

Article

The Influence of Innovation on Sustainability of Healthy Food Business in Thailand

Wawmayura Chamsuk ¹, Surapong Siripongdee ¹, Thepparat Phimolsathien ², Thitakom Leetanant ³
and Sujira Vuthisophon ^{1,*}

¹ College of Innovation and Industrial Management, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; wawmayura.ch@kmitl.ac.th (W.C.); surapong.si@kmitl.ac.th (S.S.)

² KMITL Business School, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand; thepparat.ph@kmitl.ac.th

³ Upstat International Company Limited, Bangkok 10250, Thailand; thitakom.l@upstat-inter.com

* Correspondence: sujira.vu@kmitl.ac.th; Tel.: +66-80-519-6595

Abstract

This research aims to study the factors influencing the sustainable performance of health food businesses in Thailand and to propose a sustainable performance model for these businesses. The sample group consisted of 260 health food business operators in Thailand. The research instrument was a questionnaire. Data were collected using a questionnaire and analyzed using partial least squares structural equation modeling (PLS-SEM). The findings revealed that innovation, service quality, and competitive advantage had direct effects on sustainability. In addition, innovation was found to have indirect effects on sustainability through service quality and competitive advantage as mediating variables. When innovation, service quality, and competitive advantage were jointly considered, the model explained 60.7% of the variance in sustainability ($R^2 = 0.607$). The results indicate that innovation serves as a fundamental driver that enhances service quality and competitive advantage, which subsequently contribute to sustainable performance. This research provides policy and practical implications for enhancing innovation and service quality, enabling businesses to achieve competitive advantage, respond effectively to the diversity of the food business sector, and promote continuous development toward sustainable future operations.

Keywords: innovation; service quality; competitive advantage; sustainability; healthy food business in Thailand



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1. Introduction

In Thailand, the health food trend has continued to gain popularity in line with global consumption trends, giving rise to health food innovations that respond to the changing needs of contemporary consumers. In addition, the outbreak of the coronavirus disease 2019 (COVID-19) affected various aspects of life in Thailand and contributed to changes in Thai consumers' food preferences. Current food trends have been influenced by several factors, including the promotion of food sustainability and increasing concern for health. A consumer survey conducted in Thailand in December 2020 indicated that more than half of the respondents were interested in learning more about healthy foods, reflecting a continuous increase in consumer awareness of health and well-being. Moreover, the consumption of healthy foods and beverages in Thailand has gradually increased over the past few years [1].

The organic food trend also emerged in Thailand several years ago and has become increasingly popular among health-conscious Thai consumers, alongside the growing consumer preference for “clean food.” Although organic foods and beverages are often limited to higher-income consumers due to their relatively higher prices, demand has also increased among middle-class consumers. The value of packaged organic foods and beverages consumed in Thailand has grown steadily and was projected to reach more than USD 25 million in 2022. Among Thai consumers, vegetables and fruits are regarded as the most important organic food products. However, some consumers remain hesitant to purchase organic foods because they are not convinced that organic foods provide greater health benefits than conventionally grown food products [2].

At present, plant-based health foods are also gaining increasing popularity among consumers in Thailand, not only among vegetarians but also among health-conscious consumers more broadly. As plant-based foods become more popular, business opportunities in the food industry have also expanded. The market value of plant-based foods in Thailand was expected to reach approximately THB 45 billion in 2024, increasing from nearly THB 30 billion in 2019. The development of plant-based foods can be broadly described in chronological and product category terms, beginning with vegetarian and vegan foods, followed by organic plant-based foods, plant-based milk and dairy alternatives, plant-based egg alternatives, plant-based snacks and beverages, and more recently plant-based meat alternatives. Among these categories, previous consumer research indicates that plant-based milk is generally the most accepted plant-based food category, whereas plant-based meat alternatives are often positioned as premium products and are associated with higher prices or consumers’ willingness to pay a price premium. Therefore, the growth of Thailand’s plant-based food market reflects not only increasing consumer demand but also new business opportunities for both large food corporations and start-up companies developing innovative plant-based products. Key players in Thailand’s plant-based food market include Thai start-up companies producing plant-based meat alternatives, such as More Meat, as well as major corporate and multinational brands, including Harvest Gourmet under Nestlé Thailand, Meat Zero under CP Foods, and Beyond Meat, which is internationally recognized in the plant-based food industry [3]. In 2019, the market value of plant-based foods in Thailand was approximately USD 845 million. This market value was projected to reach USD 1.5 billion in 2024, while the annual growth rate of the plant-based food market from 2019 to 2024 was also expected to be approximately 10 percent [4].

Based on the above information, the consumer goods market has continuously adapted to changing consumer needs and trends, digital innovation, and the growing emphasis on sustainable and healthy consumption. Digital transformation has made product purchasing more convenient for consumers and has enabled them to compare and verify products extensively. Consequently, consumer goods companies need to adjust their marketing strategies and brand perception in order to maintain customer loyalty in an increasingly competitive market. In particular, sustainability has played an increasingly influential role in the consumer goods market, as consumer demand has grown for sustainably, ethically, and environmentally responsible products across many consumer goods categories [5].

Over the past year, supply chain slowdowns and rising energy prices have increased production costs. In this context, sustainability has become an important approach to ensuring food and nutrition security for all across economic, social, and environmental dimensions. Sustainable food systems are expected to contribute to food and nutrition security for future generations by being profitable in economic terms, beneficial to society at large, and positive or neutral in their impact on the natural environment. Sustainable food systems are also central to the United Nations Sustainable Development Goals (SDGs), which were adopted in 2015. The SDGs call for major transformations in agriculture and

food systems in order to end hunger, achieve food security, and improve nutrition by 2030. Therefore, the global food system must be transformed into a more effective and inclusive system that reaches poorer populations and operates within a sustainable environment, while sustainably delivering healthy and nutritious food for all. Food system transformations are complex and challenging because they require the integration of interconnected actions by multiple stakeholders at the local, national, regional, and global levels [6].

