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The Relationship Between The Application Of Modern Information Technology And The Operational Efficiency Of Food Industry Enterprises In The Upper Northern Region Of Thailand

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Abstract

This study investigates the relationship between the application of modern information technology (IT) and the operational efficiency of food industry enterprises in the upper northern region of Thailand. The research adopts a quantitative design with a sample of 400 executives selected through stratified random sampling from 1,956 registered food industry enterprises. Data were collected using a structured questionnaire covering four sections: demographic characteristics, business profiles, IT application, and operational efficiency. The instrument demonstrated high validity and reliability, with Cronbach's alpha coefficients ranging from 0.793 to 0.964. The results indicate that both IT application and operational efficiency are perceived at high levels across enterprises. Managers emphasized the importance of data resource management, system planning and development, and decision support in their operations. Similarly, efficiency was highly rated in customer service, internal processes, learning and growth, and financial performance, with the learning and growth perspective scoring highest. Regression analyses revealed that IT application positively correlates with overall operational efficiency, though individual IT dimensions did not significantly predict efficiency outcomes. Notably, decision support systems showed a significant positive influence on financial performance. Comparative analyses further revealed no significant differences in IT adoption or efficiency across enterprises with varying organizational characteristics, including size, type, and capital investment. In conclusion, the findings suggest that while IT adoption contributes positively to efficiency, its strongest effects are concentrated in financial outcomes. The study highlights the importance of deepening IT integration into decision-making processes and underscores the need for strategic alignment between digital tools and broader organizational objectives.

Keywords: Modern Information Technology, Operational Efficiency, Food Industry.

Introduction

In the twenty-first century, information technology (IT) has become a central element in both daily life and organizational operations. Under conditions of rapid business change and global competition, IT serves as a key driver of organizational development and an essential tool for building competitive advantage. Enterprises increasingly prioritize the use of IT to support operations, product development, sourcing of raw materials, and the creation of innovative services. By adopting modern IT applications,

organizations can improve efficiency and effectiveness in all areas of business activity (Suonphleng, 2012). The evolution of IT has encompassed multiple dimensions, such as data processing, data storage, and communication technologies, which enhance efficiency and accuracy. IT enables faster access to information, cost reduction in operations, and improved decision-making. Therefore, the continuous development and application of IT systems are crucial for organizational success (Jaiphakdee, 2017). Organizations that strategically adapt IT applications to their business models are more likely to develop sustainable competitive strategies and achieve long-term growth. Furthermore, a well-integrated IT system provides accurate and timely data for planning, management, and operational control, contributing to overall organizational success. Modern IT applications represent the practical use of technological knowledge and innovation within organizational processes. These include information systems for resource management, system planning and development, and decision support (Iam-siriwong, 2011). Each of these areas enhances organizational performance by ensuring that operations align with strategic objectives. For managers, this requires careful planning and informed decision-making about IT investments, so that systems meet the needs of the enterprise and can be fully utilized to support business functions. Operational efficiency is a key measure of how effectively an organization uses its resources to achieve goals and deliver value. It involves minimizing costs and waste, meeting deadlines, ensuring quality, and satisfying customers. According to the balanced scorecard framework, operational efficiency can be assessed across four perspectives: customer, internal processes, learning and growth, and financial outcomes (Decharin, 2005). When aligned with IT, these perspectives provide a holistic framework for evaluating how technology adoption contributes to improved business performance. An enterprise that achieves high levels of operational efficiency is better positioned to remain competitive and resilient in dynamic economic environments. The food industry in Thailand is one of the country's most significant and high-potential sectors. With an abundance of natural resources and agricultural products, Thailand has long been recognized as a global hub for food production and exports. The industry not only ensures national food security but also contributes to the global food supply chain. Thailand's capacity for modern food-processing technology further enhances the value of agricultural products, helping the country maintain its role as a leading exporter in the ASEAN region and in international markets. Food industry enterprises typically follow rigorous quality standards, but increasing competition and rising consumer expectations require further innovation and efficiency (Kanbanchong, 2012). In the upper northern region of Thailand, food industry enterprises benefit from strong agricultural foundations but face challenges such as resource limitations, cost pressures, and changing consumer preferences. For these enterprises, modern IT applications such as supply chain management systems, enterprise resource planning, production monitoring, and customer relationship management are essential to enhancing efficiency and ensuring competitiveness. By leveraging IT, enterprises can reduce production costs, improve product safety and convenience, and increase consumer trust and satisfaction. Ultimately, IT adoption contributes to consumer loyalty and sustainable growth. Given this context, the present study investigates the relationship between the application of modern information technology and the operational efficiency of food industry enterprises in the upper northern region of Thailand. The objectives are sixfold: (1) to examine the application of modern IT in food industry enterprises; (2) to evaluate the operational efficiency of these enterprises; (3) to test the relationship between IT applications and operational efficiency; (4) to analyze the impact of IT applications on efficiency outcomes; (5) to compare IT adoption across enterprises with differing business types, sizes, capital, years of operation, workforce, and annual revenue; and (6) to compare operational efficiency across these varying enterprise characteristics.

