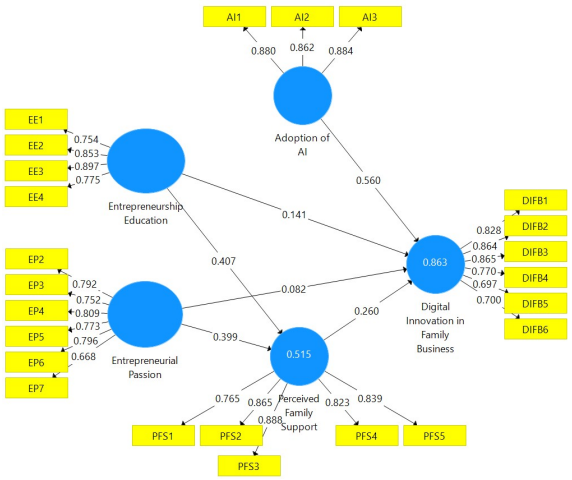

Fig. 2 *Measurement model*

All other values, as shown in the above figure, are satisfactory except "EP1". As advised by Hair et al. (2021), any indications with external loadings less than 0.40 have been eliminated from the frameworks.

Validity, reliability, and AVE

The researcher handles the measurement model's analysis. To confirm that the measurement model is appropriate, Researcher assesses the validity and reliability of the constructs. Researchers run several tests, including Cronbach's alpha (Cα),Composite Reliability (CR), and consistent reliability coefficient (rho_A) (Hair et al., 2019; Hair Jr et al., 2020). The researcher notes that all test findings (Cα>0.7, CR > 0.7, rho_A>0.7) meet the accepted threshold values (Hair et al., 2019; Hair Jr et al., 2020). Researchers also look at the Average Variance Extracted (AVE) threshold value to see if the items that belong to the same construct share a large amount of variance and have a high positive correlation. As long as the value is more than 0.5, the Researchers discover that convergent validity as determined by AVE holds true. Table 2 presents the condensed findings for the validity and reliability constructs. It also includes Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Since every item loading was over the cutoff of 0.70, the research measurement technique is suitable for additional testing of both direct and indirect channels (Hair et al., 2019; Hair Jr et al., 2020).

Table II
Reliability and validity

Construct	Item	Loadings	CA	CR	AVE
Adoption of AI	AI1	0.880	0.848	0.908	0.766
	AI2	0.862			
	AI3	0.884			
Digital Innovation in Family Business	DIFB1	0.828	0.879	0.908	0.625
	DIFB2	0.864			
	DIFB3	0.865			
	DIFB4	0.770			
	DIFB5	0.697			
	DIFB6	0.700			
Entrepreneurial Passion	EP2	0.792	0.859	0.895	0.588
	EP3	0.752			
	EP4	0.809			
	EP5	0.773			
	EP6	0.796			
	EP7	0.668			
Entrepreneurship Education	EE1	0.754	0.838	0.892	0.676
	EE2	0.853			
	EE3	0.897			
	EE4	0.775			
Perceived Family Support	PFS1	0.765	0.892	0.921	0.701
	PFS2	0.865			
	PFS3	0.888			
	PFS4	0.823			
	PFS5	0.839			

Discriminant validity

Discriminant validity is established by analyzing the inter-correlations between latent variables, as shown in table 3. According to the recommendations of Hair et al. (2021), discriminant validity across the constructs is successfully established because shared variance values are smaller than the matching Average Variance Extracted (AVE). Measures of constructs that theoretically should not show much of a correlation but instead show a robust correlation, which is indicative of discriminant validity. A significant difference between the discriminant validity coefficients and the convergent validity coefficients is necessary in practice. The Fornell-Larcker criterion is used in this study to evaluate discriminant validity. This criterion states that each column's diagonal values should be greater than other values. Table 3 shows that every value satisfies the required requirement, indicating the existence of discriminant validity.

