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Editorial: Bridging Numbers and Narratives – The Dawn of a New Forum for Interdisciplinary Rigour

Volume 1, Issue 1 (January-April 2026)

As we stand at the confluence of global financial integration and unprecedented organisational complexity, the need for a scholarly platform that not only dissects these phenomena but also anticipates their trajectory has never been more urgent. It is with profound intellectual excitement and a deep sense of responsibility that we present the inaugural issue of the International Accounting and Management Science Journal (IAMSJ). This launch represents more than the birth of a new periodical; it is the formal establishment of a transnational bridge between the empirical precision of accounting and the strategic dynamism of management science.

For decades, mainstream research has often treated accounting as a retrospective scorekeeper and management science as a prescriptive toolkit for operational efficiency. Yet, the post-pandemic economic order, marked by volatile supply chains, the rise of environmental, social, and governance (ESG) metrics, and the digital transformation of financial reporting, demands a synthesis. This Journal is predicated on a simple but powerful conviction: that sustainable value creation occurs at the intersection of accountable measurement and managerial foresight. We contend that accounting without a strategic context risks irrelevance, while management science without robust accountability risks imprudence.

The mission of IAMSJ is threefold. First, to serve as a rigorous outlet for original research that employs quantitative, qualitative, and mixed-method approaches to address pressing questions at the accounting–management nexus. Second, to foster a global dialogue that transcends jurisdictional reporting standards and culturally bound management practices. Third, to actively encourage scholarly work that translates theoretical advances into actionable insights for practitioners, regulators, and standard-setters.

We are acutely aware that the credibility of any scholarly journal rests on the integrity of its review process. Accordingly, IAMSJ has instituted a double-blind peer-review system guided by an editorial board of distinguished international scholars, each recognised for their methodological expertise and cross-disciplinary vision. We extend our deepest gratitude to these reviewers and to the authors who entrusted their pioneering work to an inaugural volume.

Welcome to the first issue of the International Accounting and Management Science Journal. Let the conversation begin.

Associate Professor Dr Ampol Navavongsathian

Editor-in-Chief

April 23, 2026

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Work Performance Efficiency Based on IES 3 Professional Accounting Skills of Treasury Registrars under District Government Offices in the Central Region

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Abstract

This research aimed to: 1) study the levels of professional accounting skills, 2) study the levels of work performance efficiency, and 3) study the influence of professional accounting skills on the work performance efficiency of Treasury Registrars (Accountants) under District Government Offices in the Central Region. The population consisted of 203 Treasury Registrars (Accountants). The research tool was a questionnaire. Statistical data analysis included frequency, percentage, mean, standard deviation, and Multiple Regression Analysis. The results indicated that professional accounting skills were overall at the highest level ($\bar{x} = 4.98, SD = 0.143$). Ranked by mean, the highest was Intellectual skills, followed by Interpersonal and Communication skills, and Personal Management Skills, Organizational Management skills, respectively, Work performance efficiency was also overall at the highest level.

The results of the multiple regression analysis showed that intellectual skills, interpersonal skills, personal management skills, and organizational management skills significantly influenced work performance efficiency at the 0.05 level. Among these factors, personal management skills had the greatest influence on work performance efficiency ($\beta = 0.384$), followed by interpersonal skills ($\beta = 0.283$), intellectual skills ($\beta = 0.202$), and organizational management skills ($\beta = 0.103$). These variables collectively accounted for 29.1% ($R^2=0.291$) of the variance in work performance efficiency. However, Organizational Management skills did not significantly influence work performance efficiency.

Keywords: Work Performance Efficiency, Professional Accounting Skills, District Government Accountants, Central Region

Introduction

Regional administration, based on the principle of Deconcentration, is central to the implementation of central policies through provincial and district mechanisms. This paper describes “Deconcentration” as the handling of accounting and administrative functions within a centralized structure without transferring decision-making authority (Khadduri, 2001). In the current economic crisis, the public sector must adopt New Public Management (NPM) to maximize the use of limited resources for societal benefit. Modern work must focus on results that are concrete, transparent, and auditable.

The "budget" is a key factor in local progress, requiring efficient management under legal frameworks. Accountants are the main mechanism for collecting and recording financial data and auditing internal control systems. To develop Thai accounting to international standards, the Federation of Accounting Professions was established under the Accounting Professions Act B.E. 2004.

In the era of globalization, Thai accountants must elevate their potential to match international standards, specifically International Education Standard (IES) No. 3, which emphasizes four professional skills: Intellectual, Interpersonal and Communication, Personal Management Skills, and Organizational Management.

However, the Department of Provincial Administration currently faces a shortage of treasury registrars (accountants) due to high turnover and heavy workloads. The researcher, as a practitioner in the Central Region, recognizes the importance of these skills and aims to use this study as a guideline to improve the efficiency of accountants and prevent future operational errors.

In the current global landscape, the Federation of Accounting Professions under the Royal Patronage of Thailand has prioritized the International Education Standards (IES) set by the International Federation of Accountants (IFAC). Specifically, IES 3 (Initial Professional Development – Professional Skills) emphasizes four critical skill dimensions: intellectual, interpersonal and communication, personal, and organizational skills. These standards serve as a benchmark for enhancing the competency of accounting professionals to meet international requirements.

However, practical evidence suggests a significant gap; government accountants at the local level frequently encounter challenges regarding reporting delays due to limitations in technical skills and data analysis capabilities aligned with international standards. Given the heavy workload and the complexity of decentralized financial regulations, the integration of IES 3 skills is not merely a compliance requirement but a vital mechanism for improving analytical accuracy, reducing errors, and ultimately enhancing work performance efficiency within the framework of New Public Management (NPM).

Research Objectives

1. To examine the level of professional accounting skills based on IES 3 standards among Treasury Registrars (Accountants) under District Government Offices in the Central Region.
2. To evaluate the level of work performance efficiency among Treasury Registrars (Accountants) under District Government Offices in the Central Region.

3. To investigate the influence of professional accounting skills on the work performance efficiency of Treasury Registrars (Accountants) under District Government Offices in the Central Region.

Literature Review

The pursuit of Work Efficiency

Setthacharoenkul (2022) stated that work efficiency refers to any form of work pattern, method, or process designed to achieve predetermined objectives. It involves managing available resources within given constraints—whether labor, capital, or natural resources—by utilizing them to their fullest potential through systematic processes. Efficiency is achieved when the use of resources is minimized while generating the maximum possible benefit.

Dechosupakorn (2020) explained that work efficiency means the ability to perform tasks accurately, completely, and reliably, with skill and attention to quality. The work must be correct, orderly, and carried out to achieve the intended goals and objectives. This requires the appropriate and economical use of human resources and equipment, ensuring the greatest possible benefit.

Evaluation of Work Performance Efficiency

The Office of the Civil Service Commission (OCSC, 2019) explained that the evaluation of work performance efficiency should be based on performance indicators and target values mutually agreed upon by both the employee and the supervisor. The assessment references the achievement of work outcomes according to these indicators and/or tangible evidence that demonstrates outputs and results. Performance indicators and target values can be established in various ways; however, they must be directly related to the responsibilities of the employee. These responsibilities may fall into three categories:

1. Tasks specified in the performance agreement or the annual operational plan of the government agency (strategic tasks).
2. Tasks that are part of the core responsibilities of ministries, departments, provinces, offices, divisions, or the employee's position, which are not included in category 1 (functional tasks).
3. Special assignments outside the regular duties of the agency or the employee, such as projects or urgent problem-solving tasks arising during the evaluation period.

Concepts Regarding the Skills of Accounting Professionals

Skill refers to proficiency or the ability to perform or carry out a particular activity. Skills may be physical, intellectual, or social, and are developed through practice or repeated performance (Distance Learning Television Foundation under the Royal Patronage, n.d.).

An accounting professional refers to individuals engaged in the fields of accounting, auditing, management accounting, accounting system design, taxation, accounting education and technology, and other accounting-related services as defined by ministerial regulations. It also includes those registered with the Federation of Accounting Professions.

The skills of accounting professionals refer to the abilities and knowledge required of accountants to perform their work effectively and in compliance with professional accounting standards. These skills are essential for delivering high-quality accounting services and adhering to relevant principles and regulations.

The skills of accounting professionals are aligned with the professional standards of the International Federation of Accountants (IFAC) (2017), specifically the International Education Standards (IES) No. 3. Professional skills, based on knowledge and competence, are categorized into four areas:

1. Intellectual skills
2. Interpersonal and communication skills
3. Personal Management Skills
4. Organizational management skills

In conclusion, Work Performance Efficiency: Refers to working methods or processes that lead to success by managing resources (labor, capital, natural resources) to achieve the highest quality with minimal resource use. Assessment of Performance: Based on performance indicators and targets agreed upon by practitioners and supervisors, focusing on concrete outputs and outcomes. Professional Accounting Skills: Skills and knowledge that accountants must possess to work effectively and accurately according to professional standards (IES 3), categorized into four areas: 1) Intellectual, 2) Interpersonal and Communication, 3) Personal Management Skills, and 4) Organizational Management.

Research Methodology

In this study, the researcher employed a quantitative research approach to obtain accurate data and to test hypotheses through statistical analysis. The procedures were as follows:

1. Population and Sample

Population The population consists of 203 administrators and Treasury Registrars (Accountants) working under District Government Offices in 21 provinces in the Central Region, based on the 2021 Directory of the Provincial Treasury Group.

Sample: Since the researcher obtained responses from the entire population of 203 individuals, this study is conducted as a Census Study to ensure comprehensive and highly accurate data.

2. Research Instruments and Quality Validation

Validity: The questionnaire was validated by three experts to determine the Index of Item-Objective Congruence (IOC), resulting in a value of 0.82.

Reliability: A pilot study (Try-out) was conducted with 30 participants in Phra Nakhon Si Ayutthaya province who possessed similar characteristics to the target group but were not part of the actual sample. The reliability analysis yielded a Cronbach's alpha of 0.840.

3. Statistical Analysis

Descriptive Statistics: Frequency, percentage, mean, and standard deviation (S.D.).

Inferential Statistics: Multiple Regression Analysis was utilized to test the influence of independent variables. Prior to analysis, fundamental assumptions including Normality and Multicollinearity (VIF) were tested to ensure the integrity of the statistical results

Research Findings

1. Analysis of Personal Characteristics of the Respondents

Table 1. Personal Characteristics of the Respondents (n = 203)

Personal Characteristics	Frequency	Percentage
Gender		
Male	145	71.4
Female	58	28.6
Age		
Under 30 years	0	0
30 – 39 years	5	2.5
40 – 49 years	135	66.5
50 years or older	63	31
Education Level		
Below Bachelor's Degree	0	0
Bachelor's Degree or Equivalent	0	0
Higher than Bachelor's Degree	203	100
Accounting Work Experience		
Less than 5 years	0	0
Between 5 – 10 years	0	0
More than 10 years	203	100
Total	203	100

From Table 1, The analysis of the personal characteristics of the 203 respondents revealed that the majority were male, totaling 145 individuals (71.4%). In terms of age, the largest group was between 40 – 49 years old, accounting for 135 individuals (66.5%), followed by those aged 50 years or older (31.0%). Notably, all respondents (100.0%) held an education level higher than a bachelor's degree and possessed more than 10 years of accounting work experience.

2. Results of the Analysis of Accounting Professionals' Skills among Accountants under District Government Offices in the Central Region

Table 2. Overall Mean and Standard Deviation of Accounting Professionals' Skills (n=203)

Skills Required of Accounting Professionals	$\bar{X}$	SD	Level	Ranking
1. Intellectual Skills	5.00	0.040	Highest	1
2. "Interpersonal Relations and Communication Skills	4.99	0.083	Highest	2
3. Personal Management Skills	4.97	0.118	Highest	4
4. Organizational Management Skills	4.98	0.105	Highest	3
Total	4.98	0.051	Highest	

Source: collected by Authors

From Table 2, which presents the level of accounting professionals' skills among accountants under District Government Offices in the Central Region (n = 203), it was found that the overall skill level was at the highest level ($\bar{x} = 4.98, SD = 0.051$). When considering each dimension, all four areas of accounting professional skills were also at the highest level. Ranking by mean scores, the results were as follows:

1. Intellectual skills ($\bar{x} = 5.00, SD = 0.040$)
2. Interpersonal and communication skills ($\bar{x} = 4.99, SD = 0.083$)
3. Organizational management skills ($\bar{x} = 4.98, SD = 0.105$)
4. Personal Management Skills ($\bar{x} = 4.97, SD = 0.118$)

Table 3. Multiple Regression Analysis of Professional Accounting Skills Influencing Work Performance Efficiency

Factors	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	-1.915	0.901		-2.126*	.035
Intellectual Skills (A)	0.546	0.162	0.202	3.372*	.001
Interpersonal Skills (B)	0.369	0.076	0.283	4.839*	.000
Personal Management Skills (C)	0.354	0.055	0.384	6.473*	.000
Organizational Management Skills (D)	0.107	0.063	0.103	1.704	.090

$R = .0539$, $R^2 = .291$, $Adjusted\ R\ Square = .284$, $SE = .901$

*Significant at the 0.05 level

From Table 3, which presents the displays the multiple regression analysis results of professional accounting skills and the work performance efficiency of accountants at the 0.05 significance level. The analysis identifies three significant factors influencing work performance efficiency, which can be expressed in the following regression equation:

$$\text{Work Performance Efficiency} = -1.915 + 0.546(A) + 0.369(B) + 0.354(C)$$

The findings are summarized as follows:

The results of the multiple regression analysis showed that intellectual skills, interpersonal skills, personal management skills, and organizational management skills significantly influenced work performance efficiency at the 0.05 level. Among these factors, personal management skills had the greatest influence on work performance efficiency ($\beta = 0.384$), followed by interpersonal skills ($\beta = 0.283$), intellectual skills ($\beta = 0.202$)

Relation each variable from equation, we use beta which 1st Personal Management Skills (C) , 2nd Interpersonal Skills (B), 3rd Intellectual Skills (A)

3. Results of the Analysis of Work Performance Efficiency of Accountants under District Government Offices in the Central Region

Table 4. Mean and Standard Deviation of Accountants' Work Performance Efficiency in Overall Terms (n=203)

'Efficiency of Accountants' Work Performance	$\bar{X}$	SD	Level	Ranking
1. Cost-Effectiveness	4.88	0.264	Highest	3
2. Timeliness	4.97	0.092	Highest	2
3. Accuracy, Clarity, and Verifiability	4.99	0.070	Highest	1
Total	4.95	0.109	Highest	

Source: Analysed by Authors

From Table 4, which presents the level of work performance efficiency of accountants under District Government Offices in the Central Region (n = 203), it was found that the overall efficiency level was at the highest level ($\bar{x} = 4.95, SD = 0.109$). When considering each dimension, all three aspects of work performance efficiency were also at the highest level. Ranking by mean scores, the results were as follows:

1. Accuracy, clarity, and verifiability ($\bar{x} = 4.99, SD = 0.070$)
2. Timeliness ($\bar{x} = 4.97, SD = 0.092$)
3. Cost-effectiveness ($\bar{x} = 4.88, SD = 0.264$)

Table 5. Analysis of Variance (ANOVA) of Work Performance Efficiency categorized by Professional Accounting Skills

Performance Efficiency Dimensions	Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Cost-Effectiveness	Between Groups	2.965	6	0.494	8.742*	.000
	Within Groups	11.081	196	0.057		
	Total	14.046	202			
Timeliness	Between Groups	0.656	6	0.109	20.585*	.000
	Within Groups	1.041	196	0.005		
	Total	1.698	202			
Accuracy, Clarity, and Verifiability	Between Groups	0.138	6	0.023	5.358*	.000
	Within Groups	0.842	196	0.004		
	Total	0.98	202			

*Significant at the 0.05 level

From Table 5, which presents comparative analysis of the relationship between professional accounting skills and work performance efficiency categorized by dimension. The results indicate that Treasury Registrars with different levels of professional skills exhibit significantly different work performance efficiency across all dimensions namely Cost-Effectiveness, Timeliness, and Accuracy, Clarity, and Verifiability at the 0.05 statistical significance level.

Table 6. Correlation Analysis between Professional Accounting Skills and Work Performance Efficiency

Variables		Professional Skills	Performance Efficiency
Professional Skills	Pearson Correlation	1	.539*
	Sig. (2-tailed)		.000
	n	203	203
Performance Efficiency	Pearson Correlation	.539*	1
	Sig. (2-tailed)	.000	
	n	203	203

* Correlation is significant at the 0.05 level (2-tailed).

From Table 6, which presents illustrates the correlation between professional accounting skills and the work performance efficiency of accountants under District Government Offices in the Central Region. The analysis reveals a correlation coefficient (r) of 0.539 with a p-value of 0.000, which is less than the significance levels of 0.05

Conclusion and Discussion

From the study results on work performance efficiency according to the professional skills of accountants under District Government Offices in the Central Region, the researcher analyzed and discussed the findings in line with the research objectives as follows:

1) Skill Levels of Accounting Professionals The study found that the overall professional accounting skills of Treasury Registrars (Accountants) in the Central Region, as well as each individual dimension, were at the highest level. The underlying reason for these results is the operational context of District Government Offices, which involves complex financial and procurement regulations that frequently change according to government policies. The governing mechanism is the high level of Intellectual Skills, which enables accountants to interpret regulations and exercise professional judgment in accordance with IES 3 standards. This minimizes the risk of operational errors, which is the heart of maintaining accuracy in public sector accounting systems. These findings are consistent with the work of Kaewdee (2018), reflecting that international standard skills remain a necessary foundation regardless of whether the context is community enterprises or District Government Offices agencies.