This study addresses an important research gap by reflecting the realities of Thailand's healthy food business sector in the post-hype era, characterized by intensified competition and rising operational costs. It highlights that innovation is not merely a tool for differentiation but a strategic mechanism for enhancing service quality, strengthening competitive advantage, and fostering the long-term economic sustainability of businesses.

Based on a review of relevant literature and research, identifying diverse drivers for the adoption of sustainable innovation, Schut et al. argue that in the context of the health food industry, sustainable innovation involves developing and promoting food products, processes, and technologies that support health and well-being while minimizing negative environmental and social impacts [7]. This considers factors such as environmental impact, resource efficiency, social equity, and economic viability. Fundamentally, it is about creating and implementing innovations that not only meet current needs but also contribute to a sustainable future for future generations. Rosenthal et al. state that the food industry faces numerous global shifts and challenges, primarily driven by consumer demand for safer, healthier, and more sensory-enhanced food [8]. Therefore, sustainable food choices and consumption behaviors do not happen automatically; they require sufficient resources and capabilities. Furthermore, current environmental issues demand more environmentally friendly technologies [9]. The best way to survive market fluctuations and thrive in the long term is to manage innovation and technological advancements to enhance sustainability. Business sustainability refers to a firm's ability to maintain long-term value creation by balancing the three dimensions of sustainability: economic, environmental, and social dimensions. In order to remain competitive, firms should consider the three dimensions of sustainability based on the Triple Bottom Line framework: economic, environmental, and social dimensions. These dimensions cover economic viability, environmental responsibility, and social well-being, which collectively contribute to long-term business sustainability [10]. This study aims to fill a gap in the literature by testing innovative approaches to service quality, sustainable operations that can ensure continued business success, and the creation of sustainable business opportunities. Although innovation has been widely recognized as a driver of sustainability, prior studies have mainly focused on its direct effects. Limited attention has been given to the mechanisms through which innovation leads to sustainable outcomes, particularly through service quality and competitive advantage. Moreover, the simultaneous mediating roles of these two variables remain underexplored in the healthy food business sector. Empirical evidence from emerging economies is also limited. Therefore, this study extends the existing literature by examining how innovation contributes to sustainability performance through service quality and competitive advantage in healthy food businesses in Thailand.

2. Materials and Methods

2.1. Literature Review

2.1.1. Innovation

Elgarhy & Abou-Shouk state that innovation often arises in response to challenges or problems. Sustainability, which focuses on meeting current needs without compromising the ability of future generations to meet their own needs, is a significant challenge [11]. Innovation provides solutions to these challenges by developing new technologies, pro-

cesses, and approaches that enable sustainable development. Sustainable innovation aims to maximize resource efficiency by using resources more effectively, reducing waste, and minimizing environmental impact. By developing innovative technologies and practices, such as renewable energy sources, recycling methods, and environmentally friendly production processes, sustainability can be achieved without compromising economic growth. Tran et al. state that sustainable innovation in the food industry involves sourcing raw materials and producing food products in a way that minimizes environmental impact and promotes social responsibility [12]. This includes the use of sustainable agricultural practices such as organic farming, agronomy, and regenerative agriculture, which improve soil health, biodiversity, and water conservation. Furthermore, innovation in food processing and production can improve efficiency, reduce waste, and decrease energy consumption, leading to a more sustainable food supply chain. Sönmez Cakir et al. identify innovation as a pathway to developing healthy and sustainable food [13]. Access to appropriate food products is a challenge for food retailers serving the health sector. This highlights the need to better understand the existing and potential supply of healthy, sustainable, safe, and acceptable food products, as well as the collaborative mechanisms and partnerships required to support the transition toward more sustainable food systems [14].

2.1.2. Service Quality

Service quality refers to the provision of services that meet or exceed customers' expectations. It involves customers' overall evaluation or judgment of service excellence from the perspective of perceived experience. Previous studies have shown that innovation plays an important role in driving service quality by improving efficiency, enhancing customer experience, increasing reliability, providing greater flexibility, facilitating communication, and promoting continuous improvement. By embracing innovation, service providers can deliver greater value to customers and differentiate themselves in the market [13].

One important conclusion is that innovative technologies and processes can improve service delivery efficiency while reducing resource consumption and waste. For example, the use of data analytics and automation can optimize scheduling, routing, and resource allocation in transportation and logistics services, leading to lower fuel consumption and reduced greenhouse gas emissions. This not only improves service quality by ensuring timely and reliable delivery but also promotes sustainability by reducing environmental impacts. At the same time, high-quality services are often associated with efficient resource utilization. By optimizing processes, reducing waste, and maximizing the use of renewable resources, service providers can reduce environmental impacts and promote sustainability [15].

In general, goods are tangible, highly durable, and usually produced according to specific standards. Services, in contrast, are more variable than goods, although they similarly aim to respond to consumer needs. Services are generally characterized by intangibility, heterogeneity, and the inseparability of production and consumption. These characteristics make service quality more difficult to standardize and control than product quality, and therefore require continuous improvement in service processes, employee capabilities, customer interaction, and organizational responsiveness.

Sondhi et al. found that service quality, corporate image, and corporate reputation can serve as general marketing benchmarks for measuring sustainable performance in the banking sector [16]. Their findings indicate that customers' perceptions of service quality and satisfaction influence loyalty through perceived value, image, and reputation. These findings suggest that service quality contributes not only to customer satisfaction but also to long-term customer relationships, corporate image, organizational reputation, and sustainable customer loyalty, thereby supporting firms' sustainable performance [17].

