



Sustainability and Technology Go Hand in Hand to Achieve Excellence in Thai Family Businesses: A Big Data Analytical Perspective

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Abstract

This paper aims to investigate the role of big data analytical (technological, management, talent) capabilities of family businesses and examines the dual aspects of family leadership focus and family members' concerns to sustain the business. Further, the study explains the generational transition, innovation, and tradition paradox and proposes a solution to maintain the family legacy. Family businesses are crucial sources of wealth in Southeast Asian countries and 80% of Thailand's family businesses are owned by second or third generations and so on. The data is collected from Phuket, Thailand which is a regional hub of family businesses. The respondents of study 203 businesses were chosen for data collection and further interpreted through Smart PLS 4.0. The results found that big data analytics management capabilities are significantly associated with the innovation and learning performance of family members and sustainable family business excellence. Specifically, talent capabilities and technological capabilities have an insignificant association with a direct relationship with sustainable family business excellence. Furthermore, the moderating role of family members' adaptability to change is particularly insignificant, associated with big data analytics technological capabilities and sustainable family business excellence. The study analysis revealed mixed findings and generally advocated the need for big data implications in a family business. Most literature focused on non-family businesses, and this study is one of the pioneering studies that discuss big data integration in a family business as a driver of sustainable excellence.

Keywords Family business · Big data analytics · Sustainable excellence · Family members' performance · Family leadership · Thailand

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Introduction

Family businesses are complex entities that serve as key support to the social development and economy of a country. The sustainable excellence of a family business is the most requested attribute to secure the interests of stakeholders, the satisfaction of employees, and the optimum level of organizational performance (Augusto Felício et al., 2022). At the beginning of the fourth revolt of industry, the pursuit of sustainable excellence continued with novel technological integrations and advanced approaches that unveiled unique performance pillars and marked different criteria for family businesses to thrive. However, the upsurge of COVID-19, the Russia and Ukraine war, global politics, a slowing down of economic growth, and customers' faith in the marketplace eliminated more than a decade of business sustainable excellence, and businesses had to struggle for sustainability. Apart from family-owned or a non-family business, there is a long way for businesses to excel while maintaining sustainable growth. However, the journey of family business sustainable excellence is complicated as decisions involve inward orientation, emotions, and their longstanding legacy. Most family businesses cannot survive and sustain their long-term success beyond the founder-owner of the first generation. For the above-mentioned reasons, the need for family businesses drives us to find the best innovation practices approach to maintain an outstanding, long-lasting family business legacy. Business learning is what family businesses can do better than others in terms of innovation and apply in their own business (Abdullah et al., 2023; de Groote & Kammerlander, 2023; Zapletalová, 2023). Business innovation can be a response to environmental variations due to technological advancements (Saura et al., 2023). However, sufficient and supportable empirical evidence has been offered to support big data analytics for sustainable excellence in family businesses (Maroufkhani et al., 2020). The path of the modern industrialized revolution is marked primarily by the assimilation of big data technological evolution. During the past several decades, organizations have undergone a revolutionary transformation in key business activities by adopting modern tools such as artificial intelligence and big data blockchain technological integrations (Murugesan et al., 2023). Big data cutting-edge technologies serve an important role in organizations. Big data enhances organizations' knowledge and helps to explore customers' preferences and the marketplace to predict existing customers' behaviour and potential customers' orientations. The big data technological, management, talent and capabilities serve as drivers for sustainable excellence, specifically for the family business and help to eliminate the third-generation curse (Davis & Harveston, 2000). However, family businesses rarely go

beyond third-generation due to being trapped in innovation and tradition paradoxes and big data not only forecasts the trends but helps family businesses to innovate while maintaining the family legacy rooted in its traditions (Walsh et al., 2020). In this era of digitization, customers rely on big data for purchase decisions and organizations rely on their quality ratings to attract customers. Gaumer and Shaffer (2018) argue that family businesses already have an advantage in terms of their positioning and digitalization further strengthens the advantage to thrive as compared to non-family businesses. Industry 4.0 requires both outstanding management capabilities with high-end technological skills and the innovativeness of employees. Thriving in the industry, in addition to adoption of alluring technologies and big data implications, also requires an amalgamation of innovative learning performances of the next generation, compassionate leadership of older family leaders, understanding of founders' vision, and an agile culture of family (Dahlgard & Anninos, 2022). Hence, the sustainable excellence of a family business stands on two ruling pillars which are its family members working at their full capacity and the assimilation of sophisticated technology. Apart from the spillover effects of the global crisis, the pursuit of sustainable business excellence can be achieved through strong business resilience (the ability to reconfigure organizations' models and the ability to recover from epidemics), the right path of insight guided by family leaders and the high-quality performance of family members as employees (Bertassini et al., 2021). The big data capabilities enhance the innovation and learning performance of family members and their leadership (Shamim et al., 2021). However, family businesses are required as well to conduct seminars, courses, and workshops to strengthen family employees with advanced technology, and this may be more essential than a nonfamily business from the perspective of generational transition (Bigliardi & Ivo Dormio, 2009).