2) Relationship Between Professional Skills and Work Performance Efficiency. The analysis revealed that professional accounting skills had a moderate positive correlation ($r = 0.539$) with work performance efficiency. The linking mechanism can be explained by Interpersonal and Communication Skills serving as a vital intermediary in coordinating between regional and central administrations. This facilitates rapid performance reporting and budget tracking (Timeliness) while reducing redundant processes.

However, the reason for this moderate correlation suggests that in the context of District Government Offices administration, there are other "intervening variables" influencing efficiency. These include excessive workloads, the readiness of government information technology systems, and executive support. This aligns with the concepts of Chulamit (2019) and Mau (2019), who pointed out that Personal Management Skills and organizational management skills contribute to effective management under limited resources.

Suggestions

From the research study, the researcher has proposed recommendations for applying the findings to policy formulation and the improvement of work practices, as follow

1. Policy Recommendations

The Department of Provincial Administration should adopt the IES 3 competency framework by IFAC as a standard for selecting and evaluating Treasury Registrars. Specifically, it should establish a Continuous Professional Development (CPD) plan focused on improving work processes at the local level.

2. Practical Recommendations

Relevant agencies should organize specialized workshops titled "Financial Data Analytics for District-Level Accountants". This training should move beyond basic accounting and focus on using information technology to enhance budget analysis and

strategic planning. Furthermore, supporting the adoption of automated accounting systems is essential to reduce manual errors and increase the speed of reporting to meet government deadlines.

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Service Satisfaction of the Student Loan Fund Office at Nakhon Ratchasima College

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Abstract

The purposes of this study were (1) to examine the level of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College, and (2) to compare satisfaction levels classified by gender, age, year of study, and academic performance. The sample consisted of 313 students who used the Student Loan Fund services (both new and continuing borrowers) in the academic year 2024 using Taro Yamane's formula with a margin of error of 0.05. The research instrument was a questionnaire based on a Likert scale. Statistical methods included percentage, mean, standard deviation, Independent Samples t-test, f-test one-way ANOVA, and Scheffe's post hoc test. The results showed that overall satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College was at a high level. The highest mean score was for staff service, followed by facilities (e-Student loan system), and processes. The lowest mean score was for publicity and information dissemination. Students differed in satisfaction levels by gender and year of study, but not by age or GPA. This study provides theoretical implications by extending the Technology Acceptance Model (TAM) through the integration of organizational change factors, thereby offering a more comprehensive explanation of employee behavioral outcomes.

Keywords: Satisfaction, Service, Student Loan Fund Office, Nakhon Ratchasima College

Introduction

Higher education institutions are key variables in developing the nation's workforce to be competitive globally. They emphasize educational opportunity, equality, quality assurance, and employability under an economy driven by innovation and creativity including dynamics within a wisdom-based and lifelong learning society, and supportive learning environment in order for its citizen to pursue their knowledge and to be self-directed so that Thailand could move beyond the middle-income trap toward developed nation status within 15 years (Office of the Education Council, 2016: 3). Private higher education institutions are defined as privately run institutions offering degree-level education to more than one person. They serve as centers of teaching, research, academic

services, and cultural preservation. They are categorized into universities, institutes, and colleges, as specified by ministerial regulations.

Education is the nation's secure future. Therefore, all educational institutions have supported education through student loan services for continuing studies within the country. These loans cover expenses for higher education at the bachelor's level and beyond, such as tuition fees, textbooks, and various educational equipment, as well as courses related to future careers. The government has emphasized the development of human resources—or simply the development of “people.” Its policy aims to promote equal educational opportunities for all citizens. As a result, the Student Loan Fund (SLF) was established in 1995 during the administration of Prime Minister Chuan Leekpai. On March 28, 1995, the Cabinet approved the principles of this project, structured as a revolving fund under Section 12 of the Treasury Reserves Act of 1948. The first loans to students were granted starting in the academic year 1996.

Later, the “Student Loan Fund Act, B.E. 2541 (1998)” was enacted, granting the Student Loan Fund (SLF) legal entity status under the supervision of the Ministry of Finance. Its primary objective is to provide loans to financially disadvantaged students at the secondary, vocational, and higher education levels. These loans cover tuition fees, educational expenses, and necessary living costs during their studies, ensuring equal access to education, easing the financial burden on parents, and contributing to the overall development of the nation's human resources. The Fund expects borrowers to complete their studies successfully, secure employment, take responsibility for themselves and society, and develop a sense of duty to repay their loans. This repayment helps create educational opportunities for future generations. By law, after graduation or after ceasing to borrow for two consecutive years, borrowers are required to begin repayment. The loan includes a two-year grace period after graduation or leaving school, after which repayment must be made over 15 years with an annual interest rate of 1%, according to the schedule and percentage of principal set by the Fund's regulations.

Nakhon Ratchasima College, a private institution under the Ministry of Higher Education, Science, Research, and Innovation (MHESI), offers bachelor's, master's, and doctoral programs. Over the years, the college has continuously improved its services, including the student loan system, to assist students who wish to borrow from the SLF. The college ensures convenience, efficiency, and satisfaction in the loan process, strictly following the Fund's procedures. Students receive updated loan information each semester, and the college assigns dedicated staff to manage the loan program, providing guidance and support specifically related to student borrowing.

While extensive research has addressed service satisfaction, a significant research gap remains regarding in-depth comparative studies within the specific context of the Student Loan Fund (SLF). Specifically, there is limited analysis of how deep-seated demographic variables influence service expectations and perceptions in the digital era. This study aims to bridge this gap by establishing new insights into student welfare administration and developing service models that effectively and sustainably meet borrowers' needs.

Research Objectives

1. To study the level of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College.
2. To compare satisfaction levels classified by gender, age, year of study, and academic performance.

Literature Review

Technology Acceptance Theory

Davis (1989) proposed the Technology Acceptance Model (TAM), which evolved from the Theory of Reasoned Action (TRA). This model posits that actual system use is driven by behavioral intention to use, which is primarily influenced by two factors: perceived usefulness and perceived ease of use. Subsequently, Venkatesh and Davis (2000) introduced the Extension of the Technology Acceptance Model (TAM2). This version incorporates external variables that influence perceived usefulness and perceived ease of use, including experience, voluntariness, subjective norms, image, job relevance, output quality, and result demonstrability.

The framework further evolved into the Unified Theory of Acceptance and Use of Technology (UTAUT). This theory suggests that actual usage behavior is a direct result of facilitating conditions and behavioral intention. The latter is determined by performance expectancy, effort expectancy, and social influence. These relationships are moderated by gender, age, experience, and voluntariness of use (Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Davis, & Morris, 2007). Later, the model was expanded into UTAUT2, which introduced new factors: hedonic motivation, price value, and habit (Venkatesh, Thong, & Xu, 2012).

In the context of online shopping, specifically for apparel and electronics, Frassetto et al. (2015) identified seven key dimensions of TAM: usefulness, ease of use, security, time pressure, hedonic orientation, product involvement, and enjoyment.

Service Concepts and Theories

Millet (1954: 400) mentioned the creation of satisfaction in providing services to the public, based on the following principles and concepts:

1) Equal Able Service, this refers to fairness in public administration, based on the principle that everyone is equal. Therefore, all citizens must be treated equally under the law, without discrimination or exclusion in service delivery. Every individual is regarded as a person who receives services according to the same standard.

2) Time Service, this is public services must be punctual. The effectiveness of government performance is judged by timeliness. If services are not delivered on time, it creates dissatisfaction among the citizens receiving them.

3) Ample Service, this is public services must be adequate and appropriately provided, with suitable facilities and locations (The Right Quantity at the Geographical Location). Equality and punctuality lose their meaning if the quantity of services is insufficient or if service locations create unfairness for recipients.

4) Continuous Service, this is services must be provided consistently, with the public interest as the guiding principle. Service delivery should not depend on the convenience or preferences of the agency, nor be arbitrarily started or stopped.

5) Progressive Service, this is public services must continuously improve in quality. In other words, efficiency and capability should be enhanced so that tasks are performed better, even while using the same resources.

Royal Institute (2003) defines service as providing assistance or convenience.

Royal Institute (2003) defines “service” as: performing duties of assistance, providing various conveniences. It gives the definition of “service” as the act of serving or facilitating, such as providing or using services.

The word SERVICE can be understood as good service, which can be broken down as follows:

S = Service Mind → Having a service-oriented mindset, desiring to bring satisfaction and happiness to others.

E = Enthusiasm → Showing eagerness and energy in providing service.

R = Readiness → Being prepared with personnel and equipment to deliver service.

V = Value → Recognizing the worth of service work as beneficial and meaningful, capable of bringing pride to life.

I = Interested → Having genuine interest and attentiveness in service work, performed willingly.

C = Cleanliness → Ensuring cleanliness in facilities, equipment, and staff as part of good service.

E = Endurance → Demonstrating patience and tolerance, since service work involves dealing with many types of people—calm, impatient, demanding, or critical. Service providers must endure.

S = Smile → Offering friendliness and warmth through smiling, treating all service recipients equally without discrimination.

Concepts and Theories of Satisfaction

Satisfaction is an abstract attitude, not physically visible. To know whether a person is satisfied, one must observe complex expressions. Direct measurement is difficult, but indirect measurement is possible through opinions, provided those opinions reflect true feelings. Scholars have discussed the meaning, characteristics, principles, factors, and measurement of satisfaction as follows:

1. Definition of Satisfaction

Satisfaction is the expression of positive feelings resulting from comparing perceptions of received services with expectations. It relates both to the satisfaction of service recipients and the job satisfaction of service providers. Satisfaction is a key factor influencing successful and effective outcomes, as it reflects the fulfillment of individual motivations or needs in desired ways.

Cullen (2001: 664) defines satisfaction as an individual’s perception, both short-term and long-term, of service quality. This includes narrow aspects such as responsibility and trustworthiness of providers, and broader perspectives of overall service experiences, which form the conclusion of user satisfaction toward an organization.

Millet (1954: 4) describes satisfaction in service (Satisfactory Service) as the ability to create satisfaction for recipients, based on five elements:

1. Ability to provide services sufficient to meet demand (Ample Service)
2. Ability to provide services fairly and equally (Equitable Service)
3. Ability to provide services continuously without interruption (Continuous Service)
4. Ability to provide services promptly and on time (Timely Service)
5. Ability to develop services progressively in both quantity and quality (Progress Service).

In summary, service user satisfaction is an indicator of positive feelings that develop into happiness with various aspects of service delivery. Satisfaction arises during the interaction between service providers and recipients, as a result of perceptions and evaluations of service quality—specifically, the comparison between what recipients expect to receive and what they actually receive in each service situation. The level of satisfaction is not fixed and may vary over time.

Therefore, to determine whether service delivery generates satisfaction, multiple components should be considered together. These include Equal Service (fairness and equality), Timely Service (punctuality), Ample Service (adequacy), Continuous Service (consistency), Progressive Service (improvement and advancement), Technological Service (integration of technology) These elements align closely with the basic needs of service recipients. When those needs are met according to their expectations, satisfaction is ultimately achieved.

Research Method and Design

In this study, the researcher employed a quantitative research methodology in order to obtain accurate data and to verify hypotheses through statistical analysis. The procedures were carried out as follows:

1. Population and Sample

Population

The population in this study consisted of students at Nakhon Ratchasima College who utilized the Student Loan Fund services, including both new and continuing borrowers in the academic year 2024, totaling 1,437 individuals.

Sample

The sample was selected using Simple Random Sampling to ensure that the respondents were representative of the overall borrower population in the academic year 2024. The sample size was determined using Yamane's formula (1973: 887, cited in Ekakul, 2003: 135)

at a 0.05 margin of error, resulting in 313 respondents.

2. Validity

The research instrument was validated for content validity by a panel of experts, yielding an Index of Item-Objective Congruence (IOC) ranging from 0.60–1.00 indicating acceptable alignment with the objectives."

3. Reliability

The reliability of the questionnaire was assessed using Cronbach's Alpha Coefficient, which resulted in a value of 0.85 demonstrating high internal consistency.

4. Research Instruments

The instrument used in this study was a questionnaire developed by the researcher to assess satisfaction with the services provided by the Student Loan Fund office at Nakhon Ratchasima College. The questionnaire consisted of three parts

Part 1: Respondent's demographic information (gender, age, academic level, GPA), presented in checklist format.

Part 2: Satisfaction with services, measured using a five-point rating scale based on the criteria of Srisa-ad (2002: 165–166).

Part 3: Open-ended questions regarding problems and additional suggestions.

5. Data Collection and Analysis

The collected data were analyzed statistically to test the research hypotheses, with the following procedures:

1. Reliability Testing: The reliability of the satisfaction questionnaire was assessed using Cronbach's Alpha Coefficient (Ekakul, 2003, 2007: 135).

2. Descriptive Statistics: Respondents' demographic characteristics (gender, age, occupation, education) were analyzed using frequency distribution and percentages.

3. Service Satisfaction Analysis: Satisfaction levels across different service aspects were analyzed using mean and standard deviation.

4. Hypothesis Testing: Inferential statistics were applied, including t-tests and one-way ANOVA.

5. Post-hoc Testing: Where significant differences at the 0.05 level were found, pairwise comparisons of mean differences were conducted using Scheffé's method.

Research Findings

1. The findings from the analysis of satisfaction with the services provided by the Student Loan Fund Office at Nakhon Ratchasima College are presented below.

Table 1. Mean, Standard Deviation, and Overall Satisfaction Level with the Services of the Student Loan Fund Office at Nakhon Ratchasima College

No.	Aspect of Service Satisfaction	Level of Practice			
		$\bar{X}$	SD	Interpretation	order
1	Services provided by staff	4.33	0.59	High	1
2	Service processes or procedure	4.11	0.65	High	3
3	Facilities (e-Student loan system)	4.27	0.58	High	2
4	Public relations and information dissemination	4.06	0.70	High	4
Total		4.19	0.63	High	

Table 1 shows that students' overall satisfaction of the students with the services of the Student Loan Fund Office at Nakhon Ratchasima College was at a high level (Mean = 4.19, SD = 0.63). The highest mean score was found in services provided by staff (Mean = 4.33, SD = 0.59) followed by, facilities (e-Student loan system) (Mean = 4.27, SD = 0.58), service processes or procedures (Mean = 4.11, SD = 0.65), and public relations and information dissemination (Mean = 4.06, SD = 0.63) respectively.

2. The results of comparing the satisfaction levels with the services of the Student Loan Fund Office at Nakhon Ratchasima College, classified by personal factors, are presented below.

Table 2. Comparison of Service Satisfaction Levels of the Student Loan Fund Office at Nakhon Ratchasima College Classified by Age by Gender

Service Satisfaction	Gender	n	$\bar{X}$	SD	t	Sig. (p)
Overall Results	Male	94	4.25	0.52	2.15*	0.033
	Female	219	4.12	0.58		

* significance level at 0.05

Table 2 shows that students of different genders had significantly different levels of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College. The overall satisfaction difference was statistically significant at the 0.05 level. Male students reported a higher mean satisfaction score (Mean = 4.25, SD = 0.52) than female students (Mean = 4.12, SD = 0.58), which is consistent with the stated hypothesis.

Table 3. Comparison of Service Satisfaction Levels of the Student Loan Fund Office at Nakhon Ratchasima College Classified by Age

Service Satisfaction	Source of Variation	SS	df	MS	F	Sig. (p)
1. Staff services	Between groups	0.85	2	0.425	1.23	0.294
	Within groups	107.32	310	0.346		
	Total	108.17	312			
2. Processes/ Procedures	Between groups	0.92	2	0.460	1.08	0.339
	Within groups	131.45	310	0.424		
	Total	132.37	312			
3. Facilities	Between groups	0.58	2	0.290	0.87	0.421
	Within groups	103.45	310	0.334		
	Total	104.03	312			
4. Public relations	Between groups	1.12	2	0.560	1.12	0.326
	Within groups	154.30	310	0.498		
	Total	155.42	312			
Overall	Between groups	1.15	2	0.575	0.61	0.544
	Within groups	291.80	310	0.941		
	Total	292.95	312			

* significance level at 0.05

Table 3 shows that students of different ages did not differ significantly in their levels of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College, either overall or in specific aspects. The differences were not statistically significant at the 0.05 level, which does not support the stated hypothesis.

Table 4. Comparison of Service Satisfaction Levels of the Student Loan Fund Office at Nakhon Ratchasima College Classified by Year of Study

Service Satisfaction	Source of Variation	SS	df	MS	F	Sig. (p)
1. Staff services	Between groups	8.42	3	2.807	8.69*	0.000
	Within groups	99.75	309	0.323		
	Total	108.17	312			
2. Processes/ Procedures	Between groups	6.54	3	2.180	5.36*	0.001
	Within groups	125.83	309	0.407		
	Total	132.37	312			
3. Facilities	Between groups	4.12	3	1.373	4.25*	0.006
	Within groups	99.91	309	0.323		
	Total	104.03	312			
4. Public Relations	Between groups	9.87	3	3.290	6.99*	0.000
	Within groups	145.55	309	0.471		

	Total	155.42	312			
Overall	Between groups	12.45	3	4.150	4.32 *	0.005
	Within groups	296.64	309	0.960		
	Total	309.09	312			

* significance level at 0.05

Table 4 shows that students at different years of study had significantly different levels of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College, both overall and in specific aspects. The differences were statistically significant at the 0.05 level, which supports the stated hypothesis.

Table 5. Comparison of Pairwise Differences in Service Satisfaction Levels Classified by Year of Study Using Scheffé's Method

Year of Study	$\bar{X}$	Year 1 (4.35)	Year 2 (4.10)	Year 3 (4.05)	Year 4 (3.90)
Year 1	4.35	-	0.25*	0.30*	0.45*
Year 2	4.10		-	0.05	0.20
Year 3	4.05			-	0.15
Year 4	3.90				-

Table 5 the results of the pairwise comparison using Scheffé's method, revealed that First-Year students reported significantly higher levels of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College compared to students in Year 2, Year 3, and Year 4. The differences were statistically significant at the 0.05 level. In contrast, the comparisons among Second-Year, Third-Year, and Fourth-Year students showed no statistically significant differences in their satisfaction levels at the 0.05 level.