The findings of this research are expected to contribute both theoretically and practically. Theoretically, the study will expand knowledge on how IT adoption relates to organizational performance in the food industry, particularly within a developing country context. Practically, it will provide guidelines for managers and policymakers to integrate IT more effectively into business operations, thus improving competitiveness, productivity, and long-term sustainability. By understanding this relationship, food industry enterprises in the upper northern region of Thailand can better position themselves to succeed in both domestic and global markets.

Research Objectives

1. To examine the application of modern information technology in food industry enterprises in the upper northern region of Thailand.

2. To evaluate the operational efficiency of food industry enterprises in the upper northern region of Thailand.
3. To test the relationship between the application of modern information technology and the operational efficiency of food industry enterprises in the upper northern region of Thailand.
4. To analyze the impact of modern information technology applications on the operational efficiency of food industry enterprises in the upper northern region of Thailand.
5. To compare the application of modern information technology among food industry enterprises in the upper northern region of Thailand with different organizational characteristics.
6. To compare the operational efficiency of food industry enterprises in the upper northern region of Thailand with different organizational characteristics.

Literature Reviews

The study "The Relationship Between the Application of Modern Information Technology and the Operational Efficiency of Food Industry Enterprises in the Upper Northern Region of Thailand" is grounded in two major conceptual frameworks: (1) modern information technology applications and (2) operational efficiency. These frameworks are adapted from prior theories and research and serve as the foundation for analyzing the relationship between technology adoption and organizational performance. 1) Modern Information Technology Application, The adoption of modern information technology (IT) is viewed as a critical factor for improving organizational competitiveness and operational effectiveness. According to Iam-siriwong (2011), management information systems provide enterprises with tools to manage resources, plan effectively, and make better decisions. Within this framework, three dimensions are emphasized, 1.1) Data Resource Management, Effective management of data resources ensures that enterprises can store, retrieve, and analyze information accurately. Well-structured data systems enhance the quality of decision-making and operational efficiency by ensuring the availability of reliable information (Laudon & Laudon, 2020). 1.2) System Planning and Development, The ability to design and implement IT systems tailored to business needs plays an important role in integrating technology with organizational goals. Strategic IT planning helps align resources with long-term growth and competitiveness (Pearlson, Saunders, & Galletta, 2019). 1.3) Decision Support Systems, IT applications that support decision-making improve responsiveness to market changes and consumer demands. Decision support systems facilitate real-time analysis, predictive modeling, and risk assessment, all of which are vital for food industry enterprises (Turban et al., 2018). 2) Operational Efficiency, Operational efficiency is another central construct of this study, emphasizing how organizations maximize performance outcomes while minimizing resource use. Decharin (2005) adapts the balanced scorecard approach, which includes four perspectives, 2.1) Customer Perspective, Efficiency is partly reflected in customer satisfaction, trust, and loyalty. IT applications enhance service quality and customer interaction (Kaplan & Norton, 1996). 2.2) Internal Process Perspective, The optimization of internal processes ensures timely production, reduced waste, and improved product quality. IT plays a key role in streamlining workflows and integrating supply chain activities (Porter & Heppelmann, 2014) and 2.3) Learning and Growth Perspective, Employee development, innovation, and organizational learning are essential for sustainable efficiency. IT systems support training, knowledge management, and continuous improvement (Nonaka & Takeuchi, 1995). 2.4) Financial Perspective, Finally, financial outcomes such as cost reduction, revenue growth, and profitability serve as key measures of efficiency. The integration of IT has been shown to reduce operating expenses while enabling higher productivity (Brynjolfsson & McAfee, 2014).Together, these two frameworks provide a comprehensive lens for examining how modern IT applications influence operational efficiency in food industry enterprises. By connecting the technological and performance perspectives, the study aims to generate valuable insights into the strategic role of IT in enhancing competitiveness and sustainability within the upper northern region of Thailand and as shown in Figure 1 Conceptual Framework.

