

# Confirmatory Factor Analysis of Sustainable Tourism Business Development

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**Abstract:** - This study aimed to conduct a confirmatory factor analysis to examine the structural consistency of sustainable tourism business development with empirical data. The sample consisted of 400 tour business operators in Thailand. A questionnaire was used as the research instrument, with an overall reliability coefficient of 0.90. The statistical methods applied included exploratory factor analysis, confirmatory factor analysis, and second-order confirmatory factor analysis. The findings revealed that sustainable tourism business development comprises four components based on the 4M theory: Machine, Material, Manpower, and Method, with factor loadings ranked in descending order. The results of the first-order confirmatory factor analysis indicated that all model fit indices met the acceptable criteria. Similarly, the second-order confirmatory factor analysis also showed that all indices met the required standards. The factor loadings were positive, ranging from 0.83 to 0.95, and were statistically significant at the 0.01 level. Among the components, Material had the highest factor loading at 0.95. The model fit indices demonstrated a good fit with the empirical data ( $p = 0.089$ ,  $CMIN/DF = 1.312$ ,  $GFI = 0.976$ ,  $RMSEA = 0.028$ ). Tourism business operators can apply this model in practice by placing a strong emphasis on the Machine component. Investments in pertinent machinery or technology can improve the quality of services and provide customers with more value.

**Key-Words:** - Confirmatory Factor Analysis, Second-order Confirmatory Factor Analysis, Sustainable, Tourism Business, Development, 4M theory.

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## 1 Introduction

Thailand has had a booming tourism industry that has rapidly expanded. The global and Thailand's tourism industry has been severely affected by COVID-19, generating recovery and adaptation challenges. Meeting the travelers' shifting demands and requirements, departure from traditional practice is required for sustainable tourism business management in the new normal post-COVID-19 epoch. Thailand – The largest number of tourist arrivals in Thailand was 39.92 million people in 2019, before the Thai government closed all its borders due to the ongoing coronavirus pandemic. The pandemic did, however, cause a notable 83.21%

drop in tourism, which led to a 6.7 million drop in 2020. The tourism industry started to rebound as travel restrictions were progressively removed, and things got better. In 2022, Thailand welcomed 11.2 million foreign visitors; in 2023, that number rose to 28.2 million. In 2024, the number rose to 35.6 million, [1].

The management of sustainable tourism businesses has grown in significance since the COVID-19 pandemic. In addition to creating jobs and revenue for nearby communities, tourism has a big influence on the environment and regional cultures, [2]. Therefore, the preservation of local cultural heritage, environmental conservation, and

economic development must all be integrated in a coordinated manner for sustainable tourism management. A number of important factors must be considered in order to develop sustainable tourism, including the effective use of natural resources, the mitigation of environmental impact, the promotion of tourism that respects and upholds local customs, and the encouragement of cooperation between public and private sectors, as well as local communities. This is to ensure that tourism growth is inclusive and beneficial to all parties involved, [3]. One of the key strategies in the post-pandemic era is emphasizing safe and hygienic tourism. There should be preventive measures against the pandemic, such as regular sanitation of tourist attractions, implementation of social distancing practices, and the use of technology for health monitoring and contact tracing. Additionally, promoting local and nature-based tourism in low-density areas can help reduce risks while enhancing the sustainability of tourism practices, [4].

Subsequently, the researcher was motivated to implement a confirmatory factor analysis of sustainable tourism business development, employing the 4M theory as the primary analytical framework. The results of this study are anticipated to provide tourism business operators and interested stakeholders with practical guidelines that will allow them to apply the insights to more effectively and sustainably manage their businesses.

### 1.1 Research Objectives

- 1) To analyze the confirmatory factors of sustainable tourism business development.
- 2) To examine the consistency between the confirmatory factor structure of sustainable tourism business development and the empirical data.

## 2 Literature Review

The 4M theory can be traced back to Japanese management and production practices, particularly the work of Kaoru Ishikawa, a professor at the University of Tokyo. He is most famous for developing the Ishikawa Diagram, also known as the Fishbone Diagram, a visual aid used to pinpoint the root causes of problems with product quality. Additionally, Ishikawa popularized the idea of quality circles, which promote a culture of ongoing development and motivate staff members to work together to address problems at work. Since quality control should be the responsibility of the entire organization, his approach emphasized the

importance of involving all employees in every stage of the product life cycle. Ishikawa's methods significantly influenced the development of Total Quality Management (TQM) in Japan and inspired business practices worldwide, leading to the adoption of these standards across various industries, [5].