Family businesses in developing countries propel each other toward developed countries and places to learn more about big data analytical tools and help in innovation and succession. The practices of in developed countries enhance knowledge of those in developing countries, provide insights about the utilization of big data to understand market trends and customers, and equip them with advanced skills that help family businesses to keep functioning in difficult times and attract customers (Ogbeide et al., 2021). The point of this learning is that big data is associated with the family legacy, balancing of tradition and innovation, leadership patterns, and the existing work practices followed in a family business (Soluk et al., 2021). The big data integration and sustainable excellence of a family business are not possible without intrinsic motivation, adaptability to change, and the innovative intellect of employees by encouraging

them to improve their learning performance (Manninen & Campbell, 2022; Pekkala & van Zoonen, 2022; Tang et al., 2022; Vu et al., 2022). To learn new innovative practices, strategies, and competitive skills, the family's agile leadership and family members' adaptability to change are crucial. This helps family members to learn more about big data, instills confidence to implement change, equips them with modern technology to innovate traditional working styles, and maintains the family's generational legacy (Abdullah et al., 2023).

The present study reflects the importance of big data analytics to eliminate the third-generation curse and promote a smoother transition in order to sustain business excellence for future generations in context of the Thai family business. Therefore, this study advances the literature discussion on sustaining business excellence by responding to the following questions: (1) Does big data analytic capabilities influence the leadership focus on big data integration and family members and sustainable family business excellence? (2) Do innovation and learning performance of family members mediate the big data analytic capabilities and sustainable family business excellence? (3) Does a family leadership focus on big data integration and family members' adaptability to change moderate the innovation and learning performance with sustainable family business excellence?

This study offers a comprehensive and insightful review of the existing literature from the perspective of the family business. The study responds to the theoretical gaps documented by the prior literature, by establishing the different factors of big data analytic capabilities and examining the three major types of analytic capabilities of big data. These capabilities are presumed to enhance sustainable family business excellence and provide a comprehensive understanding of transnational businesses. The dynamic capabilities theory is less frequently used to examine big data analytic capabilities in family business (Forés et al., 2023; Kessler & Zipper-Weber, 2023). Finally, the study finds that innovation and learning performance of family members, a family leadership focus on big data integration, and family members' adaptability to change may enhance the scope of big data analytic capabilities (Abdullah et al., 2023; Baltazar et al., 2023; Martínez-Alonso et al., 2023). The study offers valuable insights into the literature among developing countries, mainly Thailand, as to cultural understandings on big data analytics that contribute toward sustainable family business excellence.

Literature Review

Dynamic Capabilities Theory

The theory of dynamic capabilities suggests that firms need individual abilities to efficiently adapt to the hanging environment. This adaptation involves continuously creating, incorporating, and adjusting their collection of resources (Beske, 2012; Buzzao & Rizzi, 2021). This study is framed by dynamic capabilities theory. In this era of advancement and digitalization, family businesses are transforming into data-driven organizations and focusing on their sustainable excellence (Troisi et al., 2023). The family business can positively achieve a competitive advantage once they achieve control of their dynamic capabilities. The present study reflects big data technology as a dynamic competency which provides opportunities to family businesses (Soluk et al., 2021). The study of Tiberius et al. (2021) suggested that framing the study of the family business using the dynamic capabilities theory promotes sustainable excellence rather than survival. The theory of dynamic capabilities is well situated in the family business literature when investigating sustainability, technological aspects, excellence and business transformation in a changing environment (Duarte Alonso et al., 2018; Gerulaitiene et al., 2024; Soluk et al., 2021; Wang, 2016; Weimann et al., 2020).

Sustainable Family Business Excellence

The concept of business sustainability refers to filling present needs despite the continuance capacity of upcoming generations to meet these requirements (Oudah et al., 2018). Yet, the importance of every family business is to sustain the business legacy across generations. Therefore, this mindset provides a clear focus for both the family and the business to succeed harmoniously and sustain excellence over generations (Chew & Mohamed Zainal, 2024). The family business literature argues that achieving family coordination and confirming long-term business performance requires streamlined possession, governance, and building management at the right juncture by reshuffling familial participation (Bonfanti et al., 2023; Gunawan & Koentjoro, 2023; Haag et al., 2023).

Big Data Analytics (BDA) Capabilities of Family Business

BDA Management Capabilities

The COVID-19 pandemic had a major impact on industrial activities and severely impacted the working styles of businesses. Due to the abrupt shift in business and global

industry, the integration of big data to enhance management capability is imperative. Sardi et al. (2023) emphasize that big data allows for the collection of wide ranging information to help organizations advance employee performance. Big data refers to the integration of a system of systems, or meta-system. Further, the meta-system includes subsystems that assist organizations from multiple perspectives including operations, technology, geography, and context. Metasystems of big data enable businesses to achieve sustainability and to maintain sustainable excellence in complex and uncertain environments (Bickley et al., 2024). Because the implications of big data integration in family business is surprisingly overlooked (Arzubiaga et al., 2021), this study examined the impact of big data management capabilities on learning performance of family members and sustainable excellence of family business to test the following hypotheses.

H1a BDA management capabilities significantly improve the innovation and learning performance of family members.

H1b BDA management capabilities significantly enhance the sustainable excellence of the family business.

H1c BDA management capabilities significantly impact the sustainable excellence of family business through the mediation of the learning performance of family members.

BDA Talent Capabilities

The big data talent capabilities of an organization are both sought-after attributes and a key challenge. Yildiz and Esmer (2023) and Zapata-Cantu et al. (2023) note that the literature has explored the limited implications of talent management and find it worthwhile to explore big data talent management capabilities in family businesses. Even though big data is more easily accessible to organizations, organisations find it difficult to retain big data expert employees. Shamim et al. (2019) emphasized that effective big data talent capabilities assist employees in their learning performance and ensure the sustainable excellence of the business. The pressure to obtain the right knowledge from big data is not slowing down in the digital era, and to meet the demand entails a certain level of competency to acquire the right big data knowledge from family members not only to achieve sustainable excellence but to thrive in volatile market situations (Joyce & Slocum, 2012). Thus, we propose the following hypotheses.