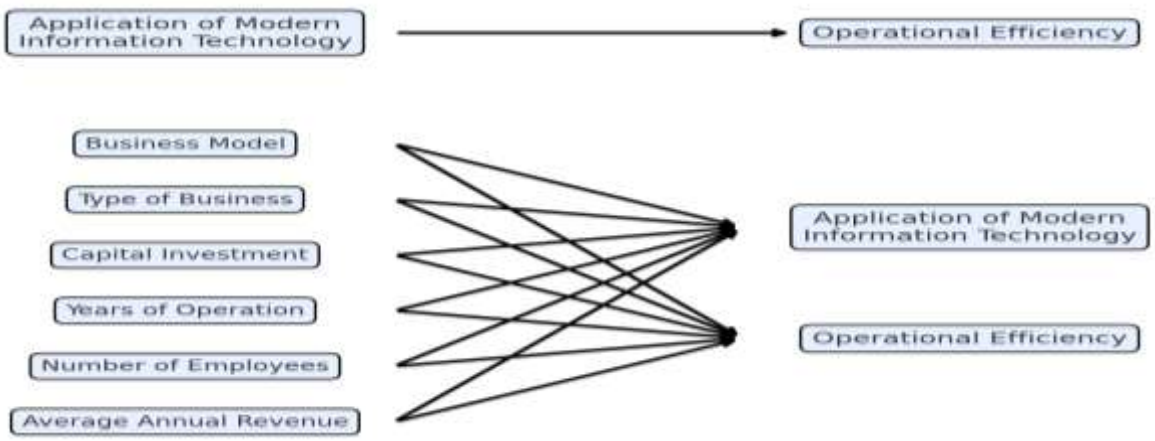

Figure 1 Conceptual Framework

Research Methodology

This study, entitled "The Relationship Between the Application of Modern Information Technology and the Operational Efficiency of Food Industry Enterprises in the Upper Northern Region of Thailand," adopts a quantitative research design. The methodology consists of four main parts: population and sample, research instrument, instrument validation, and data analysis. 1) Population and Sample, The population of this study includes 1,956 executives of food industry enterprises in the upper northern region of Thailand (Department of Business Development, 2024). Based on the Krejcie and Morgan table, a sample size of 400 executives was determined. To ensure representativeness, stratified random sampling was used (Etikan & Babatope, 2023). The sampling process involved: (1) classifying enterprises into ten categories (meat, dairy, seafood, vegetable oil, processed fruits and vegetables, grains, flour and milling, condiments and spices, sugar and confectionery, and others such as coffee and cocoa), (2) determining proportional allocation by category, and (3) drawing random samples equally from each group. 2) Research Instrument. The primary instrument was a structured questionnaire developed in line with the research objectives and conceptual framework. It consisted of four sections, 2.1) General information of executives (7 checklist items: gender, age, marital status, education, work experience, monthly income, position). 2.2) General information of enterprises (6 checklist items: business model, type, capital, years of operation, number of employees, annual revenue). 2.3) Application of modern IT (12 rating-scale items covering three dimensions: data resource management, system planning and development, and decision support). 2.4) Operational efficiency (16 rating-scale items covering four perspectives: customer, internal process, learning and growth, and financial). 3) Instrument Validation and Reliability, The questionnaire was reviewed by experts for content validity and piloted with 30 executives. Item-total correlation was used to assess discriminant power, with values ranging from 0.794 - 0.929, exceeding the acceptable threshold of 0.40. Reliability was tested using Cronbach's alpha, producing coefficients between 0.841–0.951 for IT application and 0.793 - 0.964 for operational efficiency, which surpass the standard benchmark of 0.70 for acceptable reliability (Hair et al., 2022; Sijtsma, 2024). 5) Data Analysis, Data collected from the survey were analyzed using statistical software. Descriptive statistics (frequency, percentage, mean, standard deviation) were used to summarize demographics, enterprise characteristics, IT adoption, and operational efficiency. Inferential statistics were employed to test hypotheses, including, Comparisons: independent sample t-tests, ANOVA, and MANOVA for differences across organizational characteristics (e.g., business model, size, capital). Relationships and impacts: multiple correlation, simple regression, and multiple regression analysis to test the relationship and causal effects between IT application and operational efficiency. Assumption testing: variance inflation factors (VIFs) to assess multicollinearity. This methodology ensures rigorous testing of the research objectives while integrating current standards for quantitative research. It provides reliable evidence on how modern IT adoption influences the operational efficiency of food industry enterprises in the upper northern region of Thailand, contributing both theoretical and practical insights.

Research Results