Table III
Discriminant validity

	AI	DIFB	EP	EE	PFS
Adoption of AI	0.875				
Digital Innovation in Family Business	0.889	0.790			
Entrepreneurial Passion	0.580	0.655	0.767		
Entrepreneurship Education	0.617	0.701	0.584	0.822	
Perceived Family Support	0.748	0.821	0.637	0.640	0.837

Assessment of *R*-square

The obtained R^2 value serves as an indicator of the structural model's strength, providing insights into the explanatory variance of the endogenous variable by the exogenous variables (Hair et al., 2019). In this study, the combined effect of variables on the endogenous latent variable, digital innovation in family business, is 0.862. This value signifies a positive relationship, indicating the total impact of the variables on digital innovation in family business. Mediation variable perceived family support value of adjusted *R* square is 0.512.

Table IV
Assessment of *R* square

	R-Square	Adjusted *R*-Square
Digital Innovation in Family Business	0.863	0.862
Perceived Family Support	0.515	0.512

Structural model

Following validation of the measurement model's validity and reliability, a path analysis was carried out to investigate latent variable relationships using the structural model. As suggested by Hair et al. (2021), the structural model's evaluation sought to investigate its predictive capacity and the importance of construct linkages. Using Artificial Intelligence (AI) as a moderator, the model analyzes the links between entrepreneurship education, entrepreneurship passion, digital innovation in family businesses, and the mediation role of perceived family support.

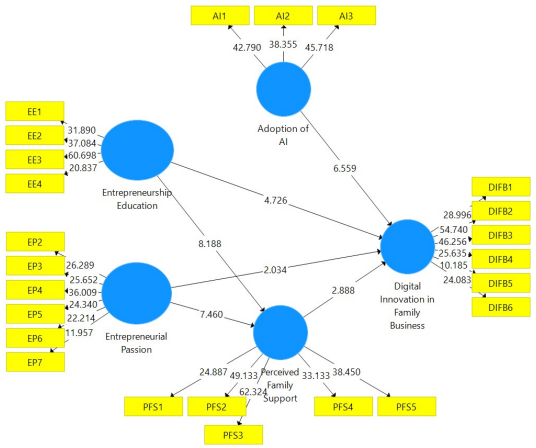

Fig. 3 *Structural model*

All other values, as shown in the above figure, are satisfactory, with the exception of "EP1". As advised by Hair et al. (2021), any indications with external loadings less than 0.40 have been eliminated from the frameworks. The external loading of lower-order structures was investigated using a PLS-SEM method. According to the findings, all constructs have Cronbach's Alpha values of more than 0.789, indicating strong internal consistency. Results from each survey measurement are quite accurate. Moreover, the measurement model is considered valid because the Average Variance Extracted (AVE) is greater than the permissible threshold of 0.50

Direct relation

The structural model is evaluated by Hair et al. (2021), evaluating the links between latent constructs and validating the conceptual model. Following the evaluation of the measurement model, the present study examined the structural model using 5000 replicates of bootstrap analysis to determine the importance of path coefficients (Hair et al., 2021). As shown in table 4, both Hypotheses (H1) and (H2) were positively supported, suggesting a noteworthy influence on digital innovation in family firms. A look at the overall impacts is given in table 5, where the Beta values indicate how much the independent factors have an impact on the dependent variable. Interestingly, larger Beta values signify a more potent effect. As shown in table 5, the *t*-values are greater than 1.96, and the *p*-values are less than 0.05, confirming the importance of the connections for every variable.