Table 6. Comparison of Service Satisfaction Levels of the Student Loan Fund Office at Nakhon Ratchasima College Classified by Academic Achievement (GPA)

Service Satisfaction	Source of Variation	SS	df	MS	F	Sig. (p)
1. Staff services	Between groups	1.85	4	0.463	1.34	0.255
	Within groups	106.32	308	0.345		
	Total	108.17	312			
2.Processes/ Procedures	Between groups	2.12	4	0.530	1.25	0.289
	Within groups	130.25	308	0.423		
	Total	132.37	312			
3. Facilities	Between groups	1.45	4	0.363	1.09	0.362
	Within groups	102.58	308	0.333		
	Total	104.03	312			

4. Public Relations	Between groups	3.24	4	0.810	1.64	0.164
	Within groups	152.18	308	0.494		
	Total	155.42	312			
Overall	Between groups	2.18	4	0.545	0.58	0.677
	Within groups	289.42	308	0.940		
	Total	291.60	312			

Table 6 shows that students with different grade point averages (GPAs) did not differ significantly in their levels of satisfaction with the services of the Student Loan Fund Office at Nakhon Ratchasima College, either overall or in specific aspects. The differences were not statistically significant at the 0.05 level, which does not support the stated hypothesis.

Conclusion and Discussion

1. Results of the analysis of satisfaction levels in the services provided by the Student Loan Fund Office of Nakhon Ratchasima College. The research found that overall satisfaction with the services of the Student Loan Fund Office was at a high level, which is consistent with the research objectives and hypotheses. This can be discussed in terms of the college's efficient operational system (Efficiency) and its customer-centric approach (Customer Centric). The office continuously improves its processes to keep pace with changes from the central fund. The fact that the results show a high level of satisfaction reflects a narrowing of the "Service Gap" between students' expectations and their actual perceptions, in line with the concept proposed by Parasuraman, Zeithaml, and Berry (1985).

2. Comparison of satisfaction levels in the services provided by the Student Loan Fund Office of Nakhon Ratchasima College, classified by gender and academic year. The findings revealed significant differences. Male students reported higher satisfaction with the quality of services than female students. The finding that male students reported significantly higher satisfaction than female students (at the 0.05 level) can be analyzed through the lens of consumer behavior psychology. It suggests that different genders employ distinct perceptual processes; female students may place a greater emphasis on meticulous documentation and information accuracy, leading to more rigorous evaluations of service quality. This result is consistent with the study of Jungkitjaroenpaisan (2009), which found that male students expressed higher satisfaction than female students in welfare loan services. It reflects that gender remains a demographic factor influencing service satisfaction in higher education.

Regarding academic year, First-year students reported the highest satisfaction levels, which may be attributed to the college's Proactive Service policy designed to foster a strong 'First Impression'. This approach aligns with Customer Relationship Management (CRM) principles, focusing on building long-term loyalty from the initial point of contact. New students typically receive intensive guidance through the current e-Student loan system, whereas senior students might perceive improvements less intensely due to prior experiences with older procedures.

Moreover, the fact that first-year students reported higher satisfaction than senior students may be attributed to differences in experience with the online system (e-Student loan). New students typically receive immediate training in the current version of the system, whereas senior students may compare it with procedures or difficulties they encountered in the past. As a result, the perception of service quality improvements may be less pronounced among senior students than among newcomers. This finding regarding academic year is consistent with the concept of Customer Relationship Management (CRM), which emphasizes building satisfaction from the very beginning to foster long-term loyalty to the institution. It also aligns with the operational approach of the Student Loan Fund, which focuses on ensuring equitable access to educational opportunities from the very first step into university life.

3. Comparison of satisfaction levels in the services provided by the Student Loan Fund Office of Nakhon Ratchasima College, classified by age and academic performance. The findings revealed no significant differences. Students of different age groups and academic performance levels reported similar satisfaction. From an academic perspective, this indicates that the Student Loan Fund Office of Nakhon Ratchasima College operates under the principle of “Equality of Service”, which is regarded as an ethical standard of the profession. The fact that the system and staff do not use academic ability as a criterion for differential treatment ensures a stable level of satisfaction across all groups of service recipients. This is consistent with the ideology of the Student Loan Fund, which emphasizes equal opportunity for everyone, and aligns with Millet’s (1954) principle of public service, which highlights equality among service recipients.

Suggestions

1. **Policy Level** The institution should integrate Digital Service Transformation into its strategic plan to fully support the evolving e-Student loan system requirements.

2. **Management Level** Service efficiency should be enhanced by implementing an online queue system or digital document pre-verification to reduce waiting times.

3. **Future Research** Qualitative studies involving focus groups with fourth-year students should be conducted to identify specific underlying issues related to their lower satisfaction scores.

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Ai Mension 2.2: A Comparative Evaluation Framework for Print-Ready 3D Model Generation from 2D Images

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Abstract

This article presents AI Mension 2.2 as a comparative evaluation framework for converting 2D images to printable 3D models via a unified AI-to-3D workflow. The study addresses a key limitation of current AI-to-3D systems: while many tools can generate realistic 3D outputs, the resulting models often lack consistency in terms of geometry, structure, size, and manufacturability. AI Mension 2.2 solves this by integrating four stages—input, image preparation, AI-powered 3D visualization, and printability/customer availability verification—within a modular system comprising engine connector layers, Blender-based standardization and quality assurance modules, and proof-based branding logic. The framework is designed to compare different build regimes, specifically single- and multi-image workflows, under a collaborative evaluation environment, rather than identifying a generally superior 3D modeling tool. The research highlights how varying input conditions impact geometric integrity, printability, and manufacturability. This article further suggests that AI-to-3D output should be evaluated at the workflow level, where build quality, technical validation, and usability in subsequent stages are collectively assessed. Instead of being separate, in this sense, AI Mension 2.2 offers a comparative manufacturing framework, a printability-focused quality assurance workflow, and a foundation for the future digital certification of verified AI-generated 3D assets.

Keywords: AI-to-3D, Image-to-3D, Print-ready Model, Blender QA, Additive Manufacturing.

Introduction

Artificial intelligence (AI) has significantly expanded the reach of 3D asset creation, enabling workflows that previously relied on specialized modeling expertise to start from sketches, concept art, photographs, or multiple-perspective references. This transformation impacts digital design, product prototyping, manufacturing, cosplay production, game assets, animation, and virtual media. Thai research also indicates that AI should not be viewed merely as a facilitating tool, but rather as a system that transforms learning, creativity, ethics, and workflow design through AI literacy, ethical governance, and human-AI collaboration (Madee, 2025; Nakburi & Leknoi, 2025; Porweerasunthorn & Phalasondhi, 2025). From this perspective, the importance of AI lies not only in accelerating content creation but also in transforming how creative and technical processes are organized, reviewed, and evaluated.

However, despite these advancements, a significant limitation of AI in 3D modeling remains unresolved. Realistic models often fail to produce or be modified in subsequent stages due to imperfect geometry, open surfaces, inconsistent scaling, unstable structures, weak wall thickness, excessive protrusions, or output incompatibility. Thai research on 3D printing design and optimization using Blender shows that successful implementation depends not only on modeling quality but also on design-informed preparation, mesh tuning, and technical readiness before deployment (Rasmidatta, 2022; Rangsoongnern et al., 2024; Charoensuk, 2026). In other words, the main problem is not whether AI can create three-dimensional shapes, but whether those shapes can be validated, standardized, and transferred to a practical manufacturing or delivery context with minimal modifications. The gap between visual realism and usability in the following stages is a significant research problem for both AI-to-3D studies and applied digital manufacturing.

This article addresses this problem by proposing AI Mension 2.2 as a comparative evaluation framework for creating printable 3D models from 2D images. Instead of replacing external AI tools, this framework creates a collaborative evaluation environment where results from various AI-to-3D systems are processed under the same conditions of input preparation, tool routing, technical standardization, printability evaluation, and output validation. Key features include a tool connector layer for linking multiple build tools. Blender's standardization and quality assurance modules for evaluating geometric and manufacturing readiness, and proof-based branding logic for linking verified results to future digital certifications, make AI Mension 2.2 function less as a standalone builder tool and more as a manufacturing and evaluation architecture designed to bridge the gap between built-only models and usable models.

Comparison is central to this study. Official documentation states that Meshy supports both single-image to 3D and multi-image to 3D transformation workflows, while Hyper3D Rodin Gen-2 supports both single-image and multi-image processing via coupling and merging modes (Meshy, n.d.; Hyper3D, n.d.). These capabilities make the use of both single-image and multi-image conditions within a shared evaluation framework appropriate. Therefore, this article argues that the value of AI-to-3D should be judged on next-stage readiness, such as geometric completeness, printability, output reliability, cleanup effort, and suitability for customer delivery, rather than solely on the novelty of the build itself. By positioning AI-to-3D comparative analysis within the general inspection

pipeline, AI Mension 2.2 offers a framework that can fairly, systematically, and more realistically evaluate different build regimes in a manner relevant to real-world production.

Research Objectives

This article has four objectives:

First, to develop AI Mension 2.2 into a structured comparative evaluation framework for transforming two-dimensional data into printable three-dimensional results within a shared AI-to-3D workflow. Second, to create a collaborative evaluation environment for comparing single and multiple AI-to-3D workflows under identical preparation, standardization, validation, and result evaluation conditions. Third, to assess the technical readiness of AI-generated 3D models by defining evaluation criteria related to geometric integrity, printability, and production readiness for use in manufacturing processes or customer delivery. Finally, to propose an evidence-based structure that can link verified technical results to digital certificates, micro certifications, or future AI-assisted 3D manufacturing capability certificates.

Literature Review

Generative Artificial Intelligence, Workflow Design, and Ethical Governance

Current Thai research views generative AI as a system requiring knowledge, ethical awareness, and process design, rather than its uncritical application. Madi (2025) emphasizes that integrating AI into Thai language learning should be understood through contemporary learning theories and ethical considerations. Meanwhile, Nakburi and Noknoi (2025) demonstrate that the ethical use of generative AI in research and academic writing depends on an understanding of AI, evaluative decision-making, and responsible practice. In a related approach, Porweerasunthorn and Phalasondhi (2025) propose the concept of embedding AI throughout the pre-production, production, and post-production stages, rather than using it as a separate technical tool. These studies are significant for current research because they affirm that AI should be considered as part of a systematic workflow, subject to human oversight, decision-making, and accountability.

This perspective directly supports the AI Mension 2.2 concept, which is not designed as a standalone output-generating tool but as a comparative evaluation framework operating within a structured workflow. This framework also assumes that the value of AI-generated results depends on how they are prepared, overseen, validated, and integrated into subsequent production stages. Beyond simply generating results, Thai research on AI literacy, ethical governance, and workflow design provides a conceptual foundation for understanding why AI-to-3D systems should be evaluated not only on the quality of their output but also on the structured processes and responsible implementation.

Research on 3D Modeling and Blender Use in Thailand

Thai research on 3D modeling supports arguments from both technical and production perspectives. Rangsoongnern et al. (2024) found that Blender add-ons can improve the performance of 3D models for metaverse applications by reducing file size, mesh complexity, material load, and rendering load, while simultaneously increasing productivity. Phattanapiphat and Choithongmun (2024) demonstrated that 3D modeling for

Bayonetta cosplay costumes requires careful asset development, technical refinement, and expert review before the results are suitable for use. Charoensuk (2026) also highlights the historical evolution of 3D modeling technology through CAD, NURBS, subdivision methods, and AI integration, while identifying ongoing challenges in linking digital modeling processes to actual production.

Overall, this research suggests that 3D results should not be evaluated solely on their appearance, but should also consider performance, structure, adaptability, and practical usability. This concept is highly relevant to AI Mention 2.2, as this framework is designed based on the same assumption: that AI-generated 3D results must be standardized, verified, and prepared before being considered ready for printing or delivery to the customer. Therefore, Thai research on Blender and 3D manufacturing directly supports the framework's emphasis on post-construction evaluation and technical readiness.

Printability and Additive Manufacturing

Printability is a key issue in AI Mention 2.2, particularly in the PR4 phase. Rasmidatta (2022) argues that successful 3D printing depends more on design constraints, manufacturing awareness, and systematic preparation than on image quality alone. This is supported by Sayin et al. (2025), who show that even if 3D models can be successfully generated from image data, dimensional inaccuracies and manufacturing sensitivity still require post-processing, validation, and parameterized evaluation. Their molten deposition modeling workflow demonstrates that nozzle diameter, layer thickness, wall thickness, printing speed, and fill ratio all influence the final usability of the printed model. Furthermore, industry evidence reported by PR Newswire (2026) indicates that 3D printing from photos remains susceptible to geometric instability, segmentation irregularities, brittle structures, and unreliable support behavior.

These studies are directly relevant to the current research because they confirm that printability is not guaranteed by successful model building alone. Conversely, manufacturing-oriented evaluation should be considered a post-process requiring explicit verification and correction. This is why AI Mention 2.2 features a standardization and quality assurance workflow using Blender. Therefore, the literature on additive printing and manufacturing supports the argument that evaluating AI for 3D should encompass manufacturability, export readiness, and real-world application conditions as key components of the research framework.

Multimodal and Multi-Perspective 3D Reasoning

Research on multi-format and multi-perspective reasoning provides strong support for the comparative logic of AI Mention 2.2. Biehler et al. (2025) considered 3D modeling as a multi-format fusion problem, demonstrating the ability to recreate 3D shapes from 2D images along with diverse process information in the context of additive manufacturing. Their work is relevant because it shows that robust 3D modeling benefits from integrating image inputs with structured supplemental information rather than relying on isolated single signals. Hu et al. (2025), although working more in the field of medical image segmentation than consumer 3D AI modeling, showed that multi-perspective swarm learning preserves richer spatial semantics and improves structural understanding

compared to single-perspective estimation. Sun et al. (2025) extended this concept industrially by incorporating neural network rendering and model extraction for digital twin scene modeling, demonstrating that multi-angle RGB capture and subsequent geometric matching can be integrated into an efficient scene reconstruction pipeline.

Overall, this research supports the core methodological hypothesis of AI Mension 2.2: different input regimes should be evaluated as different analysis conditions. Instead of categorizing them into a single, indistinct category of AI creation, this also supports the idea that more complete input structures and post-construction justifications can improve the reliability of 3D results. This is why the present study compares single- and multiple-image workflows within a collaborative evaluation environment. Multimodal and multi-view literature is therefore fundamental both for comparative design and interpretation at the workflow level of this framework.

Digital Badges and Microcredentials

AI Mension 2.2 also incorporates evidence-based badge logic, an aspect supported by Thai research on digital qualifications. Thammametha (2025) demonstrates that Thai MOOCs have begun integrating microcredentials and digital badges into lifelong learning pathways, reflecting a broader shift towards more flexible and adaptable certification systems. Hencharoenlert et al. (2023) propose a blockchain-based microcredential model for secure and verifiable certification, highlighting how evidence-based certification can be made more transparent and trustworthy through digital systems. This research indicates that qualifications are no longer limited to traditional degree structures but can be linked to specific competencies, verified results, and more portable digital records.

This literature is relevant to AI Mension 2.2 because the framework aims not only to validate 3D models but also to verify the user's competence through evidence-based results. By linking verified technical results to a badge-focused structure, AI Mension 2.2 extends the logic of quality assurance to the realm of digital certification. Thus, documentation on microcredentials and digital badges explains why the framework includes a layer of evidence beyond the creation and verification components, and why such a structure may be critical to future professional recognition in AI-assisted 3D manufacturing.

Conceptual Framework of AI Mension 2.2

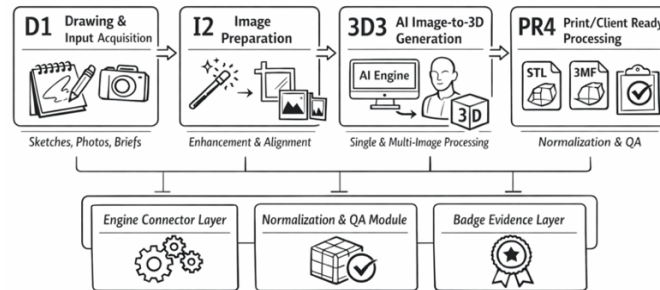


Figure 1. Conceptual Framework of AI Mension 2.2 Workflow

The AI Mension 2.2 framework is based on the assumption that the quality of AI-to-3D implementations should be evaluated at the workflow level rather than just at the fabrication stage. This framework is derived from a synthesis of knowledge from four complementary domains: AI literacy and ethical workflow design (Madee, 2025; Nakburi & Leknoi, 2025; Porweerasunthorn & Phalasondhi, 2025), 3D modeling and fabrication studies using Blender (Rangsoongnern et al., 2024; Charoensuk, 2026), printability verification and additive manufacturing (Rasmidatta, 2022; Sayin et al., 2025), and evidence-based digital authentication (Thammametha, 2025; Hencharoenlert et al., 2023). These domains are combined to create a framework that does not view AI-generated 3D outputs as separate visual results, but as an integral part of a traceable manufacturing process. Comparable and technically verifiable.

The framework comprises four operational steps: D1: Drawing and Input. Record initial input such as sketches, concept art, photographs, or structural outlines to maintain design intent and workflow traceability. I2: Image Preparation. Refine 2D input for subsequent creation through processes such as enhancement, masking, perspective alignment, style alignment, and orientation preparation. In a single-image workflow, this step emphasizes clarity and object separation, while in a multi-image workflow, it focuses on perspective consistency and structural consistency. 3D3: AI 3D Visualization. Send the prepared input to an external engine via an engine connector layer. In the current comparative design, Single-image workflows are represented by Meshy image-to-3D, while multi-image workflows are represented by Hyper3D Rodin Gen-2. Official documentation states that Meshy supports both image-to-3D and multi-image-to-3D conversion workflows, while Hyper3D Rodin Gen-2 supports multi-image processing via concat mode for capturing multiple views of the same object and fuse mode for unified feature extraction (Meshy, n.d.; Hyper3D, n.d.).

