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The Role of Digital Transformation in Enhancing Business Performance and Smart Economy Integration: A Case Study of Thailand's Retail Industry

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Abstract: This research examines the relationship between digital transformation, business performance, and the smart economy. The study uses a purposive sampling method with a quota approach, targeting business owners or managers from traditional retail businesses in smart cities across Thailand. 389 usable responses were collected and analyzed in Structural Equation Modeling (SEM). Digital transformation positively correlates with business performance. Moreover, both digital transformation and business performance positively impact the smart economy. The findings support that digital transformation enhances business performance and contributes to the smart economy in retail operations, improving customer experiences and fostering smart economies. This study advances the academic understanding of digital transformation in Thailand's retail sector, confirming the relevance of the TOE framework. The findings provide practical insights for retail businesses seeking to enhance performance and integrate with the smart economy through digital transformation.

1. INTRODUCTION

In today's rapidly evolving economic landscape, digital transformation has emerged as a pivotal force shaping business performance, including sustainable approach and organization [1,2]. The digital transformation revolution enhances operational efficiency, enables data-driven decision-making, and expands market reach technology. Environmental pressures influence the adoption of growth and lead to achieving the UN's sustainable development goals [3]. Digital

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transformation enhances businesses and urban systems, leading to higher productivity, better service delivery, and increased competitiveness in terms of business value creation [4,5].

Business performance in a smart economy contributes vitality through increased investment, job creation, and innovation [6]. Business performance can lead to a more dynamic market environment and enhanced consumer experiences. For smart cities, effective business performance supports the development of a robust digital ecosystem, attracts investment, and fosters economic growth. The relationship between business performance and the smart economy underscores the importance of integrating digital transformation strategies to achieve sustainable and inclusive economic development. Innovative digital practices optimize, enhance public services, and drive economic growth in smart cities [7]. Advancing the smart economy through digital transformation is critical in fostering innovation, sustainability, and financial resilience [8].

In Thailand, the availability of advanced technological resources is limited by insufficient government investment and financial support in the smart economy [9]. Digital disruption presents a formidable challenge to traditional retail yet offers an exciting opportunity. By adopting e-commerce platforms and mobile payments, Thai retailers can significantly boost their efficiency and expand their market reach (Feng & Jantarakolica, 2023). Nevertheless, the digital divide can impede smaller retailers, highlighting the critical need for substantial investments in digital infrastructure and targeted training. By addressing these challenges, Thailand can boost the traditional retail sector and support broader economic growth, driving the advancement of a smart economy.

Technology-Organization-Environmente and the Resource-Based View (RBV) theory have been grounded theory applied in this study. TOE framework helps understand how the adoption of smart technologies in urban environments is influenced by similar factors: the state of technology and organizational and external pressures [10]. The RBV theory explains the organization's strategic resources in smart technologies that improve business performance, thereby contributing to smart economics [11]. This research aims to elucidate the intricate connections between digital transformation, business performance, and the smart economy, providing insights into how these elements interact to shape future economic landscapes. This research also explores the multifaceted impact of digital transformation on these areas and its broader implications for the smart economy.

2. LITERATURE REVIEW

2.1 Digital Transformation (DT)

Digital transformation encompasses the extensive process of incorporating digital technologies throughout an organization, fundamentally redefining its operational processes and value delivery mechanisms to customers and stakeholders [12,13]. Cloud computing, big data

analytics, artificial intelligence (AI), and the Internet of Things (IoT) improve efficiency and create new business models [14–16]. Moreover, Digital transformation involves a strategic shift in leveraging digital tools effectively and remaining competitive in an evolving market dynamism [17,18].

Empirical research highlights that digital transformation is essential for improving the performance of traditional retail businesses [19]. Digital technologies can significantly improve customer experience, operational efficiency, and market expansion [20]. Integrating e-commerce platforms allows traditional retailers to expand their customer base and compete with online giants by applying digital tools such as data analytics. This enables retailers to understand customer preferences better and optimise in optimize management, leading to increased sales and profitability. Traditional retailers that leverage digital technologies obtain higher sales growth and profitability [21].