Table V
Direct relation

	Original Sample	*t* Statistics	*p* Values	Decision
Entrepreneurship Education -> Digital Innovation in Family Business	0.141	4.726	0.000	Supported
Entrepreneurial Passion -> Digital Innovation in Family Business	0.082	2.034	0.043	Supported

Mediation analysis

Perceived familial support serves as a mediator in our approach. The researcher performed a bias-corrected bootstrapping analysis with a 2000-bootstrap sample and a 90% confidence range Hair et al. (2021) to investigate the indirect effects indicating mediation This mediation study demonstrates that perceived family support has a significant and indirect impact on the relationship between entrepreneurship education and digital innovation in family businesses. Additionally, an additional mediation study indicates that perceived family support has a large and indirect impact on the relationship between digital innovation and entrepreneurship passion. It's interesting to note that because the direct effect is still significant, these results strongly support the adoption of our mediation hypothesis. Researchers use the methodology described by Hair et al. (2021) in a mediation study of perceived family support. Hair et al. (2021) guidelines, "Rule Z mediates the link between X and Y if the direct path between X to Z and Z to Y is significant." Furthermore, full mediation is proposed by Hair et al. (2021) when the direct path is negligible and the indirect path is large. Partial mediation is seen as having been established if both the direct and indirect pathways are significant.

Table VI
Mediation Analysis

	Original Sample	*t* Statistics	*p* Values	Decision
Entrepreneurship Education -> Perceived Family Support -> Digital Innovation in Family Business	0.106	2.568	0.011	Supported
Entrepreneurial Passion -> Perceived Family Support -> Digital Innovation in Family Business	0.104	2.873	0.004	Supported

Moderation analysis

In this study, the researcher suggests that (H5) can show how the relationship between perceived family support and digital innovation in family firms is moderated by the use of AI. The results imply that the use of AI positively moderates the relationship between perceived family support and digital innovation in family businesses. The affirmative correlations displayed in Table 7 demonstrate the moderating impact of AI adoption. Additionally, the adoption of AI has a bigger total influence when the direct and moderation effects are compared. The importance of the moderator's influence on a connection is determined by calculating the *p*-value difference between the two categories of the moderating variable. A *p*-value difference of less than 0.05 or greater than 0.95 indicates that the moderator's effects on that relationship are considered significant, according to Hair et al. (2021). All the findings are displayed in table 7.

Table VII
Moderation analysis

	Original Sample	*t* Statistics	*p* Values	Decision
Moderating Effect 1 -> Digital Innovation in Family Business	0.620	7.651	0.000	Supported