The 4M theory is commonly applied in the analysis and improvement of production processes. It categorizes the key factors influencing production into four main elements: Manpower, Method, Material, and Machine, [6].

[7] the following is a more detailed explanation of these four components: 1) Manpower: This factor discusses the people who work on the production process, including their drive, skills, knowledge, and abilities. Employee training and skill development are essential for improving production quality and efficiency. 2) Machine: Denotes the machinery and equipment that are employed during the manufacturing process. These are indispensable in the generation of superior outputs. The operational efficiency and downtime of machinery are reduced through consistent maintenance and inspection. 3) Method: This encompasses the techniques and procedures used in production. These should adhere to established standards and be continuously improved. Effective planning and management of production processes contribute to smooth and efficient operations. 4) Material: The materials used in production must meet quality standards. Waste is diminished, and product quality is improved through effective material management.

By utilizing the 4M theory to analyze and enhance production processes, business operations can effectively identify and resolve operational issues, thereby improving their long-term competitiveness in the market. This framework is also applicable to the management of tourism businesses and related sectors, as tourism is a labor-intensive industry.

The necessity of effective human resource management that is in accordance with customer expectations and the imperative to provide quality service to customers are two critical aspects that must not be disregarded, particularly in the tourism and hospitality sectors. These elements are fundamental to achieving service excellence and sustainable business success in the industry, [8]. Based on the research case study of [9], the 4M Theory was applied in the tourism business, specifically in the 4M study, to support Indonesia's maritime tourism development. The 4M Factor

analysis identifies three types of conceptual design development for passenger terminals and two types of marina development. The optimal outcome of the conceptual design development will be achieved by incorporating the local wisdom of each region. The development of maritime tourism is prioritized in IER due to its abundant natural resources and the necessity of immediate action to promote equality through robust connectivity. Therefore, Indonesia's maritime tourism can be both internationally recognized and locally connected through the implementation of these enhancements.

### 3 Research Methodology

#### 3.1 Component Synthesis

- 1) Conducting a review of documents, concepts, theories, and relevant research related to sustainable tourism business development.
- 2) Selecting variables and components based on the 4M theory—Manpower, Machine, Method, and Material.
- 3) Applying 4M-based components to construct the research conceptual framework, as illustrated in Figure 1.

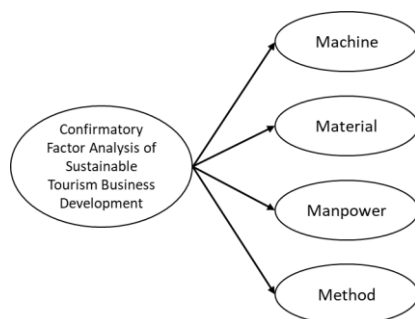


Fig. 1: Conceptual Framework

Source: created by the authors

#### 3.2 Population and Sample

The population in this study consisted of tour business operators in Thailand, totaling 3,436 entities, [10]. The sample size was determined using Taro Yamane's table at a 95% confidence level and a 5% margin of error, resulting in an appropriate sample size of 400 respondents, [11]. The sampling was conducted using a multi-stage sampling method, which included cluster sampling followed by systematic sampling, [12].

#### 3.3 Research Instrument

The research instrument was a questionnaire, developed based on a review of relevant literature,

documents, theories, and previous research. The questionnaire employed a rating scale format, using a 5-point Likert scale to provide appropriate response options for participants, [13]. The content validity of the questionnaire was assessed using the Index of Item-Objective Congruence (IOC). Five experts evaluated the alignment between the questionnaire items and the research objectives, resulting in an average IOC score of 0.97, which exceeds the minimum acceptable threshold of 0.50, [14]. To test reliability, the questionnaire was administered to a pilot group of 30 participants with similar characteristics to the target population. The resulting Cronbach's alpha coefficient was 0.90, indicating a high level of reliability (greater than 0.80), and confirming that the instrument was suitable for data collection, [15]. Subsequently, the finalized questionnaire was distributed to the defined sample group for data collection.

#### 3.4 Data Analysis

The researcher conducted a factor analysis by calculating the correlation coefficients among individual variables. The Principal Component Method was employed to extract factors for Exploratory Factor Analysis (EFA), which was subsequently subjected to Varimax rotation, an orthogonal rotation technique. Next, the measurement model was verified using Confirmatory Factor Analysis (CFA), and the higher-order factor structure was evaluated using Second-order Confirmatory Factor Analysis (S-CFA). The goodness-of-fit between the developed structural model and the empirical data was evaluated using statistical and social science software packages.