2.1.3. Competitive Advantage

Competitive advantage has become increasingly intense, as digital technologies have empowered customers with greater information, choices, and bargaining power than ever before. At the same time, advanced data-driven decision-making enables firms to conduct comprehensive analyses of their competitors more easily. Competitive advantage can significantly influence sustainability by shaping the ways in which organizations manage environmental, social, and economic practices [18].

Sustainability can serve as a source of innovation and differentiation, enabling firms to develop unique products, services, and business models that respond to changing customer needs and market demands. By integrating sustainability principles into their operations, organizations can differentiate themselves from competitors and build competitive advantage through environmental stewardship, social responsibility, and ethical business practices [19].

Previous studies have examined how different sustainability practices influence sustainability outcomes and competitive advantage. However, evidence suggests that regulatory compliance alone, including adherence to sustainability standards and codes of conduct, may be insufficient to create competitive advantage. Rather, firms are more likely to enhance competitiveness when sustainability initiatives are translated into operational improvements, such as better quality, lower costs, greater process flexibility, responsible production, and stronger collaborative relationships with suppliers [20].

Camilleri et al. emphasized that sustainability practices help organizations reduce risks associated with environmental, social, and governance (ESG) factors, such as regulatory compliance, reputational damage, and supply chain disruption [21]. By proactively managing these risks, firms can enhance resilience and long-term viability while maintaining competitive advantage under volatile and uncertain market conditions.

2.1.4. Sustainability

Sustainability refers to the concept of producing products, including goods and services, in ways that do not consume non-renewable resources excessively and do not harm the environment. It also refers to the ability to maintain a certain level of performance over time. Sustainability symbolizes social progress and advancement toward a more prosperous and stable world, in which the natural environment and cultural achievements can be preserved for future generations [22].

Service quality has been identified as an important strategic factor for strengthening competitive advantage. Syapsan found that service quality and innovation contribute to competitive advantage and sustainable economic growth among MSMEs, indicating that firms with better service quality are more capable of creating customer value and achieving stronger market positioning [23]. Green management innovation has been found to have a significant positive influence on firms' financial performance. In contrast, the effect of green process innovation on financial performance may be nonlinear. In the early stages, or at low to moderate levels of implementation, green process innovation may reduce profitability because changes in production processes and operational procedures often require additional capital investment, adjustment costs, and implementation expenses [24].

Gil-Saura et al. systematically examined innovation in healthcare and elderly care and discussed considerations related to health and environmental sustainability [25]. The study explained that sustainability innovation refers to a process in which sustainability considerations, including environmental, social, and financial dimensions, are integrated into a firm's systems from idea generation to research and development (R&D) and commercial implementation. This concept applies to products, services, and technologies.

Similarly, Coffay et al. defined sustainability innovation as innovation that improves sustainability performance [22]. In this sense, performance consists of three dimensions of

sustainability: environmental, economic, and social sustainability. Another definition of sustainability innovation describes it as a process in which sustainability considerations, including environmental, social, and financial aspects, are embedded into a firm's systems from idea generation to R&D and commercial implementation, and this applies to products, services, and technologies.

Based on the theoretical arguments and empirical evidence presented in the preceding sections, innovation, service quality, competitive advantage, and sustainability are expected to be interrelated. Innovation has been identified as a critical organizational resource that enhances service delivery, creates competitive advantage, and supports sustainable business performance. Furthermore, service quality and competitive advantage are considered important pathways through which innovation can be transformed into long-term sustainability outcomes. Accordingly, a set of direct and indirect relationships is proposed and tested in this study.

Innovation plays a critical role in improving service delivery through the adoption of new technologies, customized solutions, and customer-oriented processes. Prior studies suggest that innovative firms are more capable of providing superior service experiences.

Therefore,

H1. *Innovation positively influences Service Quality.*

Innovation enables firms to develop new products, processes, and marketing approaches that improve operational efficiency and long-term business performance. Previous studies have demonstrated that innovation contributes significantly to sustainable organizational outcomes by enhancing resource utilization and creating long-term value.

Therefore, the following hypothesis is proposed:

H2. *Innovation positively influences Sustainability.*

According to the Resource-Based View (RBV), innovation represents a strategic resource that allows firms to differentiate themselves from competitors and achieve superior performance.

Therefore,

H3. *Innovation positively influences Competitive Advantage.*

Service quality is widely recognized as a source of competitive differentiation. Organizations that consistently provide superior service are more likely to gain a sustainable competitive advantage.

Therefore,

H4. *Service Quality positively influences Competitive Advantage.*

Competitive advantage enables firms to maintain superior market positions and achieve long-term economic performance, thereby supporting organizational sustainability.

Therefore,

H5. *Competitive Advantage positively influences Sustainability.*

High service quality enhances customer satisfaction, loyalty, and business reputation, which are essential drivers of long-term organizational sustainability.

Therefore,

H6. *Service Quality positively influences Sustainability.*

Innovation enables firms to improve products, services, and operational processes, resulting in enhanced service quality. Improved service quality increases customer satisfaction, loyalty, and organizational performance, which are essential factors for long-term sustainability. Therefore, service quality is expected to mediate the relationship between innovation and sustainability.

Therefore,

H7. *The indirect effect of innovation on sustainability through service quality.*

Innovation is considered a strategic resource that helps organizations differentiate themselves from competitors and create superior value. These advantages strengthen competitive positioning and support long-term business success. Therefore, competitive advantage is expected to mediate the relationship between innovation and sustainability.

Therefore,

H8. *The indirect effect of innovation on sustainability through Competitive Advantage.*

High service quality enhances customer satisfaction, trust, and organizational reputation. These benefits strengthen a firm's competitive advantage, which subsequently contributes to sustainable performance and long-term growth. Therefore, competitive advantage is expected to mediate the relationship between service quality and sustainability.