This section presents the empirical findings for "The Relationship Between the Application of Modern Information Technology and the Operational Efficiency of Food Industry Enterprises in the Upper Northern Region of Thailand." Results are organized to address each research objective. 1) Profile of Respondents and Enterprises, Most executives were female, aged 30 - 40, married, with bachelor's degree or below, >15 years of work experience, monthly income < 50,000 THB, and currently served as managers. Enterprises were predominantly limited companies operating in sugar and confectionery, with capital 50,000,001–90,000,000 THB, >15 years of operation, >200 employees, and annual revenue 10–50 million THB. 2) Perceptions of Modern IT Application, Executives reported high levels of modern IT application overall and across the three dimensions. Data Resource Management (DR), emphasis on reliable, secure databases; fast and accurate information retrieval; routine data verification. System Planning & Development (PD), awareness of enterprise-wide IT impacts; continuous system improvement for usability; user training. Decision Support (DS), communication systems that enhance acceptance of decisions; accurate information prepared for decision support; participatory input for organizational improvement. 3) Perceptions of Operational Efficiency, Operational efficiency was rated high overall ($\bar{x}$ = 4.05, SD = 0.44). By dimension (all high), Learning & Growth (LP), $\bar{x}$ = 4.18, SD = 0.52, highest; continuous staff capability development, routine performance review, learning activities fostering cohesion. Customer (CP), $\bar{x}$ = 4.08, SD = 0.58, quality improvement, utilization of customer feedback, and increasing market share. Internal Process (IP): $\bar{x}$ = 4.08, SD = 0.51, ongoing product development, rapid innovation, structure aligned to processes, and continuous process improvement and Financial (FP), $\bar{x}$ = 4.01, SD = 0.57, sustained profitability, disciplined investment planning, and productivity gains. 4) Group Comparisons (t-tests, ANOVA, MANOVA) Differences in modern IT application by company form, business type, capital, years of operation, number of employees, and annual revenue were not significant (all $p > .05$). Similarly, operational efficiency, overall and by dimension (customer, internal process, learning & growth, financial), did not differ significantly across the same organizational characteristics (all $p > .05$). These results indicate broadly comparable adoption levels and efficiency outcomes across enterprise profiles. 5) Relationships and Impacts (Correlations, Regressions, VIFs) Bivariate correlations between overall operational efficiency (TOE) and each IT dimension were positive and statistically significant ($r = 0.393–0.404$, $p < .05$). Inter-correlations among DR, PD, and DS were moderate (VIFs 1.815–2.068), below the multicollinearity threshold. A multiple regression predicting TOE from DR, PD, DS was overall significant ($F = 9.171$, $p < .0001$; Adj R^2 = .188), yet no single IT dimension showed a significant unique effect (all $p > .10$). Thus, the combined use of IT relates to higher overall efficiency, but unique contributions are shared across dimensions. Dimension-specific models showed, Customer (CP): model significant ($F = 3.471$, $p = .001$; Adj R^2 = .065), but no individual predictor significant. Internal Process (IP), model not significant ($F = 2.035$, $p = .114$; Adj R^2 = .028). Learning & Growth (LP), model not significant ($F = 1.675$, $p = .177$; Adj R^2 = .019). Financial (FP), model significant ($F = 8.149$, $p < .0001$; Adj R^2 = .168); DS showed a positive, significant effect ($\beta = 0.259$, $p = .023$). A simplified predictive equation was obtained: $FP = 2.497 + 0.369 \cdot DS$. 6) Hypothesis Outcomes, H1 (DR → efficiency): not supported for unique effects (overall model significant but DR ns). H2 (PD → efficiency): not supported for unique effects. H3 (DS → efficiency): supported for the Financial dimension (significant positive impact), but not for other dimensions. Overall, modern IT application is broadly high and positively associated with operational efficiency. Decision-support technologies are particularly salient for financial performance, while efficiency levels and IT adoption appear uniform across organizational profiles in the upper northern region of Thailand. As show Table 1 to Table 2.