Significant research exists on the impacts of digital transformation on traditional retail and smart cities. Still, there is a gap in comprehensive studies that explore the integrated relationship between digital transformation, business performance, and the broader smart economy. Specifically, there is limited empirical evidence on how digital transformation in traditional retail influences smart cities across different sectors and its collective contribution to the smart economy. Therefore, Hypothesis 1 has formed;

H1: Digital Transformation positively impact Business Performance

2.2 Business Performance (BP)

Business performance measures a company's ability to achieve its financial and strategic goals, focusing on effectiveness and efficiency [22]. Business performance indicators may include economic factors such as revenue, profitability, and return on investment, as well as non-financial metrics like customer satisfaction, market share, and operational efficiency (Al-Dmour & Abbod, 2018; Salamah, 2023). The critical role of business performance in traditional retail highlights the impacts of competitiveness and sustainability. Non-financial business success and effective business performance management in retail settings lead to improved customer satisfaction, enhanced loyalty, and better financial results. Furthermore, operational efficiency, driven by factors such as inventory management and supply chain optimisation, contributes to superior performance in the retail sector.

Business performance is crucial for driving economic development and enhancing urban living conditions. The success of technology firms and service providers in smart cities leads to better infrastructure. High-performance businesses contribute to economic growth through innovation, increased efficiency in public services, and overall urban sustainability. The performance of businesses in smart cities serves as the drive to innovation and operational effectiveness, contributes to the city's economic vitality and improves the community's quality of

life. Although business performance has been widely studied, there is still a lack of research examining how the performance of traditional retail both affects and is affected by the evolving dynamics of smart cities. Therefore, Hypothesis 2 has formed;

H2: Digital Transformation positively impact Smart Economy

2.3 Smart Economy (SE)

Smart economy is an economic system that utilises data analysis and innovative business models to promote sustainable growth, boost productivity, and elevate the quality of life [25]. Combining smart technologies, including traditional retail and urban management, creates a more efficient, connected, and resilient economic environment. The key elements of a smart economy rely on advanced infrastructure, digital platforms and data-driven decision-making, economic competitiveness, and social well-being [26–31]. A smart economy is also characterised by technology to optimise, reoptimise, improve processes, and create new economic opportunities [32].

The smart economy is crucial for advancing urban management and sustainability. Smart Economy supports traditional retail by providing advanced analytics for inventory management and customer insights, leading to more informed decision-making and better financial outcomes. In Thailand, the availability of advanced there is limited research on how advancements in the smart economy influence business performance in traditional retail and the reciprocal impact of retail innovations on smart city developments. , Therefore, Hypothesis 3 has formed;

H3: Business Performance positively impacts Smart Economy

The TOE framework emphasizes the role that technology, organization, and external environmental factors play in enabling digital transformation, which subsequently impacts both business performance and the growth of the smart economy. Conversely, the RBV theory stresses the importance of leveraging internal resources and capabilities to achieve competitive superiority and meaningful contributions to the overall economic environment. The conceptual framework is illustrated in Figure 1.