H2a BDA talent capabilities significantly improve the innovation and learning performance of family members.

H2b BDA talent capabilities significantly enhance the sustainable excellence of the family business.

H2c BDA talent capabilities significantly impact the sustainable excellence of family business through the mediation of the learning performance of family members.

BDA Technological Capabilities

The digitalization, industrial revolution and promptly changing global business environment demand that businesses channel their resources toward big data integration. However, big data integration requires a set of techniques to utilise its full potential. Due to technological advancement, the need for big data is increasing in business, but there is less attention paid to the associated technological aspects, particularly in family businesses (Mikalef et al., 2018). Further, Nisar et al. (2022) noted that big data analytical technological capabilities are essential for business to improve learning performance of their employees in order to discover opportunities to achieve sustainable excellence (Soluk et al., 2021). Therefore, the study examines the impacts of big data analytical technological capabilities on the learning performance of family members and the sustainable excellence of family businesses. Thus we propose the following hypotheses.

H3a BDA technological capabilities significantly improve the innovation and learning performance of family members.

H3b BDA technological capabilities significantly enhance the sustainable excellence of the family business.

H3c BDA technological capabilities significantly impact the sustainable excellence of family business through the mediation of the learning performance of family members.

Innovation and Learning Performance and Sustainable Excellence

The learning of family members is a crucial predictor of sustainable excellence in family businesses (Schindler et al., 2023). Naik et al. (2023) argue that sustainable excellence can only be achieved once the learning performance of employees is guaranteed. Further, Allcot (2023) presented another perspective of family business sustainable

excellence that learning performance and innovation are key drivers of family business excellence. Erdogan et al. (2020) emphasized that innovation and learning performance can help family businesses break the tradition and innovation paradox in order to overcome the generation curse, and to maintain sustainable excellence (Bag et al., 2020). The study explores the often ignored perspectives of big data integration to improve family members' performance and innovation to boost the sustainable excellence of family businesses, by testing the following hypothesis.

H4 The innovation and learning performance of family members significantly influence the sustainable excellence of the family business.

Family Leadership Focus on Big Data Integration

Despite the well-documented role of big data integration in establishing sustainable excellence in family businesses, an essential aspect yet to be explored is family leadership focus on big data. The family business quality 4.0 (align management and quality of operations) requires integration of big data to thrive through technological innovation and this is only possible if the leadership supports the agility and innovation of businesses (Dahlgaard & Anninos, 2022). Lepäaho and Ritala (2022) mention that the generational gap in family businesses hinders the focus on big data integration. As the founders of family businesses follow traditional norms and resist applying innovative technologies, while other family members (heirs) look to technology to enhance innovation capacity and learning performance. Therefore, in this study, we test for moderation of family leadership focus on big data integration on the following proposed relationships to test the following hypotheses.

H5a The family leadership focus on big data integration moderates the relationship between BDA management capabilities and the innovation and learning performance of family members.

H5b The family leadership focus on big data integration moderates the relationship between BDA talent capabilities and innovation and the learning performance of family members.

H5c The family leadership focus on big data integration moderates the relationship between BDA technological

capabilities and innovation and the learning performance of family members.

Family Members' Adaptability to Change

The employees ability to adapt to change is a main concern of an organization, as it is uncertain how employees will respond to change. It is often the case in family businesses, that family members prefer to follow the practices established by the founders and their rejection of change keeps the business stuck in an innovation tradition paradox (Sarour & El Keshky, 2023; Smith et al., 2023). Kucharska and Kucharski (2023) found that there are always technological and non-technological members in an organization and their adaptability to change is crucial for organizations while implementing technological revolutions (Kim et al., 2023). Further, Abankwa et al. (2021) emphasized that the adaptability to change positively affects the sustainable excellence of business. The study investigated moderation of family members' adaptability to change in family business contexts (Duarte Alonso et al., 2018) to propose the following hypotheses.

H6a Family members' adaptability to change moderates the relationship between BDA management capabilities and the sustainable excellence of the family business.

H6b The family members' adaptability to change moderates the relationship between BDA talent capabilities and the sustainable excellence of the family business.

H6c The family members' adaptability to change moderates the relationship between BDA technological capabilities and the sustainable excellence of the family business (See Fig. 1).

Proposed Theoretical Framework

Methodology

Research Design and Data Collection The study investigated family businesses employing a questionnaire survey-based approach. The seven-point Likert scale was utilized due to the richness and rigorousness of the constructs (Raza, Khalid, & Raza et al., 2024a, b). The data was collected through purposive sampling from family businesses in Phuket, Thailand. The report by Cracknell (2019) noted that 80% of Thai businesses are family businesses. Further, UNESCO dubs