Table 1: Tests of Relationships and Impacts between Modern IT Applications and Operational Efficiency

Hypothesis	Independent Variable(s)	Dependent Variable	Test / Model	Key Statistics	Decision	Interpretation
H1	Data Resource Management (DR)	Overall efficiency (TOE)	Multiple regression (DR, PD, DS → TOE)	Model: $F = 9.171$, $p < .0001$; Adj $R^2 = .188$. DR (ns)	Not supported (unique effect)	Combined IT dimensions relate to higher TOE, but DR does not show a unique effect when

Hypothesis	Independent Variable(s)	Dependent Variable	Test / Model	Key Statistics	Decision	Interpretation
						controlling for PD and DS.
H2	System Planning & Development (PD)	Overall efficiency (TOE)	Multiple regression (DR, PD, DS → TOE)	Model: $F = 9.171$, $p < .0001$; Adj $R^2 = .188$. PD (ns)	Not supported (unique effect)	PD does not exhibit a unique contribution to TOE once DR and DS are included.
H3	Decision Support (DS)	Overall efficiency (TOE)	Multiple regression (DR, PD, DS → TOE)	Model: $F = 9.171$, $p < .0001$; Adj $R^2 = .188$. DS (ns)	Not supported (unique effect)	No unique DS effect on TOE after controls; relationship is carried by the combined set.
H1–H3 (by dimension)	DR, PD, DS	Customer (CP)	Multiple regression	$F = 3.471$, $p = .001$; Adj $R^2 = .065$. All predictors (ns)	Not supported (unique effects)	IT dimensions jointly relate to CP, but none is uniquely significant.
H1–H3 (by dimension)	DR, PD, DS	Internal Process (IP)	Multiple regression	$F = 2.035$, $p = .114$; Adj $R^2 = .028$	Not supported	Model not significant for IP.
H1–H3 (by dimension)	DR, PD, DS	Learning & Growth (LP)	Multiple regression	$F = 1.675$, $p = .177$; Adj $R^2 = .019$	Not supported	Model not significant for LP.
H3 (financial focus)	Decision Support (DS)	Financial (FP)	Multiple regression	$F = 8.149$, $p < .0001$; Adj $R^2 = .168$; $\beta(DS) = 0.259$, $p = .023$; FP = 2.497 + 0.369·DS	Supported	DS has a positive, significant effect on FP; stronger decision-support tools improve financial performance.