Therefore,

H9. *The indirect effect of Service Quality on sustainability through Competitive Advantage.*

Innovation can improve service quality through the adoption of new technologies and customer-oriented practices. Enhanced service quality strengthens competitive advantage by creating superior customer value and differentiation. Consequently, competitive advantage contributes to organizational sustainability. Therefore, innovation is expected to influence sustainability through service quality and competitive advantage.

Therefore,

H10. *The indirect effect of Innovation on sustainability through Service Quality and Competitive.*

Innovation contributes to service quality improvement by enhancing operational efficiency and customer experiences. Higher service quality enables firms to provide superior value, strengthen customer relationships, and achieve stronger competitive positions. Therefore, service quality is expected to mediate the relationship between innovation and competitive advantage.

Therefore,

H11. *The indirect effect of Innovation on Competitive Advantage Service Quality.***2.2. Research Methodology****2.2.1. Research Design**

This study was conducted to examine the structural relationships among innovation, service quality, competitive advantage, and sustainable performance of health food enterprises in Thailand.

Step 1: The researchers began by reviewing secondary data from concepts, theories, academic documents, electronic sources, articles, and previous studies that were directly

relevant to and consistent with the research topic. The researchers then synthesized the concepts, theories, bodies of knowledge, and related studies in order to develop the conceptual framework. As a result, four key variables were identified: innovation, service quality, competitive advantage, and sustainable performance of health food enterprises in Thailand.

Step 2: The researchers developed a questionnaire as the research instrument and examined its content validity through five experts. The experts evaluated the language, wording, and consistency of the questionnaire items with the research objectives using the Index of Item-Objective Congruence (IOC) technique. The IOC value ranges from -1 to 1 . Each questionnaire item should have an IOC value of not less than 0.50 , and preferably close to 1.00 . Items with IOC values below 0.50 should be revised and improved [26].

Step 3: After revising the questionnaire, the researchers conducted a pilot test with 30 respondents. This pilot test aimed to examine whether the respondents understood the questionnaire items and whether each item communicated its intended meaning in accordance with the research objectives. The reliability of the questionnaire was then assessed using Cronbach's alpha coefficient.

Step 4: The researchers then used the final version of the questionnaire to collect data from the sample group, consisting of executives, supervisors, or engineers working in the food industry. The collected data were subsequently analyzed, summarized, discussed, and used to develop research recommendations.

2.2.2. Population and Sampling

The unit of analysis in this study was food enterprises in Thailand. The respondents were individuals with relevant experience and senior positions within their organizations, such as supervisors, managers, directors, or equivalent positions. These criteria were established to ensure that the respondents possessed direct experience related to the key issues and empirical context of the study. The food industry is considered an important industry with a substantial impact on the national economy, with a total of 7259 establishments in Thailand [27].

In applying partial least squares structural equation modeling (PLS-SEM), it is necessary to ensure that the sample size is sufficient for reliable parameter estimation, bootstrapping, and hypothesis testing. PLS-SEM is suitable for prediction-oriented models involving multiple latent constructs and mediation paths; however, adequate statistical power remains essential for obtaining stable and interpretable results [28]. In this study, the sample size was determined based on the recommended ratio of cases to observed indicators. Following the guideline that 5 to 20 cases per observed indicator are acceptable for multivariate analysis [29], this study adopted the conservative criterion of 20 cases per indicator. Since the model consisted of 13 observed indicators, the minimum required sample size was calculated as 260 respondents. Accordingly, the final sample size of 260 respondents was considered adequate for PLS-SEM analysis.

The sample was selected using simple random sampling. Data were collected through a self-administered questionnaire. This method was considered appropriate because the study aimed to obtain standardized empirical responses across multiple latent variables from food enterprises distributed across different geographical areas.

A total of 260 questionnaires were distributed to respondents working in healthy food businesses in Thailand. All questionnaires were completed and returned, and none were excluded due to incomplete responses. Therefore, 260 valid responses were included in the final analysis, yielding a response rate of 100%. The measurement items for Innovation were adapted from previous studies [7,16]. Service Quality items were adapted from previous

studies [30–33]. Competitive Advantage items were adapted from previous studies [33–35]. Sustainability Performance items were adapted from previous studies [31,32,36].

2.2.3. Measurement Instrument

The research instrument used in this study was a questionnaire developed using a five-point rating scale [37]. The questionnaire items were developed and revised based on the relevant literature and were adapted to fit the context of health food restaurant businesses in Thailand. The instrument was designed to examine the structural relationships among innovation, service quality, competitive advantage, and sustainable performance of health food enterprises in Thailand.

A quantitative research methodology was considered appropriate for this study because the research aimed to test theory-driven hypotheses and assess the magnitude and significance of both direct and indirect relationships among latent variables within a structured model [38]. In accordance with the proposed conceptual framework, innovation was specified as the independent variable, service quality and competitive advantage were specified as mediating variables, and sustainable performance was specified as the outcome variable.

2.2.4. Data Analysis

Given the prediction-oriented nature of the proposed model, the inclusion of multiple latent constructs, and the presence of mediation paths, this study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) for data analysis. PLS-SEM is appropriate for research that emphasizes theory extension, prediction, and the estimation of complex structural relationships among latent variables, particularly when mediation effects are examined [28].

The data analysis was conducted in several stages. First, descriptive statistical analysis was performed to examine the demographic characteristics of the respondents. Second, the reliability of the measurement scales was assessed using Cronbach's alpha coefficient [39]. A Cronbach's alpha value greater than 0.70 indicates an acceptable level of internal consistency. Third, the measurement model was assessed by examining convergent validity and discriminant validity to ensure that the constructs were measured reliably and validly. Fourth, PLS-SEM was applied to test the hypothesized relationships among the constructs in the research model.