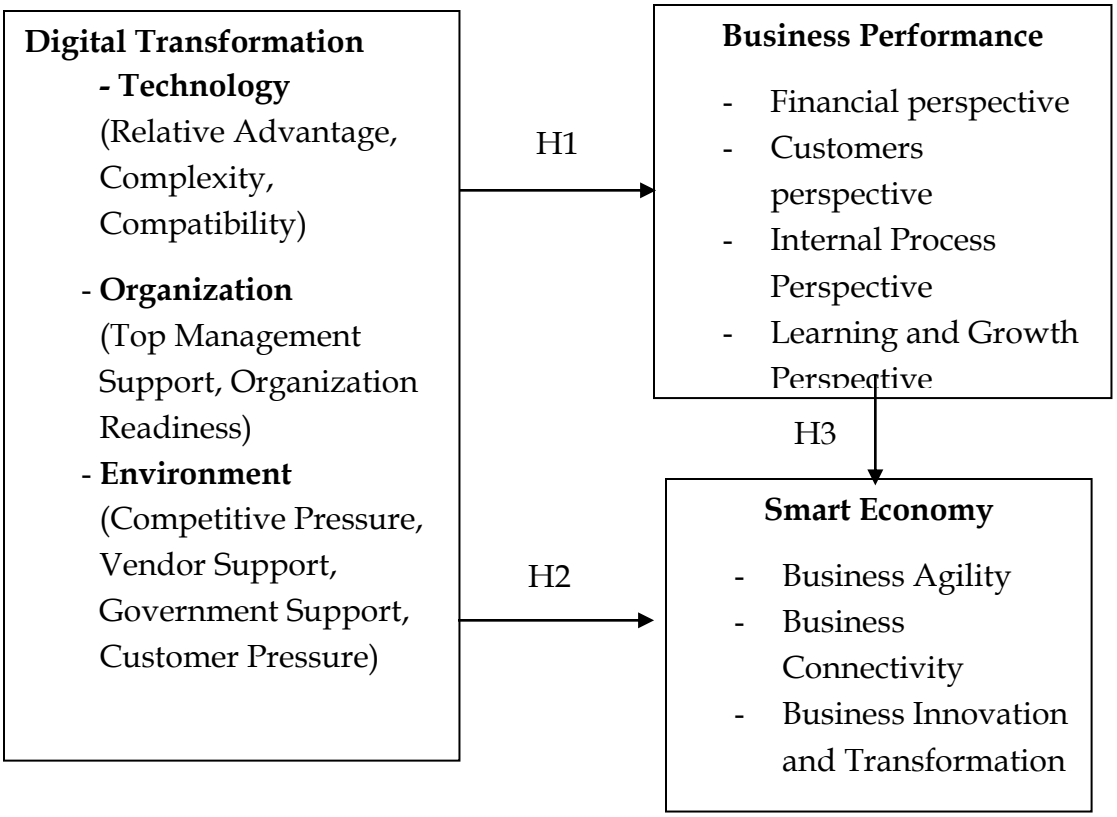

Figure 1. Conceptual framework
(Source: Author's work)

3. METHODOLOGY

This study employs a purposive sampling method with a quota approach to select business owners or managers from traditional retail businesses in smart cities in Thailand to ensure that the respondents have relevant experience and insights into the dynamics of digital transformation. 389 usable responses were gathered and analyzed in Structural Equation Modeling (SEM). PLS-SEM was chosen for its capacity to handle complex models and its robustness with non-normal data distributions. However, the data were tested for normality, passing the skewness and kurtosis thresholds of ±1.0, indicating an approximately normal distribution suitable for further analysis. Construct reliability was confirmed through the redundant test, ensuring that the measurement constructs consistently represent the underlying latent variables. Variance Inflation Factor (VIF) values were examined to assess multicollinearity, and all values were found to be below 3, as Hair et al. (2022) recommended, indicating no significant multicollinearity issues. Discriminant validity was established using both the Fornel-Larker Criterion methods, confirming that the constructs are distinct and that indicators load more strongly on their respective constructs than others.

4. RESULT

4.1 Sample Characteristics

The total 389 survey respondents, representing 100.0%, are as follows: The majority of respondents are male, with 195 individuals accounting for 50.1%. Most are between 30 and 40 years old, totalling 175 people or 45.0%. Most respondents are married, with 185 individuals or 47.6%. Most of the highest level of education is a bachelor's degree, with 312 people representing 80.2%. Many have 5 to 10 years of business experience, 166 individuals or 42.7%. Most have a monthly income of over 40,000 baht, with 178 people or 45.8%. The majority holds the current business owner position, totalling 279 individuals or 71.7%.

Regarding retail business data in Thailand from the survey responses, The majority operate as sole Private owners, with 267 individuals or 68.6%. Most businesses have fewer than five employees, with 116 people representing 29.8%. The companies have been operating for 5 to 10 years, with 140 individuals or 36.0%. The annual business revenue is less than 10 million baht for 283 firms, representing 72.8%. Most companies are located in Bangkok, with 128 individuals or 32.9%. The Sample characteristics are shown in Table 1.

Table 1 Demographic Characteristics

Items	Categories	Frequency (n=389)	Percentage (%)
Gender	Male	195	50.1
	Female	194	49.9
Marriage Status	Single	178	44.7
	Married	185	47.6
	Separated	30	7.7
Age (Years)	Less than 30	25	6.4
	31-40	175	45.0
	41-50	138	35.5
	Above 51	51	13.1
Education Background	Under- graduated	36	9.3
	Graduated	312	80.2
	Post- graduated	41	10.5
Business Experience	Less than five years	61	15.7
	5-10 years	166	42.7
	11-15 years	121	31.1
	Above 15 years	41	10.5
Personal Monthly Income ($)	Less than $500	6	1.5
	Between $501-$900	78	20.1
	Between $901-$1,200	127	32.6
	More than $1,201	178	45.8