A prominent step in the framework is PR4: Print-Ready/Customer-Ready Processing, where a headless Blender-based workflow performs calibration, scaling, and axis correction, origin adjustment, mesh validation, geometry validation, wall thickness analysis, overhang inspection, spacing estimation, and output file generation. The goal is to convert the raw AI output into usable files such as GLB for previewing and STL/3MF for additive manufacturing. Beyond these four steps, AI Mension 2.2 also includes three

additional support modules: the Engine Connector Layer, the Calibration and Quality Assurance Module, and the Seal Proof Layer. These components together create a collaborative evaluation environment where results from various AI-to-3D tools are processed under identical preparation, verification, and evaluation conditions in subsequent steps. In this sense, AI Mension 2.2 serves as an AI-to-3D framework focused on comparison, production, and validation, rather than a single, specialized modeling tool.

Research Method and Design

Research Design

This research employs a comparative design framework combined with a mixed evaluation approach. The empirical design is divided into two stages. The first stage is a use-based comparison, which aligns single-image and multi-image generation processes with actual implementations, reflecting the real-world scenarios where different AI tools are selected based on the completeness and structure of the provided image data. The second stage is a control comparison, using the same data type for more than one tool to mitigate bias caused by data asymmetry. This step is necessary because both Meshy and Hyper3D formally support multiple input modes (Hyper3D, n.d.; Meshy, n.d.).

To ensure clarity and validity in the comparisons, the same end-evaluation environment was used for all samples. The process involved the following steps: (1) collecting and classifying 2D input images; (2) assigning samples to single- and multi-image workflows; (3) generating preliminary 3D outputs via the chosen AI engines; (4) processing all outputs through the same standardization and quality assurance procedures using Blender; (5) recording relevant evaluation metrics related to geometry, printability, and production readiness; and (6) interpreting the findings in relation to the four research objectives. This design allows for comparative studies of different AI-to-3D conditions without changing the validation criteria in the next step.

Sample Design

The proposed benchmark comprises four object categories: character and distinctive forms; solid-surface objects; household products and utensils; and decorative or collectible models. These categories were chosen because they represent different geometric and manufacturing challenges. Characters emphasize natural form and continuity; solid-surface objects emphasize structural accuracy; products emphasize proportion and manufacturability; and collectibles often combine aesthetic detail with printability. The inclusion of these categories allows this study to reflect a wider range of use cases in AI-powered 3D modeling, rather than relying on a single object type or geometry.

Comparative Arms

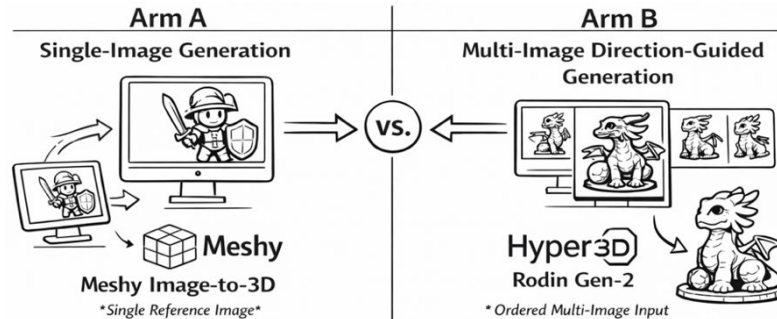


Figure 2. Two main comparative arms

This research defines two main comparison groups: Group A, representing single-image rendering using Meshy image-to-3D; and Group B, representing oriented multi-image rendering using Hyper3D Rodin Gen-2 with multiple images sequenced as input. Where necessary, additional fairness control conditions may be added by using both platforms with the same input format, whether single or multiple images (Hyper3D, n.d.; Meshy, n.d.). This structure aims to clarify whether differences in output quality arise from the engine itself, the input conditions, or the interaction between the two factors.

Workflow Procedure

The evaluation was conducted in four dimensions. Geometric integrity comprised waterproofing, asymmetrical impact, open boundary detection, directional alignment, and standardization scaling. Printability comprised minimum wall thickness, protrusion risk, support requirements, assembly spacing, and successful STL/3MF file export. Production readiness comprised successful GLB file export, UV readiness, surface integrity, cleaning time, and first build time. Expert evaluation comprised visual accuracy, geometric consistency, printability, and suitability for customer delivery.

These dimensions directly align with the research objectives. Geometric integrity and printability are technical comparisons of AI-generated results. Production readiness reflects the practical usability of those results for production or delivery, and expert evaluation supports the interpretation of verified results relevant to future brand-focused certifications. Descriptive comparisons across these dimensions were used to systematically organize the findings, while expert judgments were employed to support interpretations beyond mere visual impressions. This structure aligns with the metric-based reconstruction evaluation in multi-faceted 3D modeling and with production-focused studies that rely on systematic measurement and expert verification. Instead of considering only visible characteristics (Biehler et al., 2025; Sayin et al., 2025).

Research Findings

The findings of this study are organized in relation to the four research objectives.

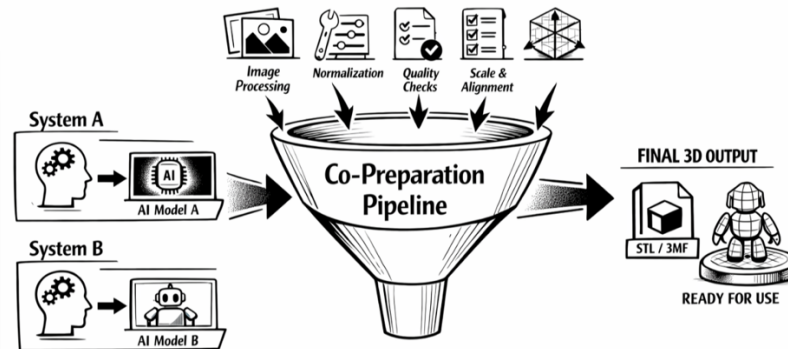


Figure 3. AI in 3D Pipeline Workflow

Firstly, this study confirms that AI Mension 2.2 can be described as a coherent comparative framework comprising four operational steps: input, image preparation, AI 3D visualization, and print-ready/customer-ready processing, supported by the Engine Connector Layer, Normalization and Quality Assurance Module, and Badge Evidence Layer. These components collectively form the framework's structural basis and clarify how diverse AI-to-3D outputs are processed within a shared evaluation environment, rather than being interpreted as separate generation outcomes.

Secondly, the comparative application of the framework demonstrates that single and multi-image workflows should be considered as distinct analysis conditions within a shared endpoint pipeline. Single-image conditions are better interpreted as a faster generation path, while multi-image conditions provide richer directional information for structural comparisons and reduce ambiguity in shape interpretation. This distinction is consistent with studies on multi-perspective reasoning, which suggest that directional inputs maintain richer spatial meaning and improve structural understanding (Hu et al., 2025; Sun et al., 2025). Therefore, a key finding of the study is that... AI-to-3D comparisons become more meaningful when performed within the normal workflow of preparation and standardization. And evaluation goes beyond considering visual results alone.

Thirdly, the findings suggest that technical evaluation must extend beyond build quality and include usability criteria in subsequent stages. The framework identifies four key evaluation dimensions: geometric integrity, printability, manufacturability, and expert evaluation, which are necessary to assess whether AI-generated 3D models are suitable for production or delivery to customers. In particular, printability cannot be assumed based solely on visual realism. Previous research has shown that even with successful 3D model creation from image data, dimensional inaccuracies and manufacturability persist, necessitating systematic post-processing and parameter evaluation (Sayin et al., 2025). Industry evidence also underscores the practical importance of wall thickness, slicer program stability, support construction, and geometric reliability for practical applications

(PR Newswire, 2026). These findings support the role of PR4 as a technical checkpoint within AI Mension 2.2.

Finally, the study suggests that evidence-linked certification is a practical extension of technical verification by documenting workflows, verification status, and technical outcomes of each model, giving rise to this framework which serves as the basis for linking model readiness to digital microcredentials. Or, in the future of competency certification, Thai research on digital and microcredential certification shows that validated badge systems are becoming more feasible in the educational and professional ecosystems (Thammametha, 2025; Hencharoenlert et al., 2023). In the context of AI Mension 2.2, this means that validated 3D results can not only be used as production assets but also as indicators of user competence. Overall, these findings demonstrate that this framework contributes not only to the evaluation of AI against comparative 3D models but also to the design of a broader production and certification environment for AI-generated 3D assets.

Conclusion and Discussion

AI Mension 2.2 shifts the perspective on AI-powered 3D modeling from mere visualization to a process of creation, standardization, technical validation, printability, and usability with minimal manual modification. A key highlight is its proposed workflow structure, where the focus isn't on realistic model appearance, but on the ability to pass standardization, printability evaluation, and subsequent deployment with reduced manual correction. This aligns with Thai research on AI literacy and ethical use, 3D manufacturing using Blender, multifaceted and multi-perspective reasoning, and additive manufacturing studies emphasizing real-world manufacturing constraints (Madee, 2025; Nakburi & Leknoi, 2025; Rangsoongnern et al., 2024; Biehler et al., 2025; Hu et al., 2025; Sayin et al., 2025). In this sense, the novelty of AI Mension 2.2 lies not in introducing a separate, independent AI tool, but in the integration of creation, standardization, technical validation, printability, and evidence-based certification. Incorporating it into a shared comparative workflow:

The development of AI Mension 2.2 can be interpreted as four stages: receiving structured input, image preparation, AI 3D visualization, and checking for printability/customer readiness. Its performance is verified through a comparative workflow design, where different AI 3D creation conditions are processed under the same end-environment. This shared evaluation setup reveals that one of the major problems with AI-generated 3D content is the inconsistency between visual realism and technical usability. Raw results may appear credible but still fail in mesh integrity, printability, or production readiness. This framework addresses this by introducing Blender-based standardization and quality assurance as common checkpoints, reducing comparative ambiguity and improving the interpretability of the results.

From a technical perspective, the framework also clarifies how to resolve several recurring problems. Input asymmetry is addressed by separating single and multiple image workflows into different analysis conditions. Geometric instability is managed through standardization and mesh verification. And with print-focused validation in PR4, workflow fragmentation is mitigated by the Engine Connector Layer, enabling processing of different AI engines under comparable end-conditions. Finally, the difficulty in linking technical

results to user capabilities is addressed through the Badge Evidence Layer, providing the basis for evidence-based certification. The practical benefit of these solutions is the transformation of AI-generated 3D output from isolated experimental artifacts into assets that can be evaluated, improved, and potentially certified within a scalable manufacturing environment.

From a platform perspective, this framework is also commercially relevant. Research on evaluating additive manufacturing providers shows that the 3D manufacturing ecosystem increasingly relies on the availability of digital models, outsourcing decisions, and provider evaluation criteria, underscoring the need for reliable print-ready validation and structured service integration within scalable AI-to-3D systems (Pourhejazy et al., 2025). From an academic perspective, AI Mension 2.2 provides a clear foundation for future benchmarking by defining what should be compared, how comparisons should be conducted, and why workflow-level evaluation is important, rather than claiming one tool is superior in every case. This framework suggests that different AI tools may be better suited to different input conditions when evaluated within the same technical architecture and validation process.

At the same time, this study has limitations. The article develops and interprets the conceptual framework at a comparative and analytical level, but it does not present a large-scale empirical benchmark encompassing all possible tools, object classes, printers, and materials. Furthermore, printability may vary depending on slicing setup, production equipment, and production context. Therefore, the current findings should be interpreted as a structured conceptual framework with analytical support rather than a universal ranking of AI tools for final 3D modeling. Nevertheless, the study demonstrates that AI Mension 2.2 offers a meaningful approach to evaluating AI-generated 3D models through a shared, production-oriented, and validated workflow.

Suggestions

Future research should conduct more comprehensive empirical comparisons using the entire dataset across both comparison groups and incorporating real-world printing experiments for selected outcomes. Additional AI-to-3D tools should be added to test the usability and interoperability of the framework on a broader scale. Beyond tool comparisons, future research should refine the Badge Evidence Layer into a standardized identity structure compatible with the broader digital certification ecosystem. Furthermore, investigating how different manufacturing settings, materials, and cutting conditions affect the relationship between technical verification and actual production performance would be beneficial. These developments will strengthen the empirical foundation of AI Mension 2.2 and expand its relevance in both academic comparisons and practical applications.

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A Comparative Study of the Marketing Mix and Hotel Guests' Decision-Making in Sung Noen District, Nakhon Ratchasima Province

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Abstract

The objectives of this research were to: (1) compare the marketing mix and decision-making of hotel guests in Sung Noen District, Nakhon Ratchasima Province, and (2) examine differences in marketing mix factors influencing decision-making classified by personal factors. The population included guests staying in Sung Noen District from January 1 to March 31, 2025. A sample size of 385 was determined using Cochran's formula (1977) for an unknown population with a 95% confidence level. Data were collected via convenience sampling and analyzed using descriptive statistics, independent samples t-test, and one-way ANOVA.

Findings revealed that the overall marketing mix influence was at a high level ($\bar{x} = 3.72, SD = 0.39$). Factors ranked by importance were: physical evidence, promotion, price, process, place, people, and product. Hypothesis testing showed no statistically significant differences in opinions across gender, education, or occupation ($p > .05$). This study contributes a localized perspective on how historical-industrial hybrid zones like Sung Noen impact hospitality marketing, advancing beyond general urban studies.

Keywords: Marketing Mix, Decision-Making, Hotel Guests, Sung Noen District

Introduction

Tourism is a cornerstone of Thailand's economy. Nakhon Ratchasima (Korat) serves as the gateway to the Northeast, welcoming 11.5 million tourists in 2022. Sung Noen District is unique, housing the ancient cities of Korat and Sema while evolving into a modern industrial hub. While previous studies focus on major cities like Chiang Mai, this research addresses a gap in understanding guest behavior in a high-growth industrial-historical transition zone.

Hotel business in the sense of industry type. This activity includes short-term accommodation and related services, which are general services that are included in the accommodation price, such as breakfast, in-room dining, and more. Most hotels will

provide other services such as parking, food, beverages, entertainment, and a swimming pool. Banquets, Conferences and Conference Facilities (National Statistics Office, 2009, p. 301)

From the above. As a result, the hotel business has an increased expansion rate and fierce competition to meet the needs of customers, so the hotel business must be prepared in various aspects to impress tourists who have visited and want to come back for more. Location and size of the hotel. The services of all employees must be of high quality to meet the standards to meet the needs of customers or visitors and achieve maximum satisfaction. Nakhon Ratchasima Province, also known as "Korat", is like the gateway to the Northeast region, about 259 kilometers from Bangkok. It is a large city in a highland that is rich in resources and tourism facilities. Visitors can enjoy a variety of tourism activities such as hiking, nature education, and recreation by the reservoir. Appreciate the grandeur of the ancient Khmer civilization and learn about the folk culture, as well as enjoy authentic Isaan cuisine. Before returning, they also bought agricultural products and folk handicrafts to choose from. The word Nakhon Ratchasima is formed from the combination of the names of two ancient cities, Korat and Sema, which are located in the district of Sung Noen. At present, Nakhon Ratchasima is home to many ancient communities from prehistoric times to the time when Dwarakadas culture and Khmer culture were spread to this area. It used to have the status of "Chao Phraya Maha Nakhon City," like the city of Nakhon Si Thammarat in the South, and has the power to rule many small and large cities in Isaan. Transportation. In 2022, Nakhon Ratchasima province had a total of 11.5 million tourists. It is the second largest in Thailand. Generating revenue of approximately 33 million baht (Nakhon Ratchasima Provincial Statistics Office, 2024) and areas and tourist attractions in Nakhon Ratchasima Province. There are various forms of tourism, such as nature tourism. Historical and Cultural Tourism. Integrated tourism has led to diverse travel behaviors based on the above priorities. Therefore, the researcher was interested in conducting research on the comparison of the marketing mix and the decision to use the service of hotel guests in Sung Noen District. Nakhon Ratchasima Province. The result. The study will guide the development and improvement of factors that affect the decision of hotel guests in the Sung Noen district. Nakhon Ratchasima Province Next.

Research Objectives

1. To compare the marketing mix and the decision-making of hotel guests in Sung Noen District, Nakhon Ratchasima Province.
2. To examine the differences in marketing mix factors influencing hotel guests' decision-making, classified by personal factors.

Literature Review

Yosrikhun (2021: Abstract) has conducted a study on factors affecting the choice of hotel accommodation in natural tourism areas in Nakhon Ratchasima Province. The purpose of the study is to study and compare the factors affecting the choice of hotel accommodation in natural tourism areas in Nakhon Ratchasima Province, classified

according to personal factors, and to propose guidelines for the development of factors affecting the choice of hotel accommodation in natural tourism areas in Nakhon Ratchasima Province. The results showed that 1) factors affecting the choice of hotel accommodation of Thai tourists in natural tourism areas in Nakhon Ratchasima province; The overall level is very high, in descending order. 2) Thai tourists with different genders and average monthly incomes. There is an opinion that the factors affecting the choice of hotel accommodation of Thai tourists in the natural tourism area in Nakhon Ratchasima province. 3) Guidelines for the development of factors affecting the choice of hotel accommodation in natural tourism areas in Nakhon Ratchasima Province (1) In terms of location, entrepreneurs should pay attention to the location of the hotel should have beautiful scenery, close to tourist attractions, and not too far from the community or service place, and tourists can travel to their accommodation conveniently. Sabai (2) Service Process Operators should focus on listing their properties through a variety of channels and managing services with convenience in mind. Comfort is important (3). Price Operators should set prices that are suitable for the quality of service and clearly communicate or inform customers or visitors. (4) Marketing Promotion Entrepreneurs should organize regular marketing promotion activities and communicate with customers through various channels. Operators should pay attention to the cleanliness of their rooms and accommodation areas. In-room amenities include a TV and a refrigerator. (6) Physical characteristics Operators should set up an atmosphere and choose a location with good weather and quiet. There is adequate equipment and facilities such as Wi-Fi, swimming pools, etc. Operators should supervise service staff with a smile, cheerfulness, politeness, and friendliness.