Descriptive statistical analysis and reliability analysis were performed using IBM SPSS Statistics version 29 (IBM Corp., Armonk, NY, USA). Partial least squares structural equation modeling (PLS-SEM), including the bootstrapping procedure, was conducted using SmartPLS 4 (SmartPLS GmbH, Bönningstedt, Germany) to assess the statistical significance of the path coefficients. The hypotheses were considered supported when the *p*-value was lower than 0.05. In addition, the structural model was evaluated by considering path coefficients, *t*-values, *p*-values, and the coefficient of determination (R^2), which indicates the explanatory power of the model.

2.2.5. Reliability and Validity Assessment

The reliability and validity of the measurement model were assessed prior to testing the structural relationships among the constructs. First, the correlation coefficients among the study variables were examined in accordance with the proposed conceptual framework. The correlation values were considered acceptable when they did not exceed 0.70, indicating the absence of serious multicollinearity problems among the constructs [40].

The measurement model assessment included reliability, convergent validity, and discriminant validity. Reliability was evaluated using Cronbach's alpha and composite reliability (CR). Composite reliability values greater than 0.60 were considered acceptable [41],

while values above 0.70 indicated satisfactory internal consistency. Convergent validity was assessed using factor loadings and average variance extracted (AVE). Factor loadings greater than 0.50 and AVE values of at least 0.50 were considered acceptable, indicating that the indicators sufficiently explained their respective latent constructs [29].

Discriminant validity was examined to ensure that each construct was empirically distinct from the others. In this study, discriminant validity was assessed using the Heterotrait–Monotrait ratio of correlations (HTMT), which is widely recommended in PLS-SEM research [28]. After the reliability and validity of the measurement model had been confirmed, the structural model was evaluated using path coefficients, bootstrapped *t*-values, and the coefficient of determination (R^2) to assess the explanatory power of the model and the significance of the hypothesized relationships.

3. Results

3.1. Descriptive Statistics and Measurement Model

The measurement model was assessed prior to the structural model evaluation in order to ensure that the key constructs were measured with adequate reliability and validity. The measurement results demonstrated satisfactory psychometric properties. The indicator loadings were consistently high, and the reliability and convergent validity statistics were within acceptable ranges. Specifically, the values of Cronbach's alpha, rho_A, composite reliability, and average variance extracted (AVE) indicated adequate internal consistency and convergent validity across all reflective dimensions.

At the higher-order construct level, innovation, service quality, competitive advantage, and sustainability reported AVE values ranging between 0.70 and 0.80, exceeding the recommended threshold of 0.50. These results indicate that each latent construct was able to explain a substantial proportion of the variance in its corresponding indicators. Thus, the constructs demonstrated strong reliability and acceptable convergent validity.

The composite reliability values were also satisfactory. In general, CR values above 0.80 indicate a high level of measurement stability. The results showed that the composite reliability and rho_A values for all constructs ranged between 0.80 and 0.90, suggesting strong internal consistency. These findings confirm that the measurement items were reliable and sufficiently consistent in representing their respective latent constructs.

In addition, all constructs demonstrated high factor loadings, with values exceeding the minimum recommended threshold of 0.50. The standard errors were examined to assess the reliability of the loading estimates, while *p*-values below 0.05 indicated statistical significance. The results showed that all dimensions were significantly associated with their corresponding higher-order constructs, confirming the appropriateness and statistical validity of the factor structure.

The dimensions of innovation loaded positively and significantly on the higher-order construct, with standardized loadings ranging from $\beta = 0.900$ to 0.914 , $p < 0.001$. The dimensions of service quality also loaded positively and significantly on the higher-order construct, with standardized loadings ranging from $\beta = 0.857$ to 0.878 , $p < 0.001$. Similarly, the dimensions of competitive advantage loaded positively and significantly on the higher-order construct, with standardized loadings ranging from $\beta = 0.862$ to 0.881 , $p < 0.001$. Finally, the dimensions of sustainability loaded positively and significantly on the higher-order construct, with standardized loadings ranging from $\beta = 0.880$ to 0.911 , $p < 0.001$.

The findings indicate that all constructs were measured with acceptable reliability, convergent validity, and statistical significance. Therefore, the measurement model was considered appropriate for subsequent structural model analysis. Table 1 reports the reliability and convergent validity results for the higher-order constructs and their dimensions.

Table 1. Reliability and Convergent Validity of the Higher-Order Constructs.

Higher-Order Construct	Dimension	β	SE	t-Value	p-Value	Cronbach's α	rho_A	CR	AVE
Innovation (Innovation)	Market	0.900	0.029	30.192	<0.001	0.889	0.890	0.931	0.819
	Process	0.901	0.030	27.984	<0.001				
	Product	0.914	0.030	28.955	<0.001				
Service quality (Quality)	Customer	0.878	0.032	24.498	<0.001	0.836	0.836	0.901	0.753
	Responsibility	0.868	0.034	24.270	<0.001				
	Personal	0.857	0.034	22.959	<0.001				
Competitive Advantage (Competitive)	Cost	0.862	0.038	19.907	<0.001	0.839	0.903	0.903	0.756
	Supply	0.881	0.032	24.651	<0.001				
	Management	0.865	0.032	25.926	<0.001				
Sustainability (Sustainability)	Environment	0.906	0.025	34.695	<0.001	0.882	0.927	0.927	0.809
	Social	0.880	0.032	24.925	<0.001				
	Economic	0.911	0.020	42.914	<0.001				

As shown in Table 2, the HTMT values for the higher-order constructs provide evidence of discriminant validity among the main constructs. The HTMT values among the four focal higher-order constructs were all below the conservative threshold of 0.85. Specifically, the HTMT values were 0.706 for innovation–sustainability, 0.781 for service quality–sustainability, 0.797 for competitive advantage–sustainability, 0.699 for service quality–innovation, 0.663 for competitive advantage–innovation, and 0.713 for competitive advantage–service quality.