Notes: Correlations between TOE and each IT dimension were positive and significant ($r = .393–.404$, $p < .05$). Multicollinearity diagnostics were acceptable (VIFs = 1.815–2.068).

Table 2: Group Comparisons of IT Application and Operational Efficiency across Organizational Characteristics

Outcome	**Organizational Characteristic**	**Test**	**Key Statistics**	**Result**	**Interpretation**
IT application (overall)	Company form (Limited vs. Partnership)	t-test	$t = -1.095$, $p = .276$	**ns**	No difference in adoption by legal form.
IT application (overall)	Business type (10 categories)	ANOVA	$F = 0.240$, $p = .982$	**ns**	Adoption does not differ by product category.
IT application (3 dimensions)	Business type	MANOVA (Wilks' Λ)	$p = .402$	**ns**	DR, PD, DS do not differ by business type.
IT application (overall)	Capital (4 groups)	ANOVA	$F = 0.151$, $p = .929$	**ns**	Adoption does not vary by capital.
IT application (3 dimensions)	Capital	MANOVA	$p = .712$	**ns**	No dimensional differences by capital.

Outcome	Organizational Characteristic	Test	Key Statistics	Result	Interpretation
IT application (overall)	Years of operation (4 groups)	ANOVA	F = 2.179, p = .095	**ns**	Adoption does not vary by firm age.
IT application (3 dimensions)	Years of operation	MANOVA	p = .114	**ns**	No dimensional differences by firm age.
IT application (overall)	Number of employees (4 groups)	ANOVA	F = 1.626, p = .188	**ns**	Adoption does not vary by size.
IT application (3 dimensions)	Number of employees	MANOVA	p = .426	**ns**	No dimensional differences by size.
IT application (overall)	Annual revenue (4 groups)	ANOVA	F = 1.671, p = .178	**ns**	Adoption does not vary by revenue.
IT application (3 dimensions)	Annual revenue	MANOVA	p = .506	**ns**	No dimensional differences by revenue.
Operational efficiency (overall)	Company form	t-test	t = −0.271, p = .787	**ns**	No efficiency difference by legal form.
Operational efficiency (overall)	Business type	ANOVA	F = 1.581, p = .140	**ns**	No efficiency difference by product category.
Operational efficiency (4 dimensions)	Business type	MANOVA	p = .371	**ns**	Customer, Internal Process, Learning & Growth, and Financial do not differ by category.
Operational efficiency (overall)	Capital	ANOVA	F = 0.836, p = .477	**ns**	No efficiency difference by capital.
Operational efficiency (4 dimensions)	Capital	MANOVA	p = .486	**ns**	No dimensional differences by capital.
Operational efficiency (overall)	Years of operation	ANOVA	F = 0.252, p = .860	**ns**	No efficiency difference by firm age.
Operational efficiency (4 dimensions)	Years of operation	MANOVA	p = .302	**ns**	No dimensional differences by firm age.
Operational efficiency (overall)	Number of employees	ANOVA	F = 0.685, p = .563	**ns**	No efficiency difference by size.
Operational efficiency (4 dimensions)	Number of employees	MANOVA	p = .565	**ns**	No dimensional differences by size.
Operational efficiency (overall)	Annual revenue	ANOVA	F = 1.056, p = .371	**ns**	No efficiency difference by revenue.
Operational efficiency (4 dimensions)	Annual revenue	MANOVA	p = .886	**ns**	No dimensional differences by revenue.

Abbreviations: DR = Data Resource Management; PD = System Planning & Development; DS = Decision Support; CP = Customer; IP = Internal Process; LP = Learning & Growth; FP = Financial; TOE = overall operational efficiency; ns = not significant.