Tathapak (2019: Abstract) has conducted a study on the needs of tourists in choosing accommodation or hotels in Mueang District, Maha Sarakham Province, with the aim of studying the satisfaction of Thai tourists who stay at 4 hotels in Mueang District, Maha Sarakham Province, to meet the needs of tourists. The results showed that 1) tourists were satisfied with the product at a high level; Most of them are satisfied with the knowledgeable and capable of providing services. The hotel has a decent number of rooms. The hotel is beautifully designed. 2) Tourists have a high level of price satisfaction, with most of them satisfied. 3) Tourists are satisfied with distribution channels to a great extent. Most of them were satisfied with booking rooms directly with the hotel and booking rooms via the Internet, respectively. Most of them are satisfied with hotel advertising through various media such as radio, billboards, magazines, pamphlets, etc.

Pratum (2019: Abstract) has conducted a study on the behavior of Thai tourists in choosing hotel accommodation. The objectives of the study were to 1) study the behavior of Thai tourists in choosing hotel accommodation in Mueang District, Chiang Mai Province, 2) Study the market mix of service factors in choosing hotel accommodation of Thai tourists in Mueang District, Chiang Mai Province, and 3) to study other factors in choosing hotel accommodation of Thai tourists in Mueang District, Chiang Mai Province. The results of the study showed that the market mix of services in choosing hotel accommodation for Thai tourists in Mueang District, Chiang Mai Province. The average

value of the service process was 4.03, followed by the average price of 4.00, the average of the individual was 4.00, the average of the product was 3.99, and the creation and presentation of physical characteristics had an average of 4.00. 3.93 In terms of distribution channels, the average is equal to 3.88. The average value of marketing promotion is equal to 3.58, respectively. As for the psychological factors that influence the choice of hotel accommodation of Thai tourists in the Mueang district, Chiang Mai province, it was found that the average perception was the highest, at 4.00. Secondly, the average learning aspect is equal to 3.92, and the average of demand and motivation was 3.78, respectively. Social factors influencing the choice of hotel accommodation by Thai tourists in Mueang District, Chiang Mai Province. It was found that the cultural aspect had the highest average of 3.40, followed by the family aspect with an average of 3.39, and the reference group with an average of 3.15, respectively. The results of the hypothesis test showed that the variables of gender, occupation, status, and monthly income Behavior in choosing hotel accommodation in Mueang District, Chiang Mai Province There was no statistically significant differences at the .05 level, age, and education level. Behavior in choosing hotel accommodation in the Mueang district, Chiang Mai province differed statistically significantly at the level of .05 The relationship between the factors of the service market mix and the behavior of choosing hotel accommodation in the Mueang district, Chiang Mai province, was found to be low. Regarding the behavior of choosing hotel accommodation in the Mueang district, Chiang Mai province, as a whole, it was found that there was a low level of negative correlation.

Sirichan (2018: Abstract) The Department of Consumer Behavior has conducted a study on consumer behavior that affects the decision to use hostel accommodation services in Mueang District, Chiang Mai Province. 1) To study the demographic characteristics of tourists using hostel accommodation services in Mueang District, Chiang Mai Province. 2) To study the behavior of tourists in the city district of Chiang Mai province to choose hostel accommodation services. 3) To study the difference between the demographic characteristics of tourist behavior and the market mix in choosing hostel accommodation services. Tourists using hostel accommodation services in Mueang District, Chiang Mai Province. The results of the study showed that the highest priority of the marketing mix was in terms of price, followed by service staff and physical environment. Hypothesis testing revealed different demographic characteristics of gender, domicile, age, education level, and occupation. There is a statistically significant difference in the choice of hostel accommodation at the level of .05 in terms of the behavior of tourists in terms of length of stay in Thailand and different purposes of stay. There was a statistically significant difference in the choice of hostel accommodation at the .05 level.

Narinya (2020): Abstract) has conducted a study on the opinions of tourists in deciding to stay at a hotel or resort in the Ubon Ratn Dam District, Ubon Ratn District, Khon Kaen Province. Study and compare tourists' opinions on deciding to stay at a hotel or resort in Ubon Ratana Dam District, Ubon Ratana District, Khon Kaen Province. Classification by personal factors. The results of the study showed that: 1) Tourists have opinions on whether to stay at a hotel or resort in the Ubon Ratana Dam area. In the big picture, at a high level. Sort the average in descending order. As follows: Location, service

process, price, marketing promotion, product, physical appearance, and personnel, respectively. There is no difference in opinions on deciding to stay at a hotel or resort in Ubon Ratn Dam District, Ubon Ratn District, Khon Kaen Province. 3) Tourists with different monthly incomes. There is no difference in opinions on deciding to stay at a hotel or resort in Ubon Ratn Dam District, Ubon Ratn District, Khon Kaen Province. 4) Tourists with different numbers of people who come to travel. There is no difference in opinions on deciding to stay at a hotel or resort in Ubon Ratn Dam District, Ubon Ratn District, Khon Kaen Province.

Research Method and Design

1. Scope of Content

This study focuses on synthesizing relevant concepts, theories, and previous research related to the marketing mix influencing hotel guests' decision-making. The framework of the study is based on the 7Ps marketing mix, which includes: (1) Product, (2) Price, (3) Place, (4) Promotion, (5) People, (6) Physical Evidence, and (7) Service Process.

The population of this study consists of hotel guests who stayed in Sung Noen District, Nakhon Ratchasima Province, during the period from January 1 to March 31, 2025. The sample size was determined using a formula for an unknown population, resulting in a total of 385 respondents.

1. Population: The population of this study consists of hotel guests staying in hotels located in Sung Noen District, Nakhon Ratchasima Province, between January 1 to March 31, 2025.

2. Sample Group: The sample group consists of hotel guests in Sung Noen District, Nakhon Ratchasima Province, during the same period (January 1 to March 31, 2025). Since the exact number of the population is unknown, the sample size was determined using the formula for an unknown population (Silpcharu, 2012: 46) at a 95% confidence level with a 5% margin of error. The calculation is as follows:

Formula

$$n = \frac{Z^2 P(1 - P)}{e^2} \dots\dots\dots(1)$$

Calculation

$$n = \frac{(1.96)^2(0.50)(0.50)}{(0.05)^2} = 384.16 \dots\dots\dots(2)$$

n represents the required sample size.

P represents the estimated proportion of the population, set at 0.50.

Z represents the confidence level, set at 95%

(which corresponds to a Z-score of 1.96).

e represents the maximum allowable error, set at 0.05.

Based on this calculation, the sample size for this research was set at 385 respondents. The study utilized probability sampling combined with convenience sampling (accidental sampling) techniques.

Table1. Distribution of Data Collection Sites and Sample Size

No.	Data Collection Sites (Hotels)	Sample Size	Remarks
1	Rombaramee Villa Hotel	77	
2	Green Villa Laguna Hotel	77	
3	The Loft Eco Hotel	77	
4	S&P Resort Hotel	77	
5	Rai Fan Pen Jing Hotel	77	
	Total	385	

The variables studied include:

- 1) Gender, Education Level, and Occupation of Hotel Guests in Sung Noen District, Nakhon Ratchasima Province
- 2) Marketing Mix: 1) Product, 2) Price, 3) Location, 4) Marketing Promotion, 5) Personnel, 6) Physical Characteristics, and 7) Service Process.
- 3) Marketing and Hotel Guest Decision Selection in Sung Noen District, Nakhon Ratchasima Province.

2. Research Process and Research Instrument

Step 1 Comparison of the marketing mix and service decisions of hotel guests in Sung Noen District, Nakhon Ratchasima Province

Step 2 Comparison of the marketing mix and service decisions of hotel guests in Sung Noen District, Nakhon Ratchasima Province by personal factors

Population and Sample Group

The population of this study consists of hotel guests who stayed in Sung Noen District, Nakhon Ratchasima Province, during the period from January 1 to March 31, 2025. The sample size was determined using a formula for an unknown population, resulting in a total of 385 respondents.

Research Instrument

The data collection instrument consisted of a questionnaire divided into three sections. Section 1 addressed the general demographic characteristics of the respondents, employing a checklist format. Section 2 examined the marketing mix factors in relation to hotel guests' service selection decisions within Sung Noen District, Nakhon Ratchasima

Province, using a five-level Rating Scale. Section 3 solicited open-ended suggestions for hotel development and improvement.

Research Instrument Testing

The questionnaire underwent content validity review by three subject matter experts to assess content validity, and an Item-Objective Congruence (IOC) index was subsequently calculated. All items yielded IOC values ranging from 0.66 to 1.00. Reliability was then established through Cronbach's alpha coefficient method, producing a coefficient of 0.94. Before full deployment, the instrument was piloted (Try Out) with 30 Thai tourists residing at hotels in Sikhio District, Nakhon Ratchasima Province.

Data Collection

The researcher personally administered the questionnaires to the study population. A total of 385 completed questionnaires were returned, representing a 100% response rate.

Data Analysis

Data were analyzed using statistical software. Section 1 data were analyzed using frequency distribution and percentage. Section 2 data were analyzed using descriptive statistics, including means and standard deviations. Comparisons of hotel guests' opinions were conducted according to personal demographic factors using an independent samples t-test and a one-way analysis of variance (F-test / One-Way ANOVA).

Research Finding

A study comparing the marketing mix with the service decision of hotel guests in Sung Noen district. Nakhon Ratchasima Province.

Table 2. Comparison of the mean and standard deviation of the market mix with the decision of hotel guests in Sung Noen district, Overall, and Individual

Marketing and decision-making mix		Level		Meaning	Ranking
Hotel Guest Services		$\bar{x}$	S.D.		
1.	Product Aspects	3.65	0.38	Very	7
2.	Price	3.74	0.40	Very	3
3.	Location	3.69	0.39	Very	5
4.	Marketing Promotion	3.79	0.38	Very	2
5.	Personnel	3.66	0.39	Very	6
6.	Physical characteristics	3.81	0.38	Very	1
7.	Service Process	3.71	0.42	Very	4
Included		3.72	0.39	Very	

From Table 1, it is found that the marketing mix and the decision to choose the service for hotel guests in Sung Noen district. Nakhon Ratchasima Province Overall and Individual. It is at a high level ($\bar{x} = 3.72, SD = 0.39$). Sort the average in descending order. As follows: Physical characteristics ($\bar{x} = 3.81, SD = 0.38$). Marketing Promotion

($\bar{x} = 3.79, SD = 0.38$), Price ($\bar{x} = 3.74, SD = 0.40$), Service Process ($\bar{x} = 3.71, SD = 0.42$), Location ($\bar{x} = 3.69, SD = 0.39$), Personnel ($\bar{x} = 3.66, SD = 0.39$) and Product Aspects ($\bar{x} = 3.65, SD = 0.38$) respectively.

These results indicated that the Marketing Mix and Service Decision-Making of Hotel Guests in Sung Noen District, Nakhon Ratchasima Province. The overall marketing mix factors influencing hotel guests' service decisions were rated at a high level. Physical evidence emerged as the most influential factor. The findings for each dimension are presented as follows: Product (Accommodation Quality): The product dimension was rated at a high level. Guests indicated that in-room facilities—including televisions and refrigerators—were complete and well-maintained, that rooms were clean and tidy, and that the interior décor was aesthetically pleasing. Price: The price dimension was rated at a high level. Guests perceived that room rates were reasonable in comparison with competing accommodations, that the quality of rooms and services was commensurate with the price charged, and that pricing structures were transparent and clearly communicated. Place (Location): The location dimension was rated at a high level. Guests noted that the accommodation was conveniently situated in proximity to community amenities such as markets, restaurants, hospitals, and bus terminals; that access to the property was easy and convenient; and that the location was in proximity to tourist attractions. Promotion: The promotion dimension was rated at a high level. Guests reported that discounts were offered to returning customers, that value-added promotional packages such as complimentary breakfast were available, and that promotional activities were consistently communicated through multiple channels. People (Personnel): The personnel dimension was rated at a high level. Guests observed that staff members provided service with a welcoming demeanor, courtesy, and friendliness, and that all customers received consistently equal levels of service. Physical Evidence: The physical evidence dimension was rated at a high level. Guests noted that shared facilities and amenities—such as wireless internet (Wi-Fi) and a swimming pool—were adequate and well-equipped. Security systems, including CCTV surveillance and fire protection measures, were deemed appropriate. Additionally, the overall environment of the accommodation was perceived as highly secure, with well-lit entrances, perimeter fencing, and controlled access corridors. Process (Service Process): The service process dimension was rated at a high level. Guests found that information about the accommodation was readily accessible, that check-in and check-out procedures were convenient and efficient, and that reservations could be made through multiple channels, including telephone and online platforms.

The comparison of marketing mix perceptions and service decision-making among hotel guests in Sung Noen District, Nakhon Ratchasima Province, classified by personal factors, revealed the following: guests differing in gender, educational level, and occupation reported no statistically significant differences in their assessments of the marketing mix factors or in their hotel service decisions.

Conclusion and Discussion

The findings of this study regarding the marketing mix factors influencing hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province, are consistent with those of Narinya (2020), who examined tourists' opinions on accommodation selection at hotels and resorts in the Ubon Ratana Dam area. That study found that tourists' overall opinions regarding accommodation selection were at a very high level. The present study similarly found that all marketing mix dimensions influenced guests' service decisions at a high level. The findings are discussed by dimension in descending order of mean score as follows:

Physical Evidence. Physical evidence was found to be the dimension with the greatest influence on hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province. This finding is consistent with that of a 2019 study examining the behavior of Thai tourists in selecting hotel accommodation in Mueang District, Chiang Mai Province, which found that the physical evidence dimension of the service marketing mix was rated at a high level. The present study found that guests placed particular importance on the availability of adequate shared facilities and amenities—such as wireless internet (Wi-Fi)—as well as appropriate security systems, including CCTV surveillance and fire protection measures. The overall security of the accommodation environment was also highly valued, including well-lit entrance areas, perimeter fencing, and controlled access points.

Marketing Promotion. Marketing promotion was found to be a significant factor influencing hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province. This finding aligns with that of Tarpak (2019), who studied tourists' accommodation selection needs in Mueang District, Maha Sarakham Province, and found that tourists were highly satisfied with marketing promotion efforts. The present study found that guests valued the availability of reasonably priced promotional packages—such as complimentary breakfast—as well as the consistent communication of promotional activities through multiple channels.

Price. Price was found to be a factor that significantly influenced hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province, consistent with the findings of Sirichan (2017), who studied consumer behavior affecting the decision to use hostel accommodation services in Mueang District, Chiang Mai Province, and found that price was the most important marketing mix dimension. The present study found that guests considered room rates to be reasonable in comparison with competing accommodations, that room and service quality were commensurate with the price charged, and that pricing structures were clearly and transparently communicated.

Service Process. The service process was found to be a dimension that significantly influenced hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province. Guests placed importance on the ease of accessing accommodation information,

the convenience of check-in and check-out procedures, and the availability of multiple reservation channels, including telephone and online booking platforms.

Place (Location). Location was found to be a factor that significantly influenced hotel guests' service decisions. Guests particularly valued proximity to community amenities such as markets and restaurants, convenient access to the property, and closeness to tourist attractions.

People (Personnel). Personnel were found to be a factor that significantly influenced hotel guests' service decisions in Sung Noen District. Guests placed importance on staff who demonstrated a welcoming demeanor, courtesy, and friendliness, as well as on prompt service delivery and the consistent, equitable treatment of all customers.

Product (Accommodation Quality). The product dimension was found to be a factor that significantly influenced hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province. This finding is consistent with that of Narinya (2020), who studied tourists' opinions on accommodation selection at hotels and resorts in Ubon Ratana District, Khon Kaen Province. Guests in the present study valued the completeness of in-room facilities—such as televisions and refrigerators—the cleanliness and condition of rooms, and the overall aesthetic quality of the accommodation's interior décor.

Comparative Analysis by Personal Factors

A comparison of marketing mix factors influencing hotel guests' service decisions in Sung Noen District, Nakhon Ratchasima Province, classified by personal factors, revealed that guests differing in gender, educational level, and occupation reported no statistically significant differences in their assessments of the factors influencing service selection. These findings indicate that personal characteristics such as gender and occupation do not influence hotel accommodation decisions in Sung Noen District, Nakhon Ratchasima Province. This is consistent with the findings of Yosrikhun (2021), who studied factors affecting hotel accommodation selection in natural tourism areas of Nakhon Ratchasima Province and found that Thai tourists differing in gender and average monthly income expressed no significant differences in their opinions regarding the factors influencing hotel accommodation selection.

Suggestion

Suggestions for the implementation of research findings

1. **Product** Modernize in-room facilities such as water heaters and electronics.
2. **Price** Ensure rates remain competitive and transparently communicated.
3. **Location** Enhance accessibility and highlight proximity to local amenities.
4. **Promotion** Offer loyalty discounts and organize events during special festivals.
5. **Personnel** Focus on staff training regarding information provision and service psychology.