Table 2. Discriminant Validity of the Higher-Order Constructs (HTMT).

Construct	Sustainability	Innovation	Quality	Competitive
Sustainability	—			
Innovation	0.706	—		
Quality	0.781	0.699	—	
Competitive	0.797	0.663	0.713	—

These results indicate that innovation, service quality, competitive advantage, and sustainability are empirically distinct from one another. Therefore, discriminant validity among the main constructs was established, confirming that each construct captures a conceptually and statistically distinct dimension within the proposed model.

Because the data were collected from the same respondents using a self-administered questionnaire, common method bias was assessed using collinearity diagnostics. As shown in Table 3, the VIF values of the construct dimensions ranged from 1.852 to 2.776, which were below the recommended threshold of 3.3. These results indicate that excessive collinearity was not present and that common method bias was unlikely to be a serious concern in this study. Therefore, the structural model results could be interpreted with confidence.

Table 3. The VIF values of the construct dimensions.

Higher-Order Construct	Dimension	VIF	Interpretation
Innovation	Market	2.444	Below 3.3
Innovation	Process	2.606	Below 3.3
Innovation	Product	2.776	Below 3.3
Service Quality	Customer	2.077	Below 3.3
Service Quality	Responsibility	1.922	Below 3.3
Service Quality	Personal	1.873	Below 3.3

Table 3. Cont.

Higher-Order Construct	Dimension	VIF	Interpretation
Competitive Advantage	Cost	1.983	Below 3.3
Competitive Advantage	Supply	2.141	Below 3.3
Competitive Advantage	Management	1.852	Below 3.3
Sustainability	Environment	2.562	Below 3.3
Sustainability	Social	2.275	Below 3.3
Sustainability	Economic	2.637	Below 3.3

3.2. Structural Model Analysis

Table 4 presents the results of the structural model assessment and hypothesis testing. The findings show that all proposed direct relationships were statistically significant and supported. First, innovation had a positive and significant effect on service quality ($\beta = 0.603$, $SE = 0.041$, $t = 16.943$, $p < 0.001$), supporting H1. This result indicates that higher levels of innovation among health food businesses are associated with improved service quality. The effect size was large ($f^2 = 0.571$), suggesting that innovation is a strong predictor of service quality in the proposed model.

Table 4. Direct Effects and Hypothesis Testing.

Hypothesis	Path	β	SE	t-Value	p-Value	f^2	Decision
H1	Innovation $\rightarrow$ Quality	0.603	0.041	16.943	<0.001	0.571	Supported
H2	Innovation $\rightarrow$ Sustainability	0.222	0.073	2.354	0.019	0.071	Supported
H3	Innovation $\rightarrow$ Competitive	0.336	0.083	3.883	<0.001	0.126	Supported
H4	Quality $\rightarrow$ Competitive	0.395	0.080	6.050	<0.001	0.173	Supported
H5	Quality $\rightarrow$ Sustainability	0.316	0.086	4.125	<0.001	0.138	Supported
H6	Competitive $\rightarrow$ Sustainability	0.372	0.079	5.506	<0.001	0.201	Supported

Second, innovation had a positive and significant direct effect on sustainability ($\beta = 0.222$, $SE = 0.073$, $t = 2.354$, $p = 0.019$), supporting H2. Although the effect was statistically significant, the effect size was relatively small ($f^2 = 0.071$), indicating that innovation contributes directly to sustainable performance, but its direct influence is modest compared with other pathways in the model.

Third, innovation also had a positive and significant effect on competitive advantage ($\beta = 0.336$, $SE = 0.083$, $t = 3.883$, $p < 0.001$), supporting H3. The effect size was small to moderate ($f^2 = 0.126$), suggesting that innovation helps firms strengthen their competitive advantage by enabling differentiation, operational improvement, and responsiveness to market changes.

Fourth, service quality had a positive and significant effect on competitive advantage ($\beta = 0.395$, $SE = 0.080$, $t = 6.050$, $p < 0.001$), supporting H4. The effect size was moderate ($f^2 = 0.173$), indicating that higher service quality contributes meaningfully to competitive advantage. This finding suggests that service quality is an important mechanism through which health food businesses can enhance customer value and differentiate themselves from competitors.

Fifth, service quality had a positive and significant effect on sustainability ($\beta = 0.316$, $SE = 0.086$, $t = 4.125$, $p < 0.001$), supporting H5. The effect size was small to moderate ($f^2 = 0.138$), showing that service quality contributes to sustainable performance by improving customer satisfaction, operational consistency, and long-term business relationships.

Finally, competitive advantage had a positive and significant effect on sustainability ($\beta = 0.372$, $SE = 0.079$, $t = 5.506$, $p < 0.001$), supporting H6. The effect size was moderate ($f^2 = 0.201$), indicating that competitive advantage plays an important role in enhancing sus-

tainable performance. Among the direct predictors of sustainability, competitive advantage showed the strongest effect, followed by service quality and innovation.

Overall, the results confirm that innovation, service quality, and competitive advantage are significant determinants of sustainability among health food businesses in Thailand. The findings further suggest that innovation plays a foundational role by enhancing both service quality and competitive advantage, while service quality and competitive advantage serve as important mechanisms that translate innovation into sustainable performance.

Table 5 presents the results of the indirect effects and mediation analysis. The findings indicate that all proposed indirect relationships were statistically significant and supported.

Table 5. Indirect Effects and Mediation Results.