Fig. 1 Conceptual framework

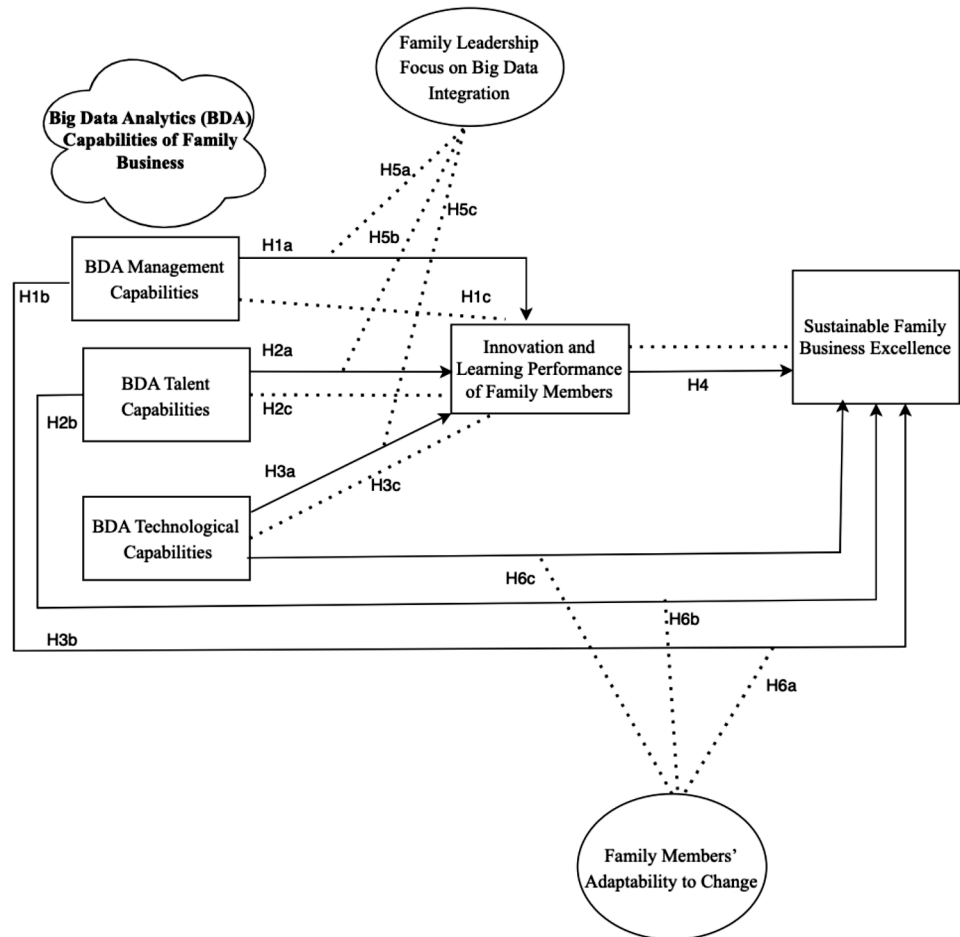


Table 1 Demographics of study

Gender	
Male	48
Female	137
Others	18
Business Transition Stage	
First generation	0
Second generation	163
third generation	12
Beyond third generation	28
Family Business Founder Status	
Living in Phuket from first generation	32
Living in Thailand from first generation	147
Working in Phuket and Founders were out of Thailand	24
Family involved in Business	
Less than 5 members	57
5 to 10 members	126
More than 10 members	20

Phuket a city of gastronomy, and therefore, Phuket city of Thailand was selected for further investigation.

The questionnaire had two sections. The first section included demographics that are further explained in Table 1.

The second section was based on the questions of interest to this study; the questions are provided in Table 2. The study focused on family businesses. Specifically, the respondents in this study were family members of small hotels or food sellers where family members both manage the business and work as employees. Typically, such businesses consist of two to five persons in a family. The study investigated the need for big data integration for the betterment of sustainable excellence.

The questionnaire was presented to two hotel owners and three academics for pre-testing purposes. Minor errors were corrected, which included the deletion of difficult jargon, biased questions, and core research terms that are not easily understood, simplifying sentences, removing dual-meaning items, and language improvements. After the questionnaire was corrected, a pilot test was conducted to ensure the validity of the questionnaire. After ensuring a reliable Cronbach's alpha, the actual data collection process was begun. A total of 250 questionnaires were administered and 217 questionnaires were returned. The reason for the small sample selection lies in its strict criteria: as the data were limited to Phuket, Thailand; among the hotel businesses and food sellers who were invited, only family businesses that

Table 2 Questionnaire of the study

Items Code	Measurement Items
Big Data Analytics Management Capabilities	
MC 1	Our planning process is systematic and includes big data analytics.
MC 2	With the integration of big data analytics, our family business plan is better to deal with a changing environment.
MC 3	We make sure to invest in big data analytics by spending money on training of family members.
MC 4	Information is easily accessible by family business leaders and family members (employees).
MC 5	Our analytics managing family leaders are clear about performance criteria.
MC 6	In our business, the responsibility for big data analytics development is transparent.
Big Data Analytics Talent Capabilities	
TC 1	Our family leaders are capable of big data management and maintenance.
TC 2	Our family leaders understand our business policies and plans.
TC 3	Our family leaders are capable of developing appropriate technical solutions of business problems.
TC 4	Our family leaders understand the business functions.
TC 5	Our family leaders are capable of organizing business projects.
TC 6	Our family leaders well manage customer relationships through big data technology.
TC 7	Our family leaders use decision-support systems driven by analytics.
TC 8	Our family leaders know the business environment.
TC 9	Our family members show interest in learning new technologies.
Big Data Analytics Technology Capabilities	
Tech 1	The big data integration in business aligns with the mission of the family business.
Tech 2	We prioritize the big data integration in our family business due to its impacts on performance.
Tech 3	The big data plans of our family business are aligned with business direction.
Leadership Focus On Big Data Integration	
FL 1	The family leaders devote considerable time to family members' training for big data.
FL 2	The family leaders share knowledge and experience frequently.
FL 3	The family leaders provide knowledge and information that is necessary for family members to perform their business.
FL 4	The family leaders assist family members in day-to-day activities.
FL 5	The family leaders suggest complementing technical activities.
FL 6	The family leaders appreciate it once family members do something innovative.
Sustainable Excellence of Family Business	
OE 1	Family leaders formally monitor the advancements of emerging technologies.
OE 2	Our family business allocates sufficient resources to integrate technology in business.
OE 3	The leadership welcomes the diverse point of view of family members.
OE 4	The family leader encourages the family bonding and considers it important for succession.
OE 5	The founders, leaders and family member sit together to discuss important tasks.
OE 6	The business undertakes research activities to understand market situation.
OE 7	The business gains customers and supplier inputs to improve its services.
OE 8	The business culture supports the family members' interactions.
OE 9	Family leadership encourage constructive conflicts of family members
OE 10	The vision and mission are well communicated among family leadership and members.
Innovation and Learning Performance of Family Members	
ILP 1	Our business recognizes family members' training and educational needs.
ILP 2	It is crucial to improve the business' knowledge base and handling skills.
ILP 3	We learn new and relevant knowledge to undertake the business activities.
ILP 4	We analyse unsuccessful activities of our business.
ILP 5	We communicate the lessons learned from the business's past experiences across the family members.
Family Members' Adaptability to Change	
FC 1	Our family business leaders believes in investing in research and development.
FC 2	The business offers provide accurate information about its performance.
FC 3	Our family business is equipped with latest communication and information technology.
FC 4	The trainings are frequently provided to family members (employees) about emerging technologies.