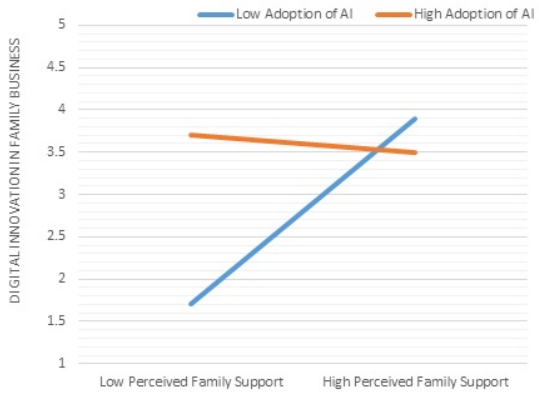

Fig. 4 *Moderating effect of adoption of AI*

Discussion

The present study centres on evaluating the influence of entrepreneurship education and entrepreneurial passion on digital innovation in family-owned enterprises. The study modifies the adoption of artificial intelligence (AI) and explores the mediating role of perceived family support. Two theoretical frameworks guide this investigation: planned behaviour theory and innovation diffusion theory. Notably, every hypothesis put out in the research has been confirmed. The results show that entrepreneurship education has a significant direct impact on digital innovation in family businesses. Numerous variables influence the phenomenon of French-language entrepreneurial education. Initially, employees' passion for participating in entrepreneurial education is sparked by the way entrepreneurship education skillfully combines traditional classroom instruction with practical business experience. Second, the managers in charge of entrepreneurship education have extensive professional backgrounds, which equips them to instruct people in a superior manner (Sitaridis & Kitsios, 2023). Thirdly, industries take an active role in promoting the entrepreneurial education of their workforce by making suitable schedule adjustments for workers who engage in entrepreneurial activities. Industries may also present pertinent policy materials, contribute cash for entrepreneurial experimentation, and provide preferred or even free venues. In addition, there exist possible tax benefits for individuals who start businesses, all of which have the potential to stimulate entrepreneurial activity. To develop employees' entrepreneurial attitudes, abilities, and skills, entrepreneurship education is essential. It strengthens their ability to recognize fresh chances for entrepreneurship, which in turn increases their readiness to take on entrepreneurial ventures (Wang et al., 2023). The results show that entrepreneurial passion has a significant direct impact on digital innovation in family businesses. According to Jneid (2023), business owners may use their enthusiasm to motivate their staff to feel the same way, which will increase dedication, hard work, and innovation. According to Jneid (2023), the component scores of the initial set of profiles will probably all be consistently high, medium, or low. This could be the case because, according to Jneid (2023), some entrepreneurs may value their identities as inventors, founders, and developers equally. We anticipate witnessing a certain number of entrepreneurs who possess a strong passion for all aspects of entrepreneurship, including invention, establishment, and development by exception. Furthermore, because launching a business requires a significant amount of self-depletion, entrepreneurs must deal with pressure and risk. Some entrepreneurs may also lack all three forms of entrepreneurial zeal. The findings indicate that the relationship between entrepreneurship education and digital innovation in family businesses is mediated by perceived family support.

Family businesses are complex organizations, and family members' perspectives may not always coincide with the company's goals. This can result in new opportunities being passed over or undervalued. On the other hand, family businesses are known for their flexibility in the face of change due to their long-term vision and wish to transfer the company to the following generation. Because they depend less on outside finance, family businesses usually have enough cash on hand to respond firmly and nimbly to the shifting market conditions. Therefore, the cost of reorganizing the company to integrate new technologies shouldn't be a barrier to transformation. It's also well known that FBs are known for being risk averse, which might occasionally slow down. However, family businesses must strike a balance between conservatism and caution in order to stay ahead of the curve, while prudence and family culture can be harmoniously combined. Businesses need a digital agenda if they want to succeed in the future. While owning digital assets may not be essential, being able to take advantage of the opportunities provided by digital assets held by third parties will be. Businesses will also need to come up with new strategies for interacting and building connections with outside parties. A changing environment creates several chances for both new and established competitors. Family-run companies will have a competitive edge if they can adapt their corporate culture and procedures to take advantage of these prospects.

Conclusion

The research illuminates the complex interplay between digital innovation and entrepreneurial zeal in family-run businesses, emphasizing the changes resulting from the use of AI and the mediating function of perceived family support. Our research shows how important it is for family-owned businesses to have a strong entrepreneurial spirit in order to advance digital innovation projects. Family-owned businesses are driven and passionate about using cutting-edge techniques and navigating the digital terrain by their founders. The study also highlights the strategic importance of integrating AI adoption into the entrepreneurial ethos of family businesses. The change in AI brings a contemporary touch and emphasizes how crucial it is to stay current with technology. By leveraging AI technologies, family-owned firms can enhance their ability to innovate digitally and achieve a competitive advantage in the dynamic business landscape. The moderating effect of perceived familial support is one significant aspect of this relationship that is revealed. The family environment, characterized by both pragmatic and affective support, acts as a conduit, quickening the process of transforming the adoption of AI and entrepreneurial enthusiasm into successful outcomes in digital innovation. Family businesses that want to get the most out of their commercial endeavours must recognize and support this supportive family environment. Although our study offers insightful information, it has certain drawbacks. The limited scope of this study, which involved only family-run enterprises in the Paris area, could potentially restrict the applicability of the results. Subsequent investigations ought to strive to overcome this constraint by augmenting the magnitude

of the sample and delving into subtleties unique to varied geographic and cultural environments. The research sheds light on the relationships that exist between perceived family support, digital innovation, AI adoption, and entrepreneurial zeal in family-owned businesses. As family businesses continue to navigate the digital landscape, these insights offer practical implications for fostering a supportive entrepreneurial environment that embraces innovation and technology, ensuring the sustainability and competitiveness of family-owned enterprises in the digital era.