Hypothesis	Indirect Path	β	SE	t-Value	p-Value	Decision
H7	Innovation $\rightarrow$ Quality $\rightarrow$ Sustainability	0.191	0.065	3.819	<0.001	Supported
H8	Innovation $\rightarrow$ Competitive $\rightarrow$ Sustainability	0.125	0.045	3.112	0.002	Supported
H9	Quality $\rightarrow$ Competitive $\rightarrow$ Sustainability	0.147	0.054	3.926	<0.001	Supported
H10	Innovation $\rightarrow$ Quality $\rightarrow$ Competitive $\rightarrow$ Sustainability	0.089	0.039	3.798	<0.001	Supported
H11	Innovation $\rightarrow$ Quality $\rightarrow$ Competitive	0.238	0.061	5.564	<0.001	Supported

First, the indirect effect of innovation on sustainability through service quality was positive and statistically significant ($\beta = 0.191$, $SE = 0.065$, $t = 3.819$, $p < 0.001$), supporting H7. This result indicates that innovation enhances sustainability by improving service quality. In other words, health food businesses that adopt higher levels of innovation are more likely to improve service processes, customer experience, and service responsiveness, which subsequently contribute to sustainable performance.

Second, the indirect effect of innovation on sustainability through competitive advantage was also positive and statistically significant ($\beta = 0.125$, $SE = 0.045$, $t = 3.112$, $p = 0.002$), supporting H8. This finding suggests that innovation contributes to sustainability by strengthening firms' competitive advantage. Innovative businesses are more likely to differentiate their products and services, improve operational efficiency, and respond effectively to market changes, which in turn enhance sustainable performance.

Third, the indirect effect of service quality on sustainability through competitive advantage was positive and statistically significant ($\beta = 0.147$, $SE = 0.054$, $t = 3.926$, $p < 0.001$), supporting H9. This result indicates that service quality does not only directly enhance sustainability, but also indirectly contributes to sustainability by strengthening competitive advantage. Therefore, superior service quality can serve as a strategic capability that enables firms to achieve stronger competitive positioning and long-term sustainability.

Fourth, the serial indirect effect of innovation on sustainability through service quality and competitive advantage was positive and statistically significant ($\beta = 0.089$, $SE = 0.039$, $t = 3.798$, $p < 0.001$), supporting H10. This finding provides evidence for the sequential mediation mechanism proposed in the model. It suggests that innovation first improves service quality, which then enhances competitive advantage, ultimately leading to greater sustainable performance.

Finally, the indirect effect of innovation on competitive advantage through service quality was positive and statistically significant ($\beta = 0.238$, $SE = 0.061$, $t = 5.564$, $p < 0.001$), supporting H11. This result confirms that service quality functions as a key mediating mechanism through which innovation strengthens competitive advantage.

Overall, the mediation results demonstrate that innovation contributes to sustainability not only through its direct effect, but also through multiple indirect pathways involving service quality and competitive advantage. These findings highlight the importance of

service quality and competitive advantage as strategic mechanisms that translate innovation into sustainable performance among health food businesses in Thailand.

Table 6 presents the explanatory power of the endogenous constructs and the overall model fit. The results indicate that the proposed model demonstrates satisfactory explanatory ability. For the main outcome variable, sustainability, the coefficient of determination was substantial ($R^2 = 0.607$), indicating that innovation, service quality, and competitive advantage jointly explained 60.7% of the variance in sustainability. The adjusted R^2 value was 0.603, suggesting that the model retained strong explanatory power even after adjusting for the number of predictors. This result confirms that the proposed predictors provide a meaningful explanation of sustainable performance among health food businesses in Thailand.

Table 6. Explanatory Power and Model Fit.

Endogenous Construct/Index	Value	Interpretation
Sustainability R^2	0.607	Strong explanatory power
Adjusted R^2	0.603	Suggests the model explains a meaningful proportion of Sustainability variance
Competitive Advantage R^2	0.428	Moderate explanatory power
Adjusted R^2	0.425	Indicates meaningful variance explained by Innovation and Service quality
Service quality R^2	0.364	Moderate explanatory power
Adjusted R^2	0.362	Indicates meaningful variance explained by Innovation
Model fit SRMR	0.048	Descriptively acceptable model fit

For competitive advantage, the R^2 value was 0.428, with an adjusted R^2 value of 0.425. This indicates moderate explanatory power, suggesting that innovation and service quality together explained approximately 42.8% of the variance in competitive advantage. The result implies that competitive advantage is meaningfully shaped by firms' innovation capability and service quality, both of which serve as important strategic resources in the health food business context.

For service quality, the R^2 value was 0.364, and the adjusted R^2 value was 0.362. This indicates that innovation explained 36.4% of the variance in service quality. The result suggests that innovation is an important antecedent of service quality, particularly in terms of improving service processes, responsiveness, operational efficiency, and customer experience.

In terms of model fit, the standardized root mean square residual (SRMR) value was 0.048, which is below the commonly recommended threshold of 0.08. This indicates that the model achieved an acceptable descriptive fit. Overall, the results suggest that the proposed structural model has adequate explanatory power and acceptable model fit, supporting its suitability for explaining the relationships among innovation, service quality, competitive advantage, and sustainability. The structural relationships among innovation, service quality, competitive advantage, and sustainability are illustrated in Figure 1.