Current Occupation	Business owner	279	71.7
	Partnership	70	18.0
	Managing director	27	6.9
	Other	13	3.3
Business Registration	Private owner	267	68.6
	Partnership	53	13.6
	Company limited	45	11.6
	Franchise	24	6.2
Number of Employees	Less than five employees	116	29.8
	6-10 employees	106	27.2
	11-15 employees	69	17.7
	More than 15 employees	98	25.2
Business Operation Period	Less than five	71	18.3
	6-10 years	140	36.0
	11-15 years	91	23.4
	More than 15 years	87	22.4
Business Revenue	Less than 10 million Baht	283	72.8
	10-15 million Baht	66	17.0
	More than 15 million Baht	40	10.3
Business Location	Bangkok	128	32.9
	Central region	38	9.8
	North-East region	94	31.2
	North region	78	20.1
	South region	51	13.1

Source: Authors' research

The reliability of the measurement model is assessed based on the outer weight, which must be greater than 0.50. Its statistical significance should be considered if an outer weight is less than 0.50. If the observable variable has a weight of less than 0.50 and is not statistically significant, it should be removed from the study [33]. The significance was analysed by the Bootstrapping method at a significance level of 0.05, with a two-tailed test (Two-tails) conducted using the Bias-Corrected and Accelerated (BCa) method, with 10,000 bootstrap samples generated. The results are shown in Table 2. As a result, the researcher removed the observable variables (RA1), "The business faces difficulties in adopting technology", and (RA2), "The technology to be adopted in the business is complex to understand ", from the study. Therefore, the component related to digital transformation in terms of relevant benefits (RA) was excluded from the study [34].

Table 2 Measurement model assessment

Items	Outer weight	P values	VIF
Top Management Support			
(TMS1) The business has a policy for incorporating digital technology into its operations.	0.268	0.001	1.393
(TMS2) The business has a clear plan for implementing digital technology across all areas of the business.	0.461	0.000	1.613
(TMS3) The business encourages employees to continuously learn new digital technologies.	0.537	0.000	1.250
Organization Readiness			
(OR1) The business has a team that is ready to adapt and learn new technologies.	0.656	0.000	1.131
(OR2) The business has training or development plans to prepare employees for adopting digital technology.	0.361	0.000	1.190
(OR3) The business has investment plans for digital technology to integrate into its operations.	0.336	0.000	1.138
Relative Advantage			
(RA1) The business has new technology that helps reduce the time required for internal operations.	0.801	0.104	1.179
(RA2) The business utilizes teutilizes that enhances service efficiency, enabling quicker responses to customer needs.	0.363	0.517	1.179
Complexity			
(COM1) The business faces difficulties in adopting technology.	0.381	0.000	1.035
(COM2) The technology to be implemented in the business is complex to understand.	0.412	0.000	1.164
(COM3) The business has technology that helps reduce costs or increase profits.	0.631	0.000	1.139
Compatibility			
(COMP1) The business has technology that aligns with customer needs and enhances their satisfaction.	0.361	0.000	1.033
(COMP2) The business has technology that meets its operational needs.	0.359	0.000	1.126
(COMP3) The business has sufficient digital technology resources to promptly integrate new technologies.	0.684	0.000	1.140
Competitive Pressure			

(CPEXP1) The business conducts surveys and gathers information about competitors and the market to formulate strategies.	0.518	0.000	1.019
(CPEX2) The business has marketing plans or strategies to respond to market competition.	0.486	0.000	1.013
(CPEX3) The business continuously assesses the competitive landscape in the market.	0.618	0.000	1.006
Vendor Support			
(VS1) The business receives support from partners or suppliers related to the adoption of digital technology.	0.487	0.000	1.155
(VS2) The business gets advice from partners or suppliers on selecting digital technologies.	0.521	0.000	1.214
(VS3) The business receives immediate assistance from partners or suppliers when issues arise with the use of technology.	0.386	0.000	1.076
Government Support			
(GS1) The business receives support or encouragement from government agencies or organizatioorganizationsng digital technology.	0.660	0.000	1.005
(GS2) The business receives additional support, such as knowledge or training on implementing digital technology.	0.601	0.000	1.041
(GS3) The business benefits from government policies or incentives that promote or support the use of digital technology.	0.283	0.039	1.043
Customer Pressure			
(CVBS1) The business responds to customer needs or suggestions by sourcing new products or developing services.	0.635	0.000	1.010
(CVBS2) The business improves or adjusts its processes to meet customer needs or enhance customer satisfaction.	0.329	0.000	1.076
(CVBS3) The business builds strong relationships with customers to foster trust and satisfaction.	0.604	0.000	1.068
Financial perspective			
(FP1) The business consistently increases revenue from both existing and new customers.	0.575	0.000	1.065
(FP2) The business experiences satisfactory growth rates in sales.	0.468	0.000	1.102