were in either second generation and ready for third generation transition, or beyond the second generation. Of the 217 questionnaires returned, half-filled questionnaire and outliers were detected and deleted. The final study sample included 203 questionnaires for further data analysis. The demographic information is available in Table 1.

Analytical Strategy

Microsoft Excel was used to input data and subsequently imported into SPSS for the detection of outliers and half-filled questionnaires. The remaining 203 questionnaires were then imported to Smart PLS 4.0.9.2. The use of Smart PLS was chosen due to the evaluation of a complicated research model combined with several hypotheses (Salem et al., 2023). Moreover, the Smart PLS effectively handles samples that are not normally distributed. The study incorporated measurement modelling, structure modelling, and the PLS Predict feature of Smart PLS (Cheah et al., 2023).

Common Method Bias

To avoid the potential threat of common method bias, precautionary measurement steps were taken to maintain the reliability and authenticity of the study. The respondents were aware of the objective of the study and their voluntary participation. The study ensured the absence of common method bias through Harman's one-factor test (Harman, 1976). Moreover, a marker-correlation test (MCT) was employed, and brand position construct was utilized as a marker variable to ensure any significant difference through the inclusion and exclusion of marker variable (Williams et al., 2010). The marker variable is a variable that does not have an association with the key variables of the study, and therefore, it is not discussed along with the key variables of the study. The marker variable assesses the validity threats, which account for a common method of bias study findings. The marker variable, which is unrelated to substantive variables, compares the sequential differences of the model (Simmering et al., 2015).

Measurement Instruments

The questionnaire presented in Table 2 are items adapted from relevant literature. The scale to measure big data management, talent and technological analytical capabilities are from Nisar et al. (2022). The scale of family leadership focus on big data is from Shamim et al. (2019). The scale of sustainable excellence of family business is adapted from Al-Dhaafri and Alosani (2023) and measurement items of innovation and learning performance are borrowed from Pinar and Girard (2008). The scale of employee adaptability

to learn to change the sphere of family business is drawn from Espasandín-Bustelo et al. (2021), adapted to the family context having four items.

Results

Outer Model Assessment

Further analyses were conducted to ensure discriminant validity through heterotrait-monotrait ratio (HTMT) in Smart PLS. The threshold criteria of HTMT is below 0.9 defined by Hair and Gudergan et al., (2017). However, Raza et al. (2024a, 2024b) argue the value of HTMT is context-based and there should not be conservative benchmarks. However, the study satisfies the threshold of below 0.9. Moreover, the Fornell and Larcker (1981) ensured discriminant validity and found maximum values on the diagonal meeting the threshold requirement.

The next phase was to ensure multicollinearity of the constructs. The VIF values of the items are below 3.3 meeting the required condition. Further, the study examined the composite reliability of the obtained data, and the values of rho-c and rho-a were found below 0.7 ensuring the criteria defined by Hair et al. (2013). The study ensured the average variance extracted value greater than 0.5 and loadings were higher than 0.7 as well. Sarstedt et al. (2020) suggested the deletion of items/loadings below 0.7 but leaves it to the researcher and research context whether or not to delete items. For this study, no items were deleted. The composite reliability, multicollinearity, and discriminant validity are explained in Table 3.

Inner Model Assessment

After ensuring assessments of the outer model, the next phase was to evaluate the inner model to ensure the model's fit (Hair et al., 2020; Khalid et al., 2023; Shehata et al., 2023).

The predefined criteria of SRMR are below 0.08 as defined by Henseler et al. (2015). The obtained statistical value of SRMR is 0.079 confirming the study's model fit and the effect size of 0.059 highlights the appropriate effects. The value of R^2 is 0.550 meets the threshold defined by Hair et al. (2013). It is crucial to ensure the predictive relevance of the proposed model, defined as Q^2 . The study of Stone (1974) noted that there are no specific criteria of predictive relevance and it is good as it is higher than zero. The predictive relevance of innovation and learning performance of family members is 0.727, and for sustainable excellence of family business, it is 0.511. Table 4 explains the model fit values for the study.