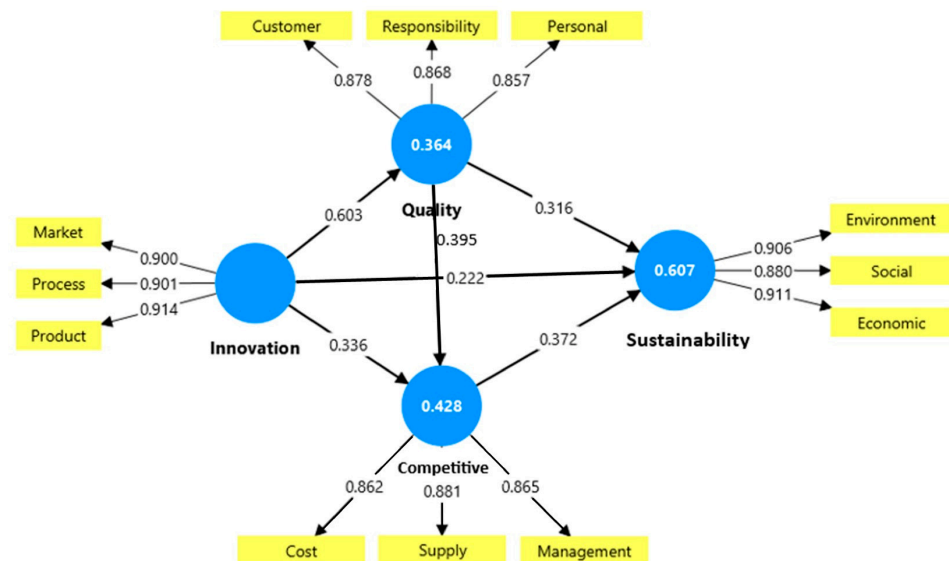


Figure 1. Structural Model.

4. Discussion

The findings of this study provide important empirical evidence regarding the role of innovation in driving the sustainable performance of health food businesses in Thailand. The results show that innovation has both direct and indirect positive effects on sustainability, indicating that innovation is not only a fundamental factor in organizational development but also a key mechanism for creating long-term value.

First, the findings confirm that innovation has a positive effect on service quality. This result is consistent with Sönmez Cakir et al., who argued that innovation enhances service delivery efficiency and customer experience, while also enabling organizations to respond more rapidly to changing market demands [13]. This finding suggests that, in the context of health food businesses, innovation is not limited to product development but also includes service processes and service delivery models, which are essential for differentiation in the market.

Second, innovation has a significant positive influence on competitive advantage. This finding is consistent with Tran et al. [12] and Piñera-Salmerón et al. [18], who emphasized that innovation is an important source of competitive advantage, particularly in highly competitive and rapidly changing markets. However, the findings of this study further indicate that competitive advantage does not arise from innovation alone. Rather, it is also developed through service quality, reflecting the systemic structure of the relationships among the variables in the proposed model.

Third, the results show that service quality has positive effects on both competitive advantage and sustainability. This supports the findings of Kumar et al., who suggested that improving service quality enhances operational efficiency and reduces resource waste [15]. The result is also consistent with Sondhi et al., who found that service quality influences corporate image and customer satisfaction, which subsequently contribute to competitiveness and sustainable performance [16]. These findings indicate that service quality functions as an important strategic mechanism that links internal innovation capability with external market outcomes.

Fourth, competitive advantage has a direct positive effect on sustainability. This finding is consistent with Bhuiyan et al. and Camilleri et al., who argued that business differentiation and the management of environmental, social, and governance (ESG) risks are important factors in achieving long-term sustainability [19,21]. The result suggests that

firms capable of developing competitive advantage are more likely to sustain continuous growth under uncertain market conditions.

However, the findings indicate that innovation has a significant direct effect on sustainability performance; however, its effect is smaller than the indirect effects through service quality and competitive advantage. This suggests that innovation alone may not be sufficient to enhance sustainability performance in healthy food businesses. Instead, innovation appears to contribute more effectively when it is transformed into improved service quality and stronger competitive advantage. From a managerial perspective, healthy food business operators should focus not only on innovation investment but also on applying innovation to create customer value, improve service quality, and strengthen competitive positioning. These findings also support the Resource-Based View (RBV) and Dynamic Capability Theory, which emphasize the importance of transforming organizational resources into capabilities and competitive advantages to achieve sustainability.

5. Conclusions

This study examined the role of innovation in enhancing sustainability among health food businesses in Thailand through the mediating mechanisms of service quality and competitive advantage. The findings confirm that innovation is an important driver of organizational performance, as it has positive and significant effects on service quality, competitive advantage, and sustainability. These results indicate that health food businesses that emphasize product, process, and market innovation are more likely to improve service delivery, strengthen their competitive position, and achieve better sustainable performance.

The results also demonstrate that service quality and competitive advantage play important mediating roles in the relationship between innovation and sustainability. Although innovation directly contributes to sustainability, its indirect effects through service quality and competitive advantage suggest that innovation becomes more effective when it is transformed into superior customer value, operational efficiency, and market differentiation. In particular, competitive advantage showed the strongest direct effect on sustainability, indicating that firms with stronger differentiation, cost management, supply capability, and management efficiency are more likely to achieve long-term sustainable outcomes.

The explanatory power of the model further supports the proposed relationships. Innovation, service quality, and competitive advantage jointly explained 60.7% of the variance in sustainability, while innovation and service quality explained 42.8% of the variance in competitive advantage. Innovation also explained 36.4% of the variance in service quality. In addition, the SRMR value of 0.048 indicates an acceptable model fit, confirming that the proposed structural model adequately explains the relationships among the key constructs.

From a managerial perspective, the findings suggest that health food business operators should not focus only on investing in innovation. They should also ensure that innovation is effectively converted into improved service quality and stronger competitive advantage. Practical strategies may include improving customer-oriented service processes, strengthening product and process innovation, enhancing supply chain responsiveness, and developing differentiation strategies that respond to changing consumer needs. These actions can help firms create long-term value and improve sustainable performance in the competitive health food market.

Overall, this study contributes to the literature by providing empirical evidence that innovation supports sustainability both directly and indirectly through service quality and competitive advantage. The findings highlight the importance of integrating innovation capability with service excellence and competitive strategy to achieve sustainable business performance among health food businesses in Thailand. Future research may extend this

model to other industries or compare different business sizes and regional contexts to provide a broader understanding of innovation-driven sustainability.

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