Implication of study

The research has advanced several academic subjects, especially by combining theories from other fields to improve discourse among scholars. One notable achievement is our use of innovation diffusion theory, which has proven particularly effective in assisting family-owned SMEs in integrating AI technology, driving digital innovation, and fostering perceived family support. Because of our research into effectuation theory, we have successfully identified correlations between the adoption of AI in family-owned SMEs and potential implementation challenges. Effectuation theory's emphasis on utilizing existing networks and resources has been empirically validated, indicating its crucial function in assisting family-owned SMEs in integrating artificial intelligence technologies. By leveraging their distinct advantages and networks, these companies can attain a competitive edge and leverage digital transformation to enhance their market share. But our research also shows the dangers of depending more on AI edge devices, especially when it comes to cybersecurity flaws like illegal access and data leaks. Therefore, it's critical to put strong security measures in place to protect against these risks and guarantee that AI is successfully integrated into family-owned SMEs. This research also emphasizes the importance of entrepreneurial education in influencing people's views and intentions about digital innovation. The foundation for embracing digital change inside the family business is laid by entrepreneurial education, which equips family members with the requisite knowledge and abilities. Furthermore, the significance of cultivating a supportive atmosphere that encourages creativity and technology adoption is highlighted by the mediation function of perceived familial support. By presenting AI as a moderating element and highlighting the importance of staying up-to-date with technological advancements, this research offers a contemporary viewpoint. With the help of this comprehensive approach, family-run businesses can now effectively navigate the digital landscape and foster long-term prosperity through innovation. This demonstrates how crucial it is for family-owned businesses to incorporate AI technologies into their workflows to stay competitive in the dynamic business environment. In essence, the study offers theoretical clarity and practical guidance that encourages family-owned enterprises to actively engage in entrepreneurship education, develop a spirit of entrepreneurship, and strategically incorporate AI technologies, all while creating a supportive and loving family environment for the greatest results in digital innovation.

Limitations and future research

This research has several limitations, even with the findings. Furthermore, answer biases may affect self-reported data, which could affect the accuracy of the findings. Although beneficial, the longitudinal design may encounter obstacles, including attrition and changes in the external environment that could impair the ongoing data gathering. Sampling bias may be introduced by the use of an online survey to gather information from owners and CEOs of family business businesses in the Paris area. The results may not be as generalizable if there are too few people with internet access or who are not willing to take part in online polls. Because the study uses respondents' self-reported data, common method bias may be introduced. The accuracy of the results may be impacted if participants give answers that they believe to be socially acceptable or in line with expectations. Even with a longitudinal design, participant attrition, changes in their circumstances, or other environmental factors may make it difficult for the study to continue collecting data over time. These problems might also affect the longitudinal analysis's validity. Restricting the study's scope to family business businesses located in the Paris region may limit the results' wider application. The various legal systems, cultural influences, and entrepreneurial ecosystems that exist in various places may have an impact on the study's analysis of correlations. Moreover, exploring specific entrepreneurial passion profiles and conducting comparison analysis in diverse cultural contexts would augment our understanding of the complex relationships being studied. More research into the intricacies of AI adoption in family businesses and the impact of organizational culture on digital innovation strategies would help us comprehend these phenomena in greater detail. Future studies should look more closely at the many characteristics of entrepreneurial zeal as well as how different passion profiles affect the outcomes of digital innovation in family-owned businesses. Comprehending the intricacy of entrepreneurial fervour may facilitate the creation of more focused strategies for advancing innovation. Comparative research in a variety of geographical or cultural contexts may improve the results' external validity. A more comprehensive understanding could result from looking at how entrepreneurial zeal, digital innovation, and entrepreneurship education change depending on the circumstances. In light of AI's growing significance, further research on the particulars of AI adoption inside family companies may be conducted in the future. Executives at family-run businesses can learn a lot by looking at the variables that affect AI adoption decisions, potential barriers, and the company culture's impact on AI integration.

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