Table 3 Measurement model

	Items	Loadings	Cron- bach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted	VIF
BDA Management Capabilities	MC 1	0.841	0.908	0.91	0.929	0.686	2.631
	MC 2	0.864					2.85
	MC 3	0.835					2.424
	MC 4	0.797					2.122
	MC 5	0.827					2.332
	MC 6	0.806					2.154
BDA Talent Capabilities	TC 1	0.769	0.924	0.925	0.937	0.624	2.152
	TC 2	0.819					2.968
	TC 3	0.774					2.469
	TC 4	0.752					2.13
	TC 5	0.767					2.095
	TC 6	0.815					2.779
	TC 7	0.829					3.312
	TC 8	0.807					2.868
	TC 9	0.771					2.372
BDA Technological Capabilities	TECH 1	0.752	0.716	0.793	0.826	0.614	1.832
	TECH 2	0.755					1.787
	TECH 3	0.84					1.185
Innovation and Learning Performance of Family Members	ILP 1	0.863	0.914	0.916	0.935	0.744	2.849
	ILP 2	0.859					2.598
	ILP 3	0.883					2.957
	ILP 4	0.888					3.077
	ILP 5	0.817					2.428
Sustainable Excellence of Family Business	OE 1	0.722	0.912	0.921	0.926	0.559	1.991
	OE 2	0.753					2.332
	OE 3	0.725					2.128
	OE 4	0.667					1.981
	OE 5	0.843					3.075
	OE 6	0.792					2.613
	OE 7	0.816					2.936
	OE 8	0.708					2.319
	OE 9	0.694					2.371
	OE 10	0.734					2.335

Table 4 Goodness of model fit

Q ² predict	0.511
RMSE	0.706
MAE	0.532
SRMR	0.079
NFI	0.759
R ²	0.733
f ²	0.059

Dual Moderations of Study

Further, the hypotheses were tested through the bootstrapping process of Smart PLS 4 at the sub-sample rate of 5000. The results were mixed for both direct and indirect hypotheses and moderating variables. The moderation of family leadership, which focuses on big data integration, was found to be significant only in the liaison between BDA management capabilities and innovation and the learning performance of family members. It is nonsignificant in relation to big data analytical talent capabilities and BDA

Fig. 2 Moderation slope of family leadership focus on big data integration

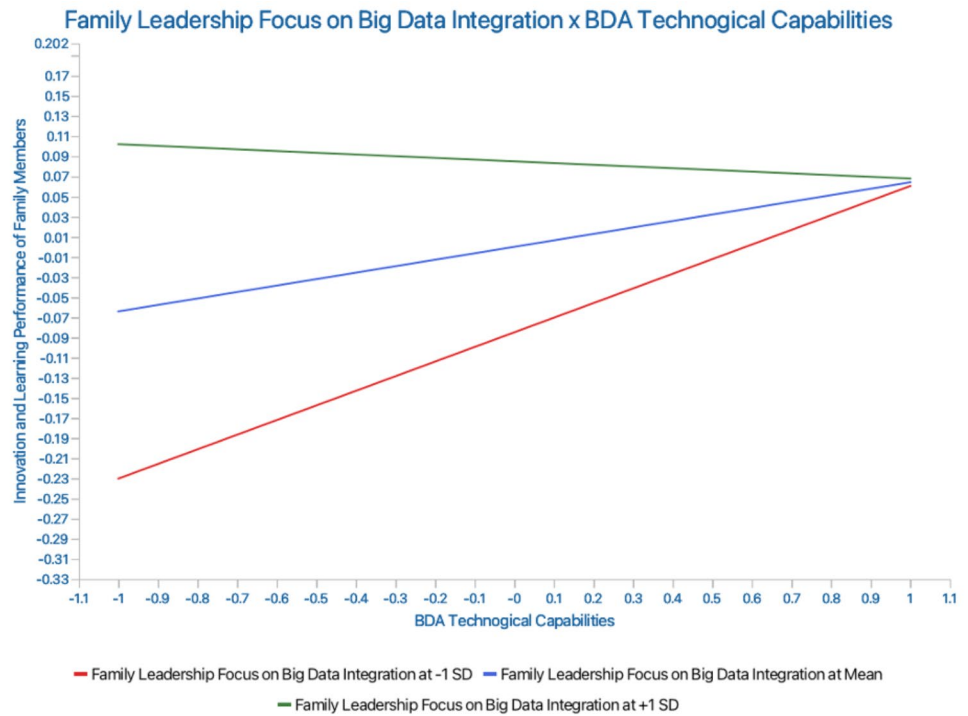
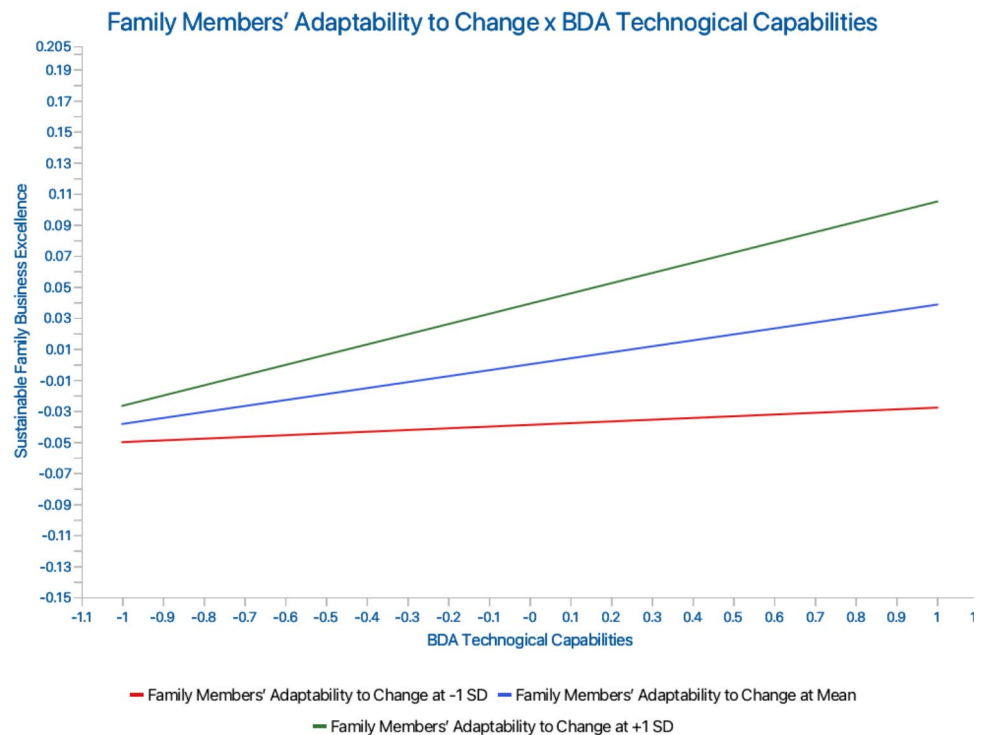