(FP3) The business successfully reduces the cost of operations per unit from the cost of goods.	0.734	0.000	1.095
Customers perspective			
(CP1)The business continuously seeks new products and services and expands into new markets or customer segments.	0.696	0.000	1.016
(CP2) The business pays attention to and considers customer feedback, analyzing ianalyzing improvements and address issues.	0.329	0.002	1.000
(CP3) The business provides customer support and consultation both during and after sales or service.	0.728	0.000	1.016
Internal Process Perspective			
(IPP1) The business consistently evaluates performance related to operational efficiency within the organization.	0.691	0.000	1.088
(IPP2) The business maintains operational manuals or documentation.	0.326	0.000	1.116
(IPP3) The business regularly monitors employee performance.	0.555	0.000	1.056
Learning and Growth Perspective			
(LGP1) The business supports creating a positive work environment.	0.378	0.000	1.025
(LGP2) The business provides employees with opportunities to fully utilize their knowledge and skills.	0.445	0.000	1.077
(LGP3) The business grants employees autonomy in their work, such as decision-making power.	0.597	0.000	1.028
(LGP4) The business consistently supports training on new programs before their implementation.	0.498	0.000	1.074
Business Agility			
(FLEX1) The business is capable of restructuring or adjusting its processes to accommodate market changes.	0.364	0.000	1.002
(FLEX2) The business utilizes digital technology to enhance operational agility.	0.383	0.001	1.009
(FLEX3) The business can swiftly respond to changing customer needs.	0.547	0.000	1.052
(FLEX4) The business has strategies or methods to maintain or increase its agility in an ever-changing market environment.	0.536	0.000	1.047

Business Connectivity			
(REL1) The business is connected and collaborates with other businesses.	0.456	0.000	1.026
(REL2) The business uses digital platforms or online networks to enhance connections with partners or customers.	0.266	0.001	1.018
(REL3) The business shares information or resources with other companies to foster collaboration and innovation.	0.642	0.000	1.008
(REL4) The business has policies or partnerships that promote connectivity and cooperation with external organizations.	0.442	0.000	1.018
Business Innovation and Transformation			
(APP1) The business plans and implements internal changes to support the adoption of innovation within the organization.	0.540	0.000	1.025
(APP2) The business has a strategy for studying and keeping up with the latest innovation trends in the retail industry.	0.528	0.000	1.084
(APP3) The business plans and executes internal changes to accommodate the adoption of innovation within its operations.	0.497	0.000	1.065

Source: Authors' research

4.2 Hypothesis Testing

Path analysis was conducted using a High Order Construct (HOC) approach in this study. All three constructs are high-order with formative-formative constructs [35,36]. Thus, the researcher employed a two-step approach. The first step evaluated the measurement model, and non-significant observable variables were removed. In the second step, latent variable scores for each construct were computed to use as proxies in path analysis. The second-order constructs also have a formative structure, similar to the first-order constructs. Path analysis was performed using Bootstrapping with a significance level of 0.05, employing a one-tailed test with the Bias-Corrected and Accelerated (BCa) method, simulating 10,000 bootstrap samples as illustrated in Figure 2.