6. **Physical Evidence** Maintain adequate common facilities and high-standard security systems.
7. **Process** Diversify information and booking channels to reach more customers

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Botare Content Engine: A Process Innovation Framework for Integrated Marketing Strategy Formulation

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Abstract

This article develops Botare Content Engine as a process innovation framework for transforming fragmented content production into an integrated marketing strategy system in a social commerce environment. Using an action research-oriented single-case approach, the study explains how the framework integrates six core mechanisms: content taxonomy, product wave strategy, proof-first creative design, batch production, winner-only paid amplification, and CRM-driven retention. The findings show that these mechanisms help connect awareness, trust, conversion, and repeat purchase through pod-based execution, platform-role optimization, and integrated performance measurement. The article argues that Botare Content Engine reframes content from isolated communication output into an organizational capability for improving marketing efficiency, commercial coherence, trust formation, and sustainable growth in FMCG and e-commerce contexts.

Keywords: Botare Content Engine, Integrated Marketing Strategy System, Content Operations, Social Commerce, FMCG

Introduction

The digital marketplace has significantly changed how firms create and evaluate marketing value. In highly competitive FMCG and e-commerce environments, marketing effectiveness can no longer be judged by posting frequency or content volume alone. Consumer attention is now fragmented across short-video platforms, social media, marketplaces, live commerce, and messaging channels. As a result, firms need marketing

systems that connect awareness, trust, conversion, and repeat purchase rather than relying on isolated promotional activities.

This study is situated in the context of Botare Network Technology (Thailand) Co., Ltd., where the main managerial challenge was to improve the company's marketing workflow from a daily post-based model into an integrated marketing strategy system. The purpose of this improvement was to make content function not only as communication output, but also as a commercial asset that supports product prioritization, paid-media decisions, conversion, and customer retention.

The need for such transformation is supported by prior literature. Marketing strategy research emphasizes the alignment of organizational resources, market conditions, and target segments (Marketing strategy, 2021), while relationship marketing highlights trust, loyalty, and long-term customer value (Relationship marketing, 2021). Recent studies also show that digital marketing capability, content strategy, CRM, and AI-driven personalization are increasingly important for building integrated and adaptive marketing systems (Homburg & Wielgos, 2022; McKinsey & Company, 2024; Forsey, 2025).

Against this background, this article proposes Botare Content Engine as a process innovation framework for developing an integrated marketing strategy system. The framework combines content taxonomy, product wave strategy, proof-first communication, batch production, winner-only boost, and CRM-driven retention into a coordinated operating model designed to improve efficiency, build trust, and drive sustainable business growth.

Research Objectives

This article has three objectives.

First, it aims to develop Botare Content Engine as a process innovation framework for an integrated marketing strategy system. Second, it seeks to explain how the framework connects content production, platform roles, conversion, and retention into one coordinated operating model. Third, it offers practical implications for firms seeking to improve marketing efficiency, build trust, and achieve sustainable growth in FMCG and e-commerce contexts.

Literature Review

Prior literature suggests that effective marketing systems depend on strategic alignment, customer relationship quality, and coordinated execution. Marketing strategy research emphasizes that firms must align resources, capabilities, and market opportunities rather than rely on isolated promotional activity (Marketing strategy, 2021). Relationship marketing further highlights the importance of trust, commitment, communication, and long-term customer value, especially in digital and platform-based environments (Relationship marketing, 2021; Martins et al., 2025).

Content marketing literature also shows that content should be managed as a structured system rather than as a collection of disconnected posts. Content strategy involves planning, creation, publication, management, and governance, while funnel-based thinking requires different content forms for awareness, proof, conversion, and retention

(Forsey, 2025; Stricak, 2018). Thai studies similarly indicate that content relevance, credibility, and format significantly influence consumer decision-making in digital contexts (Kasem et al., 2023; Yaowarach, 2024; Deemek & Prommai, 2024).

Recent research further highlights the role of digital marketing capability, data, and agility in improving firm performance. Digital marketing capability contributes to profitability through scalability, measurability, adaptability, and interconnectivity, while agile marketing capability supports faster response, experimentation, and coordinated execution (Homburg & Wielgos, 2022; Moi & Cabiddu, 2021). In FMCG and e-commerce contexts, these capabilities are increasingly strengthened by big data analytics, CRM, and platform-specific optimization (Mukhopadhyay et al., 2024; Srisook et al., 2022).

Finally, AI-driven personalization and generative AI are becoming central to modern marketing systems. Prior studies show that AI can improve engagement, personalization, and purchase intention, but its effectiveness depends on transparency, governance, and customer trust (Alghaswyneh, 2025; Jith et al., 2025; Lou et al., 2025). Taken together, this literature supports the development of Botare Content Engine as a process innovation framework that integrates strategy, content operations, platform roles, conversion, and retention into a single marketing system.

Conceptual Framework

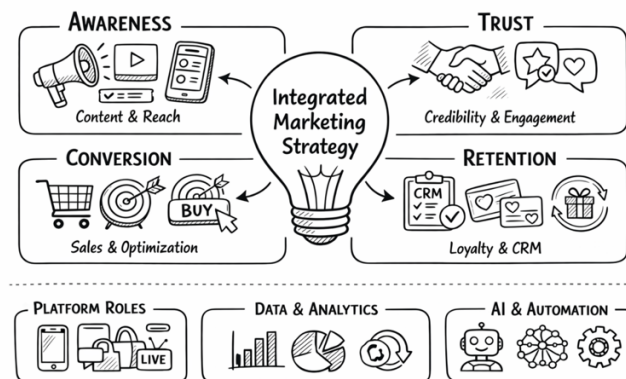


Figure 1. Conceptual Framework of FMCG integrated marketing strategy framework.

The conceptual framework of this study positions Botare Content Engine as an integrated marketing strategy system for FMCG businesses, built around four connected outcomes: awareness, trust, conversion, and retention. At the foundation of this framework is the idea that content should not be treated as isolated communication output, but as a structured managerial system that links customer attention, business priorities, and measurable performance. This logic is consistent with content marketing research showing that effective content must be designed around a clear target audience, marketing-funnel logic, useful and credible information, and channel-appropriate presentation to attract prospects and guide them toward purchase and repeat engagement (Kasem et al., 2023). The same study also emphasizes that content should sustain customer engagement and

support repeat purchase or referral, which makes it highly relevant to the awareness and retention layers of the Botare model.

At the cognitive and strategic intelligence level, this framework assumes that consumer goods marketing performance improves when companies leverage data and digital infrastructure to understand customer behavior, segment target groups, and support timely decision-making. Mukhopadhyay et al. (2024) describe how big data-driven Marketing 4.0 enables consumer goods companies to improve customer experience, foster repeat purchases, enhance market analytics, and support data-driven decision-making rather than relying on intuition. Their framework also emphasizes the role of content and recommendation optimization, campaign targeting, and real-time response generation in building a competitive advantage. For Botare Content Engine, this supports the idea that awareness is not just about reach, but about generating quality, data-driven interest that can later be converted into commercial value. These four domains are not independent stages but mutually reinforcing components of one system. To support them, the framework incorporates three enabling layers. The first is platform-role optimization, which assigns a distinct commercial role to each platform rather than treating all channels as interchangeable. The second is data and analytics, which provide the basis for evaluating content performance, identifying winners, tracking customer movement, and improving future decisions. The third is AI and automation, which enhance personalization, operational efficiency, content iteration, and decision support, while also requiring governance and quality control.

At the transformation and cross-functional implementation level, this framework considers digital marketing capabilities as more than just communication functions. Liang et al. (2025) demonstrated that digital marketing capabilities improve company performance by enabling companies to extract actionable customer insights, refine marketing activities, and generate business value. Importantly, their study also indicates that this capability impacts other business functions, particularly production and research and development, by embedding real-time marketing intelligence into organizational decision-making. This is highly relevant to the Botare Content Engine because the framework links content effectiveness not only to creative outcomes but also to product prioritization, operational coordination, and commercial actions. In other words, transformation in the Botare model depends on how effectively content insights are translated into product page availability, offering design, and customer-responsive systems.

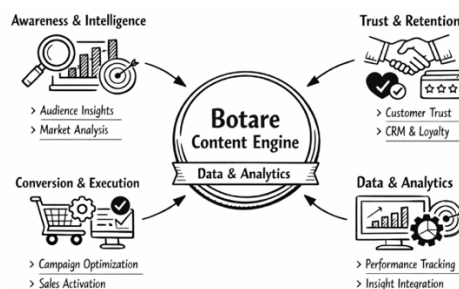


Figure 2. Conceptual Framework of Botare Model.

At the level of trust and customer retention, this framework assumes that long-term value depends more on the continuity of the relationship than on the success of the initial purchase alone. Previous research in relationship marketing and social commerce, as documented in the project paper, has shown that trust, quality of CRM communication, and post-purchase interaction significantly influence customer loyalty, repeat purchases, and purchasing decisions. This logic is supported by the content marketing research of Kasem et al. (2023), which explicitly states that content should create a positive impression, build brand engagement, and maintain customer relationships through relevant and timely communication. In Botare's framework, this is implemented through proof-focused content, CRM segmentation, and the customer retention cycle. Thus, the framework can be summarized as a system where content architecture drives perception, proof-building reinforces trust, role-based platform actions support transformation, and CRM follow-up retains customers, while data and analytics serve as the integration mechanism across all four stages.

Research Method and Design

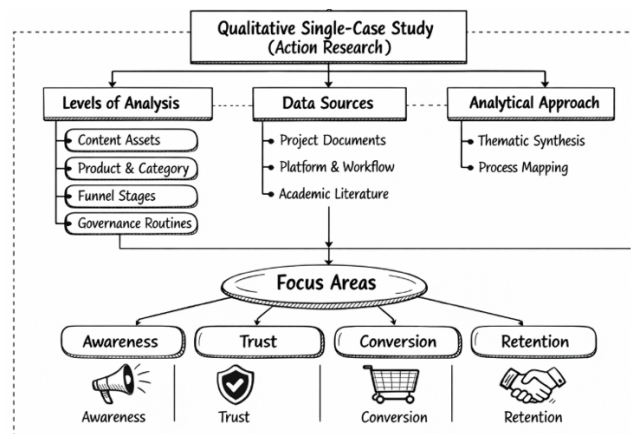


Figure 3. Diagram of Method and Design.

This research employs a qualitative, single-case study approach, emphasizing action research. This method is appropriate because the Botare Content Engine was developed to solve a real-world organizational problem and was refined through the practical actions of management, rather than being viewed as merely an external phenomenon. This research methodology allows the study to focus on the system's logic, implementation structure, and capacity development within the context. Similar logic is found in the research by Moi and Cabiddu (2021), which uses a case-study approach to describe how agile marketing capabilities are realized through speed, flexibility, transparency, collaboration, and customer engagement during digital transformation. Their research is relevant to this study because it demonstrates that marketing transformation

should be considered as an organizational process, not merely a change in communication tools.

The units of analysis in this research encompass four interconnected levels: content assets, product/category priorities, funnel stages, and governance stages. This structure reflects the view that digital marketing capabilities are interdisciplinary and cannot be reduced to isolated promotional outcomes. Homburg and Wielgos (2022) show that digital marketing capabilities are valuable because they are scalable, measurable, and adaptable. And interconnected throughout the organization. Liang et al. (2025) expand on this argument by showing that digital marketing capabilities affect company performance, in part, through their linkage to production and research and development capabilities. These studies support the current design because Botare Content Engine is examined not only as a content process but also as an integrated system linking strategy, implementation, and commercial outcomes.

This study draws data from multiple organizational sources and documents, including project documentation, workflow design, platform role logic, content architecture, management routines, and relevant academic literature. This source data structure is appropriate because the framework itself integrates content, data, and customer management. Mukhopadhyay et al. (2024) showed that Marketing 4.0 in FMCG relies more on big data, analytics, personalization, and decision support than on separate campaign activities. Kasem et al. (2023) similarly described how content marketing should be designed with audience clarity, funnel logic, credibility, and relationship building in mind. These studies support the integration of operational documents and literature to interpret the Botare Content Engine as a coordinated marketing decision-making system.

The analytical approach relies more on thematic synthesis and process mapping than on statistical hypothesis testing. This research identifies structural weaknesses in existing post-marketing workflows, then constructs a new framework through core mechanisms, and finally interprets those mechanisms through relevant theories. Performance is viewed in terms of awareness, trust, conversion, and customer retention, rather than using single metrics. This aligns with Srisook et al. (2022), who showed that digital marketing and social CRM influence customer decision-making, and with Vijitjan and Poon-Ead (2024), who demonstrated that trust and social media marketing significantly influence purchasing behavior. Therefore, the current approach is designed to describe how Botare Content Engine functions as an integrated marketing strategy system, while also providing a foundation for future quantitative analysis.

Conclusion and Discussion

This research concludes that Botare Content Engine should be understood as a process innovation framework rather than a routine content production approach. Its key strength lies in transforming content into coordinated marketing capabilities that link planning, execution, and business outcomes. This interpretation aligns with Homburg and Wielgos (2022), who demonstrated that digital marketing capabilities create value through their scalability, measurement, adaptability, and interconnectedness.

This framework also reinforces the argument that content must be strategically governed, not managed as separate posts. Forsey (2025) defines content strategy as a

system of planning, creating, publishing, managing, and governing, which closely aligns with the Botare Content Engine structure. Stricak (2018) further illustrates that content must align with the customer journey, supporting the framework's integration of awareness, trust, conversion, and retention.

From a relational perspective, this framework emphasizes that long-term growth depends on customer trust and continuity. Martins et al. (2025) demonstrated that trust, communication, and commitment foster loyalty, while Srisook et al. (2022) showed that digital marketing and CRM together shape customer decisions. Overall, Botare Content Engine offers a practical model for building more integrated, trust-focused, and sustainable marketing systems.

Suggestions

Companies should strengthen content governance and planning, as effective content systems require more systematic management than fragmented posting (Forsey, 2025). Additionally, platform alignment should be improved to align with roles and sales channel matching, as different content types support various customer stages (Stricak, 2018). Finally, organizations should invest in CRM and customer retention processes, as trust, continuity, and quality of customer relationships are crucial for long-term marketing effectiveness (Srisook et al., 2022; Martins et al., 2025).

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Bridging the Gap: Learning from South Korea's KOCCA Model to Build a Concrete Public-Private Partnership Framework for Soft Power Promotion in Thailand

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Abstract

This article aims to analyze the public-private partnership (PPP) institutional framework for soft power promotion in Thailand and to derive actionable reform principles through focused comparative analysis with South Korea's Korea Creative Content Agency (KOCCA) model. Since 2023, Thailand has intensified efforts to transform its cultural assets into global influence, primarily through the 'One Family, One Soft Power' (OFOS) initiative and the National Soft Power Strategy Committee (NSPSC). The analysis finds that, despite significant political commitment and investment, Thailand's PPP framework remains fragmented, legally ambiguous, and weakly institutionalized, marked specifically by the absence of a statutory lead agency, diffuse budgetary responsibility across more than fifteen government units, and the structural marginalization of private-sector actors to a consultative rather than co-governance role. At the same time, Thailand's findings reveal genuine foundational strengths, including a rich portfolio of internationally recognized cultural assets, cuisine, performing arts, festival culture, and a rapidly growing entertainment sector, alongside demonstrated political will and existing subcommittee structures that provide a basis for institutional reform. Drawing on comparative institutional analysis of South Korea's Korea Creative Content Agency (KOCCA), the article identifies three governance elements from these comparators that are most transferable to Thailand's institutional context: the establishment of a unified statutory lead agency with directive authority, the creation of a co-governed creative investment fund with structured private co-financing, and the implementation of a formal interagency

coordination protocol supported by systematic impact measurement. The article argues that selectively adapting these regional models to Thailand's administrative culture and political economy, rather than wholesale replication, offers the most viable pathway to converting Thailand's existing cultural strengths into coherent, accountable, and internationally competitive soft power outcomes.

Keywords: Soft Power, Public-Private Partnership, Creative Economy, National Soft Power, Strategy Committee (NSPSC)

Introduction

The concept of soft power, a state's ability to shape preferences and attract cooperation through cultural attraction, political values, and foreign policy legitimacy rather than through coercion or payment, has occupied an increasingly prominent place on the policy agendas of Asian governments since the early 2000s (Nye, 2021). Thailand's engagement with this concept has intensified substantially since 2023, when the Pheu Thai government formally established the NSPSC and launched OFOS, a flagship initiative to develop 20 million skilled creative workers across 11 priority cultural industries.

Thailand possesses significant soft power resources, including its cuisine, martial arts, festival culture, and entertainment industries. Notably, the 'Boys' Love' (BL) television drama genre and K-influenced Thai popular music have attracted substantial international audiences and generated economic value (Jin, 2024; Yoon, 2023). However, a persistent gap exists between governmental ambitions and implementation capacity. This gap arises from the lack of a coherent, legally grounded, and mutually accountable framework for public-private partnerships in soft power promotion.

This article addresses this institutional gap by arguing that the primary constraint on Thailand's soft power trajectory is not a lack of political will or cultural resources, but rather deficiencies in the institutional design of the PPP architecture. Accordingly, it proposes a reform agenda comprising three integrated pillars: establishing a unified statutory agency as the central authority, creating a co-governed creative investment fund to mobilize public and private resources, and developing an interagency coordination protocol to align efforts across ministries and private-sector stakeholders. Section two reviews the theoretical literature on soft power and creative economy governance. Section three examines Thailand's institutional landscape and its framework limitations. Section four examines South Korea's KOCCA model as a comparative institutional reference, selected for its documented success in building a coherent, agency-led PPP framework for soft power promotion. Section five develops the three-pillar reform framework. Section six considers implementation challenges, and section seven concludes.

This article employs a qualitative, document-based research design organized around three complementary methodological components: systematic literature review, policy document analysis, and comparative institutional analysis. Together, these methods enable a rigorous examination of Thailand's soft power PPP framework and the derivation of reform principles grounded in both theoretical scholarship and empirically documented institutional practice.