Fig. 3 Moderation slope of family members' adaptability to change



technological capabilities to innovation and learning performance of family members. The graphical representation of moderation of family leadership focus on big data integration is provided in Fig. 2.

However, family members' adaptability to change was found to be nonsignificant only in relation to big data

analytical technological capabilities and sustainable excellence of the family business. It was found to be significant to big data analytical talent capabilities and big data analytical management capabilities to sustainable excellence of family business, which is explained in the Fig. 3.

Discussion of Results

The study revealed the impacts of big data analytical capabilities in family businesses in Thailand. This study found the liaison between big data analytical management capabilities to innovation and the learning performance of family members significant (H1a). The paper also found the significance of big data analytical management capabilities with sustainable excellence of family business and following the mediation of the learning performance of family members (H1b, H1c). The results are in line with the literature (Azevedo & Reis, 2019; Chaurasia et al., 2018; Hsu et al., 2022) and possible reasons can be found in its contextual and geographical aspects. As previously mentioned there are 80% of family businesses in Phuket, Thailand and they are dominating the market based on their cutting-edge technological capabilities of management.

Further, big data analytical talent capabilities' relationship with innovation and learning performance of family members was significant, but it was found nonsignificant to the sustainable excellence of the family business (H2b). However, the relationship with sustainable excellence of family business is significant through the mediation of innovation and the learning performance of family members (H2a, H2c). The outcomes are supported by previous study assumptions (Bag et al., 2020; Bhattacharya, 2021; Nocker & Sena, 2019; Russell & Bennett, 2015). The big data analytical talent capabilities require time, knowledge transfer from the founders of family businesses, and the development of programming skills and these skills assist family members in their learnings and set the business trajectory to growth and sustainable excellence.

The study revealed nonsignificant results of BDA technological capabilities to innovation and learning performance of family members and sustainable excellence of family business (H3a, H3b, H3c). The sequels of these specific assumptions are contrary to the literature and assumptions (Azevedo & Reis, 2019; Evans, 2015; Sardi et al., 2023) and this study has suggests plausible interesting reasons. Although technological skills are essential for a business, family businesses typically rely on their unique amalgamation of innovation through tradition. The transition of generation to generation makes family businesses capable of maintaining the traditions of ancient founders of business and innovating through technology but the high-tech technology may not be needed by family business members to thrive in the marketplace.

Hypothesis H4 proposed the liaison between innovation and the learning performance of family members to sustainable excellence of family business. The findings revealed its significance and are in line with previous studies (Asif & Gauthier, 2014; Chien et al., 2015; Santos et al., 2018). The

learning performance in a family business not only uplifts family members as individual employees but also leads the business to excellence, strengthens its position in the marketplace, and helps to sustain it in chaotic economic times.

Further, the study investigated the moderation of family leadership focus on big data integration and found it significant for big data analytical management capabilities to innovation and learning performance of family members (H5a) and in line with previous studies (Doeleman et al., 2012; Fosso Wamba & Mishra, 2017). However, it was found to be nonsignificant for big data analytical talent and technological capabilities to innovation and learning performance of family members (H5b, H5c). The findings are rare in literature and contrary to most studies. However, the plausible reason for such mixed results is rooted in the contextual aspect of Thailand. The leadership of a family business can alter the big data management handling of family members (employees), but it may not be able to influence the inherited talent shaped through big data and integration of big data in a family business.

The analysis demonstrated the moderation of family members' adaptability to change between big data analytical management capabilities (H5a) and big data talent capabilities (H5b) to sustainable excellence of family business. The findings are in line with the literature (Wan & Liu, 2021; Wided, 2023). However, the moderation divulged a nonsignificant relation with big data analytical technological capabilities (H5c). The plausible reason lies within employees' attitudes as their adaptability to change can enhance their talent and managing abilities (See Table 5).

Conclusion

Sustainable excellence is of rising concern for family businesses. Family businesses are striving for excellence and maintaining their family legacy. Bellas (2022) argues that less than 4% of businesses manage to maintain their legacy beyond the third generation and calls to examine the factors that can overcome this third-generation curse. Nisar et al. (2021) noted that big data analytical capabilities are necessary for business excellence and performance in the digital age. The character of family leadership, their life-long experience, and their ability to inherit the knowledgeable combination ensure the sustainable excellence of family business (Sorenson, 2000). Leadership alone cannot effectively manage the family business unless the members are able to adapt to the change. Their ability to adapt to change can help businesses themselves by sustaining family legacy, norms, and culture while including requirements of the digital era, rapidly changing preferences of customers, and innovation to stay competitive (Bargoni et al., 2023).