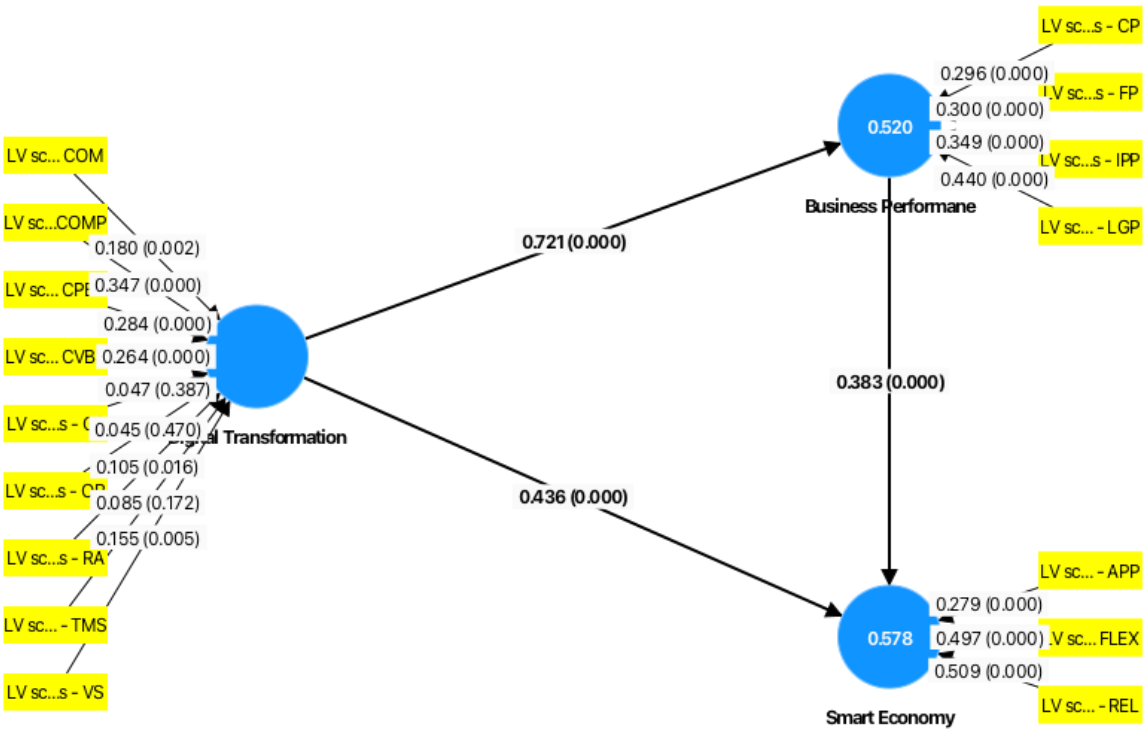

Figure 2. Path Analysis

(Source: Author's work for SMART PLS4.0)

The proportion of variance in latent dependent variables accounted for by independent variables is represented by the R^2 (R-Square) coefficient. An R^2 value of 0.25 or higher suggests that the independent variables sufficiently explain the variance in the dependent variables. The findings indicate that the coefficients of determination for business performance and smart economy exceed 0.25, demonstrating their substantial explanatory power. The model's predictive accuracy, evaluated through Cross-Validated Redundancy (Q^2), further substantiates the robustness of the structural model, with a Q^2 value greater than zero affirming the model's fit [37]. Business performance and smart economy have interpreted and substantiated the robustness fit.

Table. 3 Path Coefficients, Standard Deviations, t-statistics, and p-Values

Path Analysis	Path Coefficient	Standard Deviation	t- Statistics	P Value	R^2	Q^2
H1: Digital Transformation -> Business Performance	0.721	0.029	24.999	0.000	.520	.497
H2: Digital Transformation -> Smart Economy	0.436	0.056	7.773	0.000	.578	.485
H3: Business Performance -> Smart Economy	0.383	0.059	6.536	0.000		

Source: Authors' research

The relationship results are summarised in Table 3. digital transformation to business performance was significant, with a path coefficient of 0.721 ($t = 24.999$, $p < .001$), indicating a strong positive relationship. The R^2 value of 0.520 suggests that digital transformation explains 52% of the variance in Business Performance, with a Q^2 value of 0.497, indicating good predictive relevance. The path from digital transformation to smart economy was also significant, with a path coefficient of 0.436 ($t = 7.773$, $p < .001$), indicating a moderate positive relationship. The R^2 value for this path was 0.578, meaning that digital Transformation accounts for 57.8% of the variance in the smart economy, with a Q^2 value of 0.485, indicating good predictive relevance. Finally, the path from business performance to smart economy was significant, with a path coefficient of 0.383 ($t = 6.536$, $p < .001$), indicating a moderate positive relationship. The results support the hypothesised relationships, with all paths showing significant positive effects. Digital transformation appears to have a substantial impact on business performance, which, in turn, positively influences the development of the smart economy.