Soft Power, Creative Economies, and Public-Private Partnerships

Nye's (2021) retrospective account of soft power's conceptual evolution clarifies an important analytical distinction: soft power is a relational outcome—the capacity to shape others' preferences by attraction—not simply a stock of cultural assets. A country can possess abundant cultural resources while failing to convert them into influence if the institutional infrastructure for such conversion is absent. Nye emphasizes that credibility, consistency, and narrative control are essential intermediate mechanisms; cultural products that circulate without a coherent state narrative or enabling institutional architecture generate appreciation but not necessarily influence.

This conversion problem has attracted growing scholarly attention. Yoon (2023) examines the discursive construction of soft power in the Korean Wave context, demonstrating that state-sponsored framing and institutional investment interact dynamically with organic fan community activity to shape the international reception of cultural exports. The implication for policy design is significant: state institutions do not simply produce soft power; they create enabling conditions within which private creative actors generate it. The policy architecture must therefore be enabling, not directive.

Ohnesorge (2020) offers a complementary institutional analysis, arguing that the operationalization of soft power in practice requires states to develop what he terms “soft power infrastructure”, the agencies, funding mechanisms, and interorganizational networks through which cultural attraction is systematically cultivated and deployed. This infrastructure conception directly informs the institutional reform agenda proposed in this article: soft power promotion is not simply a question of choice.

Research on the creative economy identifies a central tension: while states provide strategic direction, creativity emerges from bottom-up processes. UNCTAD (2023) demonstrates that South Korea's post-1997 model was effective because the government adopted a “developmentalism” approach in partnership with chaebol, establishing priorities and providing funding through agencies like KOCCA; yet private actors maintained creative autonomy, as state-driven content initiatives were less successful due to the sector's need for “freedom and flexibility needed for artistic and cultural creation” (citing Otmazgin, 2011), whereas market-oriented and investment-based support yielded positive outcomes. This dynamic aligns with Thailand's challenges, where excessive state direction risks stifling private innovation.

Jakonen and Renko (2023) studied Finland and found that emphasizing industry outcomes fragments coordination when many ministries claim authority; Finland's split between the Education, Culture, and Economic ministries mirrors Thailand's situation and stresses the need for a single lead agency. The governance literature further differentiates between different modalities of PPP in creative industries. Casady et al. (2020) define PPPs in the new public governance (NPG) paradigm as arrangements characterized by genuine co-ownership of strategic objectives, shared risk and reward, and mutual accountability mechanisms, thereby sharply separating them from the more common consultation model in which private actors advise but do not govern. Thailand's current NSPSC subcommittee architecture resembles a consultative model: private-sector expertise is formally incorporated, but decision-making authority and budgetary control remain exclusively with the government.

Kim and Jin (2016) analyzed cultural policy in the Korean Wave context through a discourse analysis of presidential speeches, finding that explicit governmental framing of cultural industries as strategic national assets created durable political commitment that survived changes in administration. Their data show that the rhetorical and legislative embedding of soft power policy—not simply executive-level championing—is a prerequisite for the institutional continuity that effective PPPs require.

Thailand's Soft Power Institutional Landscape: Structures, Gaps, And Failures Governance Architecture and the NSPSC

Thailand's formal soft power governance architecture centers on the NSPSC, constituted by Prime Minister's Office Order No. 230/2023 in September 2023. The NSPSC is a forty-nine-member inter-ministerial body chaired by the Prime Minister, with representation from the Ministries of Culture, Higher Education, Tourism, and Commerce, among others. Its strategic framework identifies 11 priority soft-power industries and sets targets for the OFOS program, which aims to develop 20 million skilled creative workers, each earning at least 200,000 baht annually.

The NSPSC model reflects a state-centric conception of soft power promotion that sits in tension with the enabling-conditions model supported by the academic literature. As Yoon (2023) argues in the Korean Wave context, state-directed soft power promotion is most effective when it focuses on structural enablement, market access, co-financing, and infrastructure, rather than content prescription. The NSPSC's assignment of specific programmatic tasks to private-sector subcommittee members, as illustrated by the resignation of the fashion subcommittee in February 2024, suggests that Thailand's governance model has not yet resolved this fundamental design tension.

Institutional Fragmentation and Budget Diffusion

The Thailand Creative Culture Agency (THACCA), intended to serve as Thailand's equivalent of South Korea's KOCCA or Taiwan's TAICCA, has operated informally through the Strategic Transformation Office since early 2024, lacking formal legal status, an independent budget, and an established legal identity. In practice, THACCA has functioned as a budget distributor rather than a strategic actor, distributing funds to pre-existing government departments: film initiatives to the Department of Cultural Promotion, food programs to the Ministry of Industry, and so on across 15 or more organizational units.

This fragmentation is analytically significant. Jakonen and Renko (2023) identify 'barriers across administrative branches' as the primary structural impediment to effective creative economy policy, noting that fragmentation prevents cross-sectoral synergies and renders systemic impact assessment structurally impossible. Thailand's institutional architecture exemplifies this failure: parliamentary analysis found that total government expenditure on soft power initiatives across fiscal years 2024 and 2025 approached eight billion baht when all ministerial programs were aggregated, yet this figure was not visible in any single agency's accounts, making enforcement of accountability and planned prioritization effectively impossible.

Private Sector Engagement: Structural Marginalization

A central paradox of Thailand's soft power governance is the structural gap between the government's rhetorical celebration of the private sector as a source of cultural creativity and its practical exclusion of private actors from meaningful governance authority. The NSPSC subcommittee model includes private sector figures as domain experts or technical advisors, but does not grant them co-governance authority over strategy or budget. This arrangement reproduces what Casady et al. (2020) identify as a 'pseudo-PPP': a form of private-sector engagement that creates the appearance of collaboration while retaining exclusive governmental control over substantive decisions.

The consequences of this governance design are evident in program outcomes. For instance, the OFOS program aimed to train 10,000 Thai chefs in 2024 but achieved only 1,300 completions, representing approximately 13% of its target. Over the first two years of the four-year program, total training completions reached about 20,355, far short of the 20 million targets. This substantial gap reflects, among other factors, the absence of genuine private-sector co-ownership in program design and implementation. Industry professionals involved in consultation phases, but lacking governance authority, were unable to adjust program design when implementation challenges emerged.

Legislative Ambiguity: The THACCA Bill

The Thailand Creative Culture Agency Bill, drafted during the Srettha administration and held public hearings in 2024, represents the most important legislative effort to address Thailand's institutional fragmentation. As currently drafted, the bill would establish THACCA as a full statutory agency, transformed from the Creative Economy Agency, with authority to create strategic plans, administer a soft-power development fund, establish tax benefit frameworks for creative industries, and collect market intelligence.

However, the bill's passage has been repeatedly delayed by political transitions. Following the Constitutional Court's August 2024 ruling removing Prime Minister Srettha, THACCA's legislative trajectory was disrupted for several months. As of early 2026, the bill remains pending Cabinet approval and Council of State review. Kim and Jin's (2016) finding that legislative embedding—not simply executive championing—is a prerequisite for institutional continuity acquires particular urgency in this context: until THACCA achieves formal statutory status, Thailand's soft power governance architecture is essentially fragile.

The KOCCA Model: Institutional Lessons from South Korea **Institutional Architecture and Mandate**

South Korea's Korea Creative Content Agency (KOCCA), established in 2009 through the consolidation of three previously independent agencies, represents the most directly appropriate institutional comparator for Thailand's aspirations. KOCCA is affiliated with the Ministry of Culture, Sports, and Tourism and carries a unified mandate to support Korean cultural content industries across gaming, animation, television drama, film, music, and related sectors. UNCTAD (2023) characterizes KOCCA as the operational centerpiece of South Korea's neo-developmental cultural policy—the institutional node through which state strategic direction is translated into industry-level support.

Jin (2024) documents KOCCA's changing role in the digital platform era, analyzing how the agency has adapted its PPP model to address the increasing role of domestic and global internet platforms in cultural production and distribution. This adaptation is instructive for Thailand: an effective soft power agency cannot simply replicate mechanisms designed for the pre-streaming era, but must develop institutional relationships with global content platforms, streaming services, and digital distribution networks. KOCCA's formal co-production agreements with Netflix, Disney, and other global platforms—enabling Korean content producers to access international distribution at scale—illustrate what such institutional embeddedness can achieve.

Co-Investment and Financial De-Risking

KOCCA's most distinctive PPP feature is its co-investment model, which operates in partnership with the Export-Import Bank of Korea to provide direct loans to small cultural content companies. This model—in which the state structures and partially guarantees private investment rather than simply subsidizing state-directed production—produces a fundamentally different incentive structure from Thailand's current approach of distributing government budgets through government departments. Casady et al. (2020) identify co-investment risk-sharing as a defining characteristic of high-performing PPP arrangements, discriminating them from models in which risk remains with a single party.

The institutional logic of co-investment is that it simultaneously subjects cultural projects to market-discipline tests that pure government grants cannot impose and enables private investment in high-risk creative projects that market actors alone would not fund. UNCTAD (2023) traces this logic through the evolution of Korean cultural policy following the 1997 crisis, demonstrating that the government's willingness to absorb downside risk while preserving private sector creative autonomy was central to the Korean Wave's commercial success. The T-Wave Thailand's nascent cultural export phenomenon could similarly benefit from institutional arrangements that de-risk private investment without directing creative content.

Impact Measurement and Strategic Intelligence

A further distinguishing feature of the KOCCA model is its systematic investment in impact measurement and industry intelligence. KOCCA conducts annual surveys of global Korean content consumption, generating longitudinal data that inform strategic management and enable public accountability reporting. Jin (2024) analyzes how this intelligence function has been adapted to the digital platform era, with KOCCA developing new methodologies to track Korean cultural content across streaming platforms, social media, and global fan communities.

Thailand's current institutional architecture lacks a systematic intelligence function. Without baseline measurements of the international reach, audience profiles, and economic value of Thai cultural content, it is not possible to assess the return on public investment in soft power promotion or to make evidence-based strategic decisions. This gap, marked by significant investment and minimal accountability infrastructure, is precisely what an institutionalized THACCA with a formal intelligence mandate could address.

Toward A Concrete PPP Framework: A Three-Pillar Reform Agenda for Thailand

Building on the theoretical and comparative analysis presented in previous sections, this section proposes a three-pillar reform framework for Thailand's soft power PPP architecture. The framework is intended to address Thailand's specific institutional deficiencies while incorporating internationally validated governance principles.

Pillar One: A Unified Lead Agency with Genuine Legislative Mandate

The foundational reform is the expedited passage of a strengthened THACCA legislation. The current bill requires amendment in at least three respects. First, it should explicitly confer on THACCA not simply coordinative but directive authority over other agencies' soft power activities—meaning that ministries with partial soft power mandates must operate within THACCA-approved strategic systems. This is the mechanism by which South Korea's KOCCA achieves institutional coherence: its mandate from the Ministry of Culture, Sports and Tourism is sufficiently specific and influential to coordinate the activities of multiple sector-specific agencies).

Second, the legislation should consolidate all government soft power expenditure under a single THACCA budget line, even if funds are subsequently delegated to implementing agencies. The discovery that Thailand's total soft power investment approached eight billion baht across 2024-2025, yet remained invisible in any single agency's accounts, signifies a fundamental accountability failure that only consolidated budget authority can remedy. Casady et al. (2020) identify unified budget accountability as a prerequisite for effective PPP governance: without it, incentive alignment between public and private partners is structurally impossible.

Third, THACCA's governance board should include private-sector representatives with genuine co-governance authority—not simply advisory status. This means private-sector board members should be able to initiate budget proposals, block programs incompatible with industry realities, and hold THACCA management accountable for delivery. This structural redesign would convert THACCA's current 'consultation PPP' into the 'co-governance PPP' identified by the academic literature as most effective for creative industries (Casady et al., 2020).

Pillar Two: A Co-Governed Creative Investment Fund

The second pillar addresses Thailand's financing architecture. The current model, in which NSPSC budgets flow from government-to-government departments, with private-sector actors as recipients rather than co-investors, excludes the market discipline and co-ownership dynamics that the KOCCA model indicates are central to best-performing creative industry support. Thailand should establish a National Creative Culture Investment Fund structured around the co-investment principle.

The fund should require private sector co-financing for major project grants, analogous to KOCCA's Export-Import Bank partnership, with government contributions matched by private investment at a structured ratio. An investment committee with private-sector majority representation should govern the fund under a published investment policy statement that specifies sector allocation criteria, project selection methodology, impact measurement metrics, and exit provisions. Tax incentive mechanisms should be integrated

into the fund framework, creating a reinforcing incentive stack that makes private co-investment financially attractive. UNCTAD (2023) shows that this integrated incentive architecture—combining co-investment de-risking with beneficial tax treatment—was central to Korea's ability to attract sustained private investment in culturally valuable but commercially risky creative projects.

Pillar Three: A Formal Interagency Coordination Protocol and Impact Measurement Framework

The third pillar addresses coordination failures and accountability gaps. Even with a unified statutory agency, the multiplicity of government actors with legitimate roles in soft power promotion necessitates formal coordination mechanisms. Thailand should establish a Soft Power Interagency Coordination Protocol requiring each participating ministry to designate a senior soft power focal point with resource-commitment authority, and mandating THACCA to maintain a real-time soft power budget registry aggregating all government expenditure across agencies.

The impact measurement component should draw directly on KOCCA's annual intelligence model, adapted for Thailand's specific cultural asset profile. Thailand should invest in an annual Thai Creative Industries Survey measuring export revenues, international audience reach and demographics, employment generation, and the contribution of soft power initiatives to tourism and foreign direct investment attraction. Ohnesorge (2020) argues that systematic impact measurement is not simply an accountability mechanism but an essential strategic enabler: longitudinal data on cultural influence enable evidence-based strategy adjustment and provide the credibility signals that distinguish genuine soft power from mere cultural promotion.

Implementation Challenges and Political Economy Considerations

The proposed reform framework faces significant political economy obstacles that institutional design alone cannot resolve. Ministries and departments with established stakes in soft-power budget allocation will resist the consolidation of financial authority in THACCA, and the creation of a genuinely directive lead agency will require them to cede bureaucratic autonomy. This challenge is not unique to Thailand; Jakonen and Renko (2023) document similar ministerial resistance in Finland's experience with creative economy reform, but it requires an explicit political strategy alongside technical institutional design.

A second challenge concerns institutional continuance across political transitions. Thailand's THACCA legislation has already experienced a delay attributable to government change; the larger soft power agenda has been recalibrated with each new administration. Kim and Jin (2016) demonstrate that the Korean Wave's institutional durability depended on legislative embedding—the formal codification of institutional mandates in statute rather than executive order—which bound successive administrations to continued investment. The same logic applies to Thailand: THACCA's mandate and funding commitments must be embedded in primary legislation with cross-party support to achieve the multi-year implementation horizon that effective soft power institutions require.

A third challenge concerns the risk of institutionalizing cultural conservatism. Yoon (2023) observes that state-sponsored soft power framing can narrow the range of cultural production that receives institutional support, privileging commercially legible representations of national identity over more experimental, diverse, or politically complex creative work. Thailand's 5F framework and the NSPSC's prioritization of traditional and marketable cultural forms reflect this tendency. The reform framework must therefore incorporate explicit provisions for independent creative sector representation in THACCA's governance, making certain that the agency's mandate supports enabling conditions for creative ecosystems rather than prescribing cultural content.

Finally, the conceptual boundary between soft power and creative economy must be resolved at the institutional design level. Nye (2021) insists that soft power operates through the attraction of values and political legitimacy, not simply through the commercial success of cultural products. An institutional mandate defined primarily around economic metrics—export revenues, employment, tourism contribution—may successfully develop Thailand's creative economy while failing to generate the reputational and relational influence that constitutes soft power in the authentic sense. THACCA's legislation should explicitly mandate attention to the non-economic dimensions of cultural influence, including governance credibility, international partnership, and values projection.

Conclusion

Thailand possesses substantial soft power resources and sustained political commitment to their deployment. However, the country currently lacks the institutional infrastructure required to transform cultural assets and political will into coherent, accountable, and verifiable outcomes. The three-pillar reform framework proposed in this article—a unified statutory lead agency, a co-governed creative investment fund, and a formal interagency coordination protocol—offers a concrete strategy for addressing this gap, drawing on peer-reviewed scholarship in creative economy governance and comparative analysis of South Korea's successful KOCCA model.

The South Korean experience documented by UNCTAD (2023), Jin (2024), and Kim and Jin (2016) demonstrates that these institutional outcomes are achievable within a single policy generation, provided that political commitment to institutional quality, rather than mere institutional creation, is sustained. Thailand's THACCA legislation, if strengthened as proposed and enacted with sufficient legislative robustness to withstand political transitions, could initiate a comparable trajectory.

Further research should examine the implementation of the THACCA legislation once enacted, comparing outcomes against the reform principles articulated in this article, and should develop a comparative institutional analysis of soft power governance across ASEAN contexts. The conceptual distinction between soft power and creative economy, central to Nye's (2021) retrospective critique and directly relevant to Thailand's policy design choices, warrants sustained theoretical attention as scholarship on Asian soft power continues to evolve.