Table 5 Hypotheses testing

Hypotheses of Study	Original sample	Sample mean	STD Dev.	T Values	P values	Decision
H1a BDA Management Capabilities -> Innovation and Learning Performance of Family Members	0.366	0.367	0.07	5.241	0	Significant
H1b BDA Management Capabilities -> Sustainable Family Business Excellence	0.461	0.465	0.1	4.593	0	Significant
H1c BDA Management Capabilities -> Innovation and Learning Performance of Family Members -> Sustainable Family Business Excellence	0.115	0.113	0.041	2.789	0.005	Significant
H2a BDA Talent Capabilities -> Innovation and Learning Performance of Family Members	0.468	0.469	0.068	6.844	0	Significant
H2b BDA Talent Capabilities -> Sustainable Family Business Excellence	-0.008	-0.004	0.119	0.066	0.947	Insignificant
H2c BDA Talent Capabilities -> Innovation and Learning Performance of Family Members -> Sustainable Family Business Excellence	0.147	0.144	0.05	2.975	0.003	Significant
H3a BDA Technological Capabilities -> Innovation and Learning Performance of Family Members	0.085	0.085	0.06	1.421	0.155	Insignificant
H3b BDA Technological Capabilities -> Sustainable Family Business Excellence	0.024	0.023	0.077	0.31	0.756	Insignificant
H3c BDA Technological Capabilities -> Innovation and Learning Performance of Family Members -> Sustainable Family Business Excellence	0.027	0.028	0.024	1.13	0.258	Insignificant
H4 Innovation and Learning Performance of Family Members -> Sustainable Family Business Excellence	0.315	0.31	0.101	3.115	0.002	Significant
H5a Family Leadership Focus on Big Data Integration x BDA Management Capabilities -> Innovation and Learning Performance of Family Members	0.166	0.172	0.07	2.382	0.017	Significant
H5b Family Leadership Focus on Big Data Integration x BDA Talent Capabilities -> Innovation and Learning Performance of Family Members	-0.121	-0.133	0.092	1.308	0.191	Insignificant
H5c Family Leadership Focus on Big Data Integration x BDA Technological Capabilities -> Innovation and Learning Performance of Family Members	-0.081	-0.073	0.066	1.239	0.215	Insignificant
H6a Family Members' Adaptability to Change x BDA Management Capabilities -> Sustainable Family Business Excellence	-0.412	-0.414	0.094	4.409	0	Significant
H6b Family Members' Adaptability to Change x BDA Talent Capabilities -> Sustainable Family Business Excellence	0.383	0.391	0.129	2.973	0.003	Significant
H6c Family Members' Adaptability to Change x BDA Technological Capabilities -> Sustainable Family Business Excellence	0.027	0.017	0.097	0.282	0.778	Insignificant

Theoretical Implications

This study offers theoretical knowledge of sustainable family business excellence by integrating big data analytics into the family business. Despite the increasing interest in big data analytics in management, a handful of studies exist on how big data analytics enhance sustainable family business excellence. This study addresses this gap by providing a framework for developed and developing economies. Both developed and developing economies for family businesses face common challenges such as succession planning and authority issues in operational and strategic context; moreover, their concerns can significantly change due to shifting economic landscapes, laws, and regulations, gain access to resources, and market dynamics.

Further, the study advances the literature on innovation and learning performance of family members and provides theoretical information about the family business, norms, working styles, culture, and the way family leaders and

members work together for the excellence of the business. Further, the study articulates dynamic capabilities theory to strengthen the relationship of constructs assimilated of dual moderation. The moderation of family leadership focus on big data integration covers the business leaders' aspect and family members' adaptability to change covers the employees' perspective. The study offers an initial attempt to document the efforts of family businesses to maintain their generational legacy. Further, the study provides some direction for family businesses to achieve excellence in the digital age.

Practical Implications

The present study outcomes provide the direction and managerial implications to family business owners and managers who are engaged in implementing big data analytics. The outcomes have demonstrated managerial involvement in questing to achieve operational excellence, especially

in family businesses. Additionally, the owners of family businesses can accomplish the operational qualities from the noteworthy association between big data analytic capabilities and sustainable family business excellence. Consequently, executives must focus on developing organizational dynamic capabilities that assist them in discovering and using opportunities for business excellence. Further, innovative learning performance of employees, family leadership focus on big data integration, and family members' adaptability to change can enhance the innovative way of working to achieve sustainable family business excellence. The findings of the study identify the need for big data integration in Thailand's family business. There are some studies that reveal the bridge to connect family traditions to innovation. As modern problems require modern solutions, family businesses must integrate big data to understand their customers and marketplace. The finding implies that big data integration is not effective until the founders of the business and family members are on the same page and have the potential to develop the business. The study highlights that family businesses are different from non-family business as business direction decisions involve emotions and inward orientations (Valeri, 2023). Therefore, family members and leaders need to collaborate to lead the market and maintain customers' confidence.

Limitations and Future Directions

This study offers several opportunities to future researchers through its limitations. First, the data was obtained from Phuket and may not be generalizable beyond that location. However, as family businesses are plentiful in Asia, the study does offer an Asian perspective. An application of this proposed framework in European, American, and other Western markets would be interesting. The study has discussed the need to bridge the tradition and innovation paradox of family business. The study invites future researchers to interview family business entrepreneurs to understand how they balance intergenerational transitions and changing business models. Further, this study highlighted the generational transitional failures and invited researchers to work on ways to confront the third generational curse of family business.

Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Competing of Interest The authors report there are no competing interests to declare.

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