5. DISCUSSION

Digital transformation is positively correlated with the performance of retail businesses in Thailand, supporting Hypothesis 1. This finding aligns with current research highlighting the impact of digital transformation on business performance across various sectors[2,38,39]. For instance, studies in the UK emphasize the role of data-driven digital transformation in enhancing business performance in the retail industry, especially in emergencies, by improving demand forecasting and trends, which leads to successful business outcomes [40,41] . Similarly, research in Russia points to the advantages of digital transformation in modernising retail businesses, improving convenience, and enhancing distribution, shipping, and payment processes [42]

Conversely, studies highlight the negative consequences of neglecting digital transformation, such as diminished market share and reduced organizational, and technological capabilities [43]. Moreover, the integration of digital transformation is recognized as a means to advance sustainability in retail, emphasizing omnichannel strategies to provide innovative solutions and share real in-store experiences through online platforms [1,44]. These insights underscore embracing digital transformation to improve business performance and adapt to the evolving retail landscape.

Digital transformation positively correlates with developing a smart economy in Thailand's retail sector, thus supporting Hypothesis 2. The findings emphasize digital transformation's critical role in enhancing retail businesses' overall es and adapting to smart digital systems. Adopting digital marketing and internet technologies reflects a shift towards a smart digital system that improves sales channels and customer engagement [45].

Research supports that the Internet of Things (IoT) is pivotal in transforming traditional retail into a smart economy, facilitating advancements such as smart workplaces, Big Data systems, and modern retail practices [46–48]. This transformation is particularly significant in developing countries, where mobile applications and digital payments are revolutionizing traditional retail and contributing to the emergence of smart retail models [49].

The study also aligns with projections indicating that by 2025, the integration of robotics in retail will increase alongside advancements in smart logistics and smart spaces as part of national economic development plans [6,50,51] . This evidence underscores the positive impact of digital transformation on fostering a smart economy within the retail sector.

The positive relationship between business performance and the smart economy in Thailand's retail sector supports Hypothesis 3. The findings align with previous studies demonstrating that organizational performance contributes to advancing a smart economy through adopting technology and development [52]. Specifically, smart retail emerges from enhanced business acumen and marketing strategies [53]. High-performing retail businesses often create superior customer experiences, leading to the development of smart retail environments [54,55]. Further research indicates that efficient retail operations, such as blockchain technology, smart inventory systems, and effective supply chain management, are crucial in fostering smart businesses [56]. These factors collectively contribute to a thriving smart economy in the retail sector by optimizing operations and enhancing customer engagement.

6. CONCLUSION

The research demonstrates several vital relationships within Thailand's retail sector. First, a positive correlation exists between digital transformation and business performance, indicating that businesses embracing digital technologies experience enhanced performance outcomes. Additionally, digital transformation is positively related to the smart economy, suggesting that businesses driving digital advancements contribute to the overall development of a smart economy. Furthermore, business performance positively affects the smart economy, showing that improved business performance is associated with advancements in the smart economy. These results underscore the significant role that digital transformation and business performance play in fostering a more sophisticated and efficient smart economy.

6.1 Academic Implications

This study is based on theory and focuses on retail businesses in Thailand as a case study. The findings reveal a combination of the TOE (Technology-Organization-Environment) framework, which contributes to the knowledge on driving digital transformation through key components in technology, organization, and environment. The study confirms the expertise and supports applying the TOE theory in academic findings. Additionally, this research provides

empirical evidence from Thailand, contributing valuable knowledge for developing countries in expanding the understanding of how technology can be leveraged to create sustainability in traditional retail businesses.

6.2 Practical Implications

The relationship between digital transformation and the performance of retail businesses in Thailand was found to be positively correlated. Therefore, adopting digital technology in management and business development can enhance the efficiency of retail businesses, mainly through advancements in digital marketing and internal management. Furthermore, integrating with a smart economy through digital technology is crucial in improving transportation efficiency and supply chain management. Applying innovations like the Internet of Things (IoT) and other technologies to develop smart retail systems can help meet customer demands and adapt to purchasing and payment methods changes.

Retail businesses in Thailand that aim to strengthen business performance and the smart economy should focus on increasing digital transformation. This can be achieved by leveraging critical factors identified in this study, such as support from top management, organizational readiness, simplification, and partnerships. Additionally, promoting digital transformation should go hand in hand with developing and establishing policies related to financial perspectives, customer perspectives, internal processes, and learning and growth perspectives.

6.3 Recommendations for Future Research

Future research should explore additional factors, such as the size of SMEs, the duration of business operations, or annual profit levels, to clarify the internal factors within organizations that influence the digital transformation development model. Moreover, an in-depth study of the causal factors related to entrepreneurial capability is recommended, as the results may lead to the design of more tailored training programs for entrepreneurs.

Conflicts of Interest: The author declares that there are no conflicts of interest regarding the publication of this paper.

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