Discussion & Conclusion

The findings of this study provide important insights into the relationship between the application of modern information technology (IT) and the operational efficiency of food industry enterprises in the upper northern region of Thailand. Overall, the results indicate that while IT adoption is perceived at a high level across enterprises, its direct and unique impacts on overall operational efficiency are more nuanced than expected. First, descriptive analyses showed that enterprises actively implement IT in the areas of data resource management, system planning and development, and decision support. These findings are consistent with global trends in digital transformation, where food industries increasingly invest in IT infrastructure to enhance supply chain management, product traceability, and customer service (Chen et al., 2022). In the context of the northern Thai food sector, managers emphasized the importance of reliable data systems, continuous system development, and IT-based decision-making tools. This demonstrates a readiness to align with Industry 4.0 practices, which stress integration of digital tools into traditional industries (Li et al., 2021). Second, operational efficiency across all enterprises was rated at a high level, with learning and growth showing the highest mean score. This finding suggests that enterprises place significant emphasis on human capital development and organizational learning as drivers of efficiency. Prior research similarly highlights that IT systems often support efficiency indirectly by facilitating knowledge sharing, innovation, and employee capability development (Kraus et al., 2021). Third, regression results revealed that IT adoption as a whole correlate positively with operational efficiency; however, individual IT dimensions such as data resource management, planning, and decision support did not significantly predict overall efficiency. The exception was the financial perspective, where decision support systems demonstrated a significant positive effect. This suggests that while IT adoption improves organizational practices broadly, its most tangible benefit lies in enhancing financial outcomes through improved decision-making. This aligns with recent studies showing that advanced decision support tools such as predictive analytics and business intelligence enable firms to optimize investment strategies, cost management, and profitability (Zhang & Xie, 2023). Fourth, comparative analyses found no significant differences in IT adoption or efficiency across enterprises with varying business forms, capital levels, years of operation, workforce size, or revenue. This indicates that IT has become a standardized practice across enterprises regardless of structural characteristics. Such results contrast with earlier research emphasizing firm size and resources as determinants of IT adoption (Thong & Lertwongsatien, 2020; Pongwiritthon, K. 2023), suggesting that digital tools are increasingly accessible to both large and smaller enterprises in the Thai food sector. In conclusion, this study demonstrates that modern IT adoption plays a positive but differentiated role in supporting efficiency within food industry enterprises in northern Thailand. While the overall relationship is evident, the strongest impacts are seen in financial performance rather than customer, process, or learning outcomes. These findings suggest that managers should focus on deepening IT integration into decision-making and financial planning while simultaneously developing complementary strategies to leverage IT for customer engagement and innovation. Future research could extend this study by incorporating qualitative insights to explore how organizational culture and leadership mediate the effectiveness of IT in enhancing efficiency.

Recommendations

1. Practical Recommendations

The findings suggest that while food industry enterprises in Upper Northern Thailand demonstrate high levels of modern IT adoption, the strongest benefits emerge in financial performance through decision-support systems. Managers should therefore prioritize the integration of IT tools that directly support financial decision-making, such as predictive analytics, business intelligence platforms, and cost optimization software. At the same time, firms should strengthen training programs to ensure that employees can fully utilize IT systems across all functions, linking data resource management and system development with customer engagement and process innovation. Policymakers and industry

associations should also provide incentives and shared platforms that make advanced IT solutions accessible to smaller enterprises, reducing cost barriers and fostering sector-wide competitiveness.

2. Recommendations for Future Research

Future research should examine the organizational and contextual factors that mediate IT effectiveness, including leadership, innovation culture, and supply chain collaboration. Longitudinal studies could track how sustained IT adoption influences efficiency outcomes over time, particularly as firms move deeper into Industry 4.0 integration. Comparative studies across industries and regions would also provide insights into whether the observed patterns are unique to the northern Thai food sector or represent broader national and regional trends. Finally, incorporating qualitative methods such as interviews or case studies would yield richer perspectives on how managers and employees perceive and apply IT in practice.

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