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Integrating Circular Economy and Blockchain Technology for Sustainable Supply Chain Development in Thai Modern Retail: A Literature Synthesis and Future Research Agenda

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Abstract

Background: Modern retail supply chains in developing economies face mounting ESG compliance pressures alongside persistent transparency and resource-efficiency deficits. Circular Economy (CE) principles and Blockchain technology have been proposed as complementary interventions; yet integrated frameworks tailored to this context remain absent from the literature. **Method:** This review synthesises peer-reviewed studies published between 2019 and 2025, identified through structured searches of Scopus and Web of Science using CE–Blockchain–supply chain keywords and screened against explicit inclusion criteria. **Findings:** Blockchain consistently functions as a trust infrastructure that enhances CE effectiveness through traceability and smart contracts, operating at operational, organisational, and ecosystem levels. Evidence is concentrated in developed-economy and sector-specific contexts. Four critical research gaps are identified: the absence of a systemic framework for developing-economy retail supply chains; limited understanding of CE–Blockchain adoption determinants in Thailand; sparse empirical measurement of specific ESG indicator impacts; and insufficient public policy analysis. **Agenda:** A five-directional future research agenda is proposed, progressing from framework development through empirical testing to policy design, providing a structured roadmap for scholars, practitioners, and policymakers pursuing sustainable retail supply chain transformation.

Keywords: Circular Economy, Blockchain, Sustainable Supply Chain, Modern Retail, ESG; Developing Economy

Introduction

Modern retail supply chains are simultaneously confronted with pressures from two converging directions. The first is the intensification of Environmental, Social, and Governance (ESG) requirements, which institutional investors, consumers, and regulators increasingly employ to evaluate and select business partners (Elkington, 1997). The second is the growing complexity of supply chains driven by omnichannel expansion and multi-tier supplier integration across national boundaries, rendering traceability and transparent resource management progressively more difficult.

Within this context, Circular Economy (CE) principles and Blockchain technology have attracted considerable scholarly attention as a conceptually complementary pairing. CE aims to restructure supply chains from the conventional linear model of take–make–dispose towards a regenerative system in which resources retain their value throughout the product lifecycle (Geissdoerfer et al., 2017). Blockchain, in turn, functions as a data infrastructure that enables circularity to be verified, trusted, and coordinated among multiple stakeholders (Upadhyay et al., 2021).

For the purposes of this review, "Thai modern retail" refers to organised retail businesses operating under standardised management systems—including hypermarkets, supermarkets, department stores, and large-format convenience store chains—with multi-branch national networks. This definition excludes traditional wet markets, informal traders, and pure-play e-commerce platforms.

A systematic review of the existing literature reveals that several knowledge gaps remain inadequately addressed, particularly in the context of modern retail in developing economies. This article pursues three objectives: first, to synthesise the development of scholarly knowledge concerning CE–Blockchain integration in supply chains; second, to identify research gaps in the context of Thai modern retail; and third, to propose a structured future research agenda with clearly articulated directions that can be developed into actionable research projects. This study explicitly aims to synthesise CE–Blockchain knowledge, analyse Thai retail constraints, and propose an actionable research agenda.

The article is structured as follows. Section 2 describes the review methodology. Section 3 presents the theoretical foundations. Section 4 synthesises contemporary literature. Section 5 analyses the Thai context. Section 6 identifies research gaps and proposes the future agenda. Section 7 presents conclusions and contributions.

Review Methodology

A structured literature search was conducted in Scopus and Web of Science using the combined search string: ("*blockchain*" OR "*distributed ledger*") AND ("*circular economy*" OR "*sustainable supply chain*") AND ("*retail*" OR "*supply chain management*"). The search was restricted to peer-reviewed journal articles and conference papers published between January 2019 and March 2025, with no language restriction applied at the search stage; however, only English-language records were retained for full-text screening given the target publication audience.

The synthesis was conducted thematically rather than statistically, as the corpus is heterogeneous in method and context. Four thematic clusters were identified inductively: (1) Blockchain as a CE enabler, (2) organisational dynamic capabilities, (3) sector-specific

empirical evidence, and (4) barriers and systemic constraints. The synthesis matrix in Section 4 operationalises this classification. This review acknowledges that the relatively small number of studies ([X]) and the focus on English-language publications are methodological limitations, but this approach is used to meet international publication standards while recognising that some relevant Thai and local studies may not be included.

Theoretical Foundations

1) Triple Bottom Line and Sustainable Supply Chain Management

The Triple Bottom Line (TBL) framework proposed by Elkington (1997) is an important concept in sustainable supply chain management because it helps organisations consider economic, social, and environmental aspects together, and it has been further developed into the ESG framework, which also includes governance and links to international standards such as the Global Reporting Initiative (GRI Standards, 2021) and the Task Force on Climate-related Financial Disclosures (TCFD, 2017).

2) Circular Economy as a Supply Chain Strategy

Geissdoerfer et al. (2017) established that CE represents a system redesign rather than incremental optimisation. Whereas efficiency-focused approaches retain the linear logic of the supply chain while reducing waste at the margins, CE demands the reconstruction of the system from product design and material selection through to reverse logistics and resource recirculation. The four operational principles of CE—Reduce, Reuse, Recycle, and Recover—each imply different supply chain configurations and inter-organisational coordination requirements. Nandi et al. (2021) extended this framework by demonstrating that CE in supply chains is inherently a systemic phenomenon. Their analysis of post-pandemic supply chain redesign illustrates that CE principles can simultaneously enhance sustainability performance and build resilience against supply disruptions, a finding with direct implications for retail supply chains exposed to high demand volatility.

3) Blockchain as a Trust Infrastructure

Saberi et al. (2019) argue that a fundamental constraint of modern supply chains is information asymmetry—the unequal distribution of data about product origins, compliance standards, and quality attributes among supply chain actors. Blockchain addresses this constraint through three core properties: immutability, transparency, and traceability. Smart Contracts extend these properties into the operational domain by enabling automatic execution of agreed conditions—such as sustainable sourcing certification—without requiring manual verification or intermediary oversight (Upadhyay et al., 2021). The convergence of these properties justifies treating Blockchain not as a data management tool but as an institutional mechanism that lowers transaction costs and enables coordinated action in multi-party circular supply chains.

4) Multi-Level Analytical Framework

This review adopts a multi-level analytical framework integrating three theoretical lenses. The Resource-Based View (RBV) explains why organisations with superior IT assets and data infrastructure are better positioned to implement CE–Blockchain systems. The Dynamic Capabilities View (DCV) explains why technology investments alone are insufficient and why the ability to sense, seize, and transform is equally decisive (Meier et al., 2023). Institutional Theory explains why adoption trajectories diverge across national contexts—organisations respond differently to regulatory pressures, normative expectations, and mimetic forces depending on their institutional environment (Mukherjee et al., 2025). The integration of these three lenses is more adequate for explaining the heterogeneity of CE–Blockchain outcomes than any single framework applied in isolation.

Synthesis of Contemporary Literature

Blockchain as a CE Enabler: Mechanisms and Evidence

Upadhyay et al. (2021) proposed a multi-level framework positioning Blockchain as a CE enabler at operational, organisational, and ecosystem levels. This multi-level framing was an important departure from earlier literature that treated Blockchain as a primarily technological intervention. Rejeb et al. (2023), drawing on a systematic literature review, identified five mechanisms through which Blockchain supports CE: enhancing supply chain transparency, tracking materials and products across their lifecycle, enabling verifiable waste management and recycling, certifying sustainable practices among suppliers, and creating incentives for partners to participate in circular systems. Their analysis revealed that these mechanisms are interdependent: data transparency is a prerequisite for effective waste management, which in turn enables credible incentive structures. This interdependence has methodological implications, suggesting that isolating a single mechanism may underestimate the systemic value of CE–Blockchain integration.

Schmidt et al. (2024) catalogued systemic barriers across four categories: technical complexity and the absence of shared data standards; high initial investment and uncertain short-term returns; the requirement for process and culture change; and regulatory and infrastructure constraints. The identification of non-technical barriers challenges the implicit assumption in much earlier literature that overcoming technical challenges is sufficient for successful implementation—a finding that carries particular weight in developing-economy retail contexts where governance and infrastructure constraints are more pronounced.

Organisational Capabilities and Dynamic Readiness

Meier et al. (2023) propose that three dynamic capabilities are essential for CE–Blockchain implementation: sensing capabilities (identifying opportunities and threats), seizing capabilities (mobilising resources and reconfiguring processes), and transforming capabilities (adapting continuously based on operational learning). The implication is that Blockchain investment is necessary but not sufficient; organisations must concurrently develop internal capabilities to integrate technology with process redesign and stakeholder coordination. For multi-tier retail supply chains with diverse supplier bases, this capability-building challenge extends across organisational boundaries, requiring what Meier et al.

(2023) describe as "circular supply chain orchestration" rather than unilateral firm-level action.

Sector-Specific Empirical Evidence

Pakseresht et al. (2022), studying food supply chains, found that Blockchain significantly reduced food waste through real-time monitoring of storage conditions and freshness verification—a finding directly applicable to the Fresh Food and FMCG categories central to modern retail operations. Yontar (2023a) analysed critical success factors in agri-food supply chains and found that institutional factors—regulatory support, infrastructure readiness, and partner incentive systems—carry weight comparable to technical factors. This is consistent with the institutional logic developed by Mukherjee et al. (2025), who found that institutional pressures and internal resources jointly determine CE performance improvements achieved through Blockchain adoption.

Yontar (2023b), using a Grey-DEMATEL methodology, ranked Blockchain characteristics by their influence on supply chain sustainability, finding traceability to be the highest-influence property, followed by transparency and data security. Chen et al. (2024), studying the Chinese automotive industry, found that top management support and IT readiness were the dominant predictors of Blockchain adoption for CE purposes—evidence that the organisational dimension identified by the DCV framework operates in developing-economy contexts analogous to Thailand.

4 Synthesis Matrix

Author(s) (Year)	Method	Industry / Region	Core Theme	Journal (Abbreviated)	Key Finding and Implication for Thai Retail
Upadhyay et al. (2021)	Conceptual / Survey	Multiple / Global	Blockchain × CE × CSR	J. Clean. Prod.	Blockchain enables CE at three levels; predominantly developed-country evidence base
Nandi et al. (2021)	Conceptual Framework	General SCM / Global	CE + Blockchain + Resilience	Sustain. Prod. Consum.	CE + Blockchain builds post-disruption resilience; relevant to multi-tier retail SCM
Pakseresht et al. (2022)	Systematic Review	Food / International	Blockchain → CE transition	Sustainability	Reduces food waste, improves transparency; directly relevant to retail Fresh Food
Meier et al. (2023)	Dynamic Capabilities	Circular SCM / Global	DCV + Blockchain + CE	Transp. Res. E	Organisational capabilities, not technology alone, determine success
Rejeb et al. (2023)	Systematic Lit. Review	Multiple / Global	5 CE-enabling mechanisms	Resour. Conserv. Recycl. Adv.	Mechanisms are interdependent; evidence base skewed toward developed economies
Yontar (2023a)	CSF Analysis / Circular	Agri-food / Turkey	Critical Success Factors	J. Environ. Manage.	Institutional factors equal in weight to technical factors

Author(s) (Year)	Method	Industry / Region	Core Theme	Journal (Abbreviated)	Key Finding and Implication for Thai Retail
Yontar (2023b)	Grey DEMATEL	General SCM / Turkey	Blockchain features × Sustainability	Clean. Logist. Supply Chain	Traceability = highest sustainability influence; prioritisation guidance for resource-constrained implementations
Schmidt et al. (2024)	Literature Review	Multiple / Global	Barriers to Blockchain → CE	Corp. Soc. Resp. Environ. Manage.	4 barrier types: technical, financial, process, regulatory; non-technical barriers underestimated in earlier work
Chen et al. (2024)	TOE-TAM Survey	Automotive / China	Blockchain adoption for CE	Sustainability	Top management support and IT readiness are dominant adoption factors; developing- economy context partially analogous
Mukherjee et al. (2025)	Institutional Theory + RBV	Multiple / Global	Blockchain → CE performance	Sustain. Futures	Institutional pressures and internal resources jointly improve CE outcomes; single-lens models are insufficient

Thai Modern Retail Context and Constraints on Knowledge Transfer

Structural Characteristics and ESG Readiness

Thai modern retail supply chains are characterised by pronounced multi-tier complexity, encompassing large-scale international suppliers and small-scale community producers whose digital readiness and data infrastructure capacity differ substantially. While large retailers listed on the Stock Exchange of Thailand are increasingly subject to ESG disclosure requirements, the information systems that underpin such disclosures—particularly at the supplier level—remain underdeveloped. Thailand's BCG Economy Policy explicitly articulates ambitions aligned with CE principles (NESDC, 2021), yet lacks specific mechanisms to incentivise or standardise Blockchain adoption in retail supply chains. These conditions create a structural gap between policy intention and operational capability that the existing international literature has not systematically examined.

Constraints on Knowledge Transfer from International Studies

Three categories of constraints limit the direct transferability of knowledge from the existing literature to the Thai modern retail context. The first is geographic and infrastructural: the majority of empirical studies reviewed have been conducted in the European Union, the United States, or China—jurisdictions with more advanced digital infrastructure, clearer data governance frameworks, and greater Blockchain pilot experience than Thailand. The second is sectoral: the industries most represented in the literature (food, agriculture, automotive) have supply chain structures and competitive dynamics that differ from multi-category modern retail, where assortment breadth,

seasonal demand patterns, and omnichannel integration create distinct traceability challenges.

The third constraint is methodological. Technology adoption models commonly employed—TOE-TAM and Institutional Theory frameworks—have been tested in contexts where managers possess prior Blockchain exposure and clear IT investment authority. In Thai modern retail, where the majority of organisations remain at the feasibility assessment stage, these models may require adaptation to capture early-stage adoption dynamics and intra-organisational persuasion processes. Recognising these constraints, the following section identifies the resulting research gaps and proposes an agenda to address them.

Research Gaps and Future Research Agenda

Systematic Identification of Research Gaps

Four critical research gaps emerge from the synthesis. The first is the absence of a systemic, validated framework specifically designed for CE–Blockchain integration in modern retail supply chains under the constraints of a developing economy. The second concerns limited understanding of adoption determinants in the Thai context. While Chen et al. (2024) and Mukherjee et al. (2025) offer analytical starting points, neither has been tested with Thai retail executives or calibrated to local institutional conditions. The third gap involves the absence of empirical measurement of specific ESG indicator impacts. The literature consistently argues that Blockchain supports CE performance, but quantitative evidence on the magnitude of effects on measurable outcomes—such as carbon footprint reduction, waste volume, or supplier ESG scores—is sparse, particularly in retail. The fourth gap is the lack of public policy design research targeting Blockchain-enabled CE in developing-economy retail.

Future Research Agenda

Direction 1: Development and Validation of a Systemic Framework for the Thai Context. The most urgent priority is the development of a practical, validated framework integrating CE principles with Blockchain capabilities for Thai modern retail supply chains. The core research question is: What components and implementation sequence constitute an effective, feasible, and ESG-aligned sustainable supply chain framework for Thai modern retail? Design-Based Research (DBR) is proposed as the appropriate methodology, combining contextual analysis, expert consensus, and empirical evaluation to produce a framework that is both theoretically grounded and operationally applicable.

Direction 2: Large-Scale Empirical Testing and ESG Impact Measurement. Following framework development, large-scale quantitative studies should test causal relationships between CE–Blockchain adoption and measurable ESG outcomes. Key research questions: Which supply chain processes in modern retail yield the highest CE impact when Blockchain-enabled? What organisational and contextual variables moderate these relationships? Longitudinal panel designs would capture performance trajectories over time, addressing a limitation evident across the reviewed literature.

Direction 3: Cross-Industry and Cross-Country Comparative Studies. To test the transferability of findings from Thai modern retail to adjacent sectors and geographies, comparative research should examine structurally similar supply chains in food and beverage, fashion, or consumer electronics, as well as comparable developing economies in Southeast Asia. Research questions should address: What context-specific factors differentiate CE–Blockchain requirements in Thai retail from those in other sectors or countries?

Direction 4: Integration with Emerging Technologies and Longitudinal Dynamics. Research should investigate how the integration of Blockchain with IoT sensors and AI predictive analytics performs in partially underdeveloped infrastructure environments, and whether the cost–benefit calculus justifies investment relative to Blockchain alone. Longitudinal studies tracking organisational change and sustainability outcomes over three to five years would address the gap in knowledge about sustained CE–Blockchain performance that single cross-sectional studies cannot provide.

Direction 5: Public Policy Design and Institutional Ecosystem Analysis. Core research questions: What governance mechanisms and standards development processes most effectively enable interoperability across multi-tier retail supply chains? What can Thailand learn from more advanced regulatory frameworks—such as those in the European Union or Singapore—in designing its own Blockchain-for-sustainability policy?

Conclusion and Contributions

This review has synthesised contemporary evidence on the integration of CE principles and Blockchain technology in sustainable supply chain development, with specific focus on Thai modern retail as a developing-economy context. The synthesis confirms that Blockchain functions as a trust infrastructure enabling CE at operational, organisational, and ecosystem levels. However, evidence remains concentrated in developed-economy and sector-specific contexts; non-technical barriers are systematically underweighted in the literature; and no validated framework exists for developing-economy retail supply chains.

This review advances the field in three respects. First, it provides the first systematic synthesis of CE–Blockchain integration evidence framed specifically around the developing-economy retail context, establishing boundary conditions that constrain the direct transferability of findings from advanced economies—a contribution that has not been made explicitly in prior reviews. Second, by integrating Resource-Based View, Dynamic Capabilities View, and Institutional Theory within a single analytical frame, it proposes a multi-level theoretical lens that is more adequate for explaining adoption heterogeneity than any single-framework approach applied in the reviewed literature. Third, the five-directional research agenda links identified gaps to specific research questions, methodological approaches, and policy implications, contributing not merely to a single study but to a structured research programme that scholars and practitioners can operationalise.

This review has some limitations. First, it uses only English-language publications, so some important studies in Thai or other Asian languages may not be included. Second, the number of studies is quite small, so the results may not be generalised. Third, there is no bibliometric analysis to show citation patterns. Fourth, it does not include grey literature such as government or industry reports. However, this approach follows international publication standards, and future research should include more data sources and languages.

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