### 4 Research Results

#### 4.1 Results of Exploratory Factor Analysis

Utilizing responses to 60 questionnaire items from a sample of 400 participants, the Exploratory Factor Analysis (EFA) was implemented. Following the Principal Component Analysis method, the Varimax rotation was implemented to extract the factors. The analysis considered factor loadings, the number of variables indicating each factor, and the variance explained by each component, following the criteria set forth. The results revealed four components, consistent with the 4M theory, namely: Manpower, Machine, Method, and Material. The inclusion criteria for each factor were as follows: Each factor must be indicated by at least three variables. Each

factor must have Eigenvalues greater than 1. The cumulative percentage of explained variance must exceed 60%. Subsequently, each variable must exhibit a factor loading of 0.4 or greater, [16]. In order of the total variance explained, the components were ranked from highest to lowest. Four elements were identified by the exploratory factor analysis. Based on the conceptual framework and pertinent theory, each component was designated according to the shared characteristics of the variables that were loaded onto it. As summarized in Table 1, this naming process guaranteed that each component accurately represented the aspect it was designed to measure.

Table 1. Summary of Exploratory Factor Analysis Results

| Component Name | Variables (Items) | Eigenvalues | % of Variance | Cumulative % of Variance |
|----------------|-------------------|-------------|---------------|--------------------------|
| Machine        | 18                | 19.73       | 32.88         | 32.88                    |
| Material       | 13                | 2.13        | 3.55          | 36.43                    |
| Manpower       | 15                | 1.79        | 2.98          | 39.41                    |
| Method         | 9                 | 1.53        | 2.54          | 41.95                    |
| Total          | 55                | 25.18       | 41.95         | -                        |

Source: created by the authors

Table 1 summarizes the results of the exploratory factor analysis, which identified four components: 1) Machine – Consisting of 18 variables, with 4 variables excluded for not meeting the inclusion criteria. 2) Material – Consisting of 13 variables, all of which met the criteria. 3) Manpower – Comprising 15 variables. 4) Method – Containing 9 variables, with 1 variable excluded for not meeting the threshold. A total of 55 variables met the factor selection criteria and were subsequently retained for further analysis.

## 4.2 Results of Confirmatory Factor Analysis (CFA)

During this phase, the researcher implemented Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) techniques. The research conceptual framework was initially established by employing EFA to organize a substantial number of variables into coherent groups. This technique is a common statistical method used to reduce complex and interrelated variables into a simpler, more interpretable structure. Subsequently, Confirmatory Factor Analysis (CFA) was implemented to evaluate the construct validity of the measurement model and to ascertain the extent to which the proposed factor structure aligns with the empirical data. In accordance with conventional

research methodologies, the model was refined and developed until it achieved an acceptable level of fit. In this process, it was necessary to consider evaluation criteria that are widely recognized and commonly used in structural model assessment. According to [17], four key model fit indices should be applied for evaluation, as shown in Table 2.

Table 2. Model Fit Criteria for Assessing the Consistency between the Proposed Model and Empirical Data

| Evaluating the Data-Model Fit                      | Criteria      | Interpretation                                                   |
|----------------------------------------------------|---------------|------------------------------------------------------------------|
| 1) CMIN- $\rho$ (Chi-square Probability Level)     | $\rho > 0.05$ | $\rho$ must be greater than 0.05; The higher $\rho$ , the better |
| 2) CMIN/df (Relative Chi-square)                   | $< 3$         | CMIN/ df must be less than 3; CMIN/df closer to 0, the better    |
| 3) GFI (Goodness of fit Index)                     | $> 0.90$      | GFI must be greater than 0.90, GFI closer to 1, the better       |
| 4) RMSEA (Root Mean Square Error of Approximation) | $< 0.08$      | RMSEA must be less than 0.08; RMSEA closer to 0, the better      |

Source: created by the authors

The confirmatory factor analysis conducted to evaluate the construct validity of the measurement model produced the following results:  $p = 0.000$ , CMIN/DF = 2.580, GFI = 0.750, and RMSEA = 0.063. The empirical data did not fit the model adequately, as indicated by these values. Three common modification methods were analyzed to enhance model fit: 1) removing specific variables, 2) merging variables, and 3) connecting elements with arrows, [18]. The model was refined by the researcher by removing observed variables that exhibited insufficient factor loadings. This method was designed to improve the alignment between the empirical data and the adjusted latent constructs. Following the modifications, the confirmatory factor analysis yielded the following results:  $p = 0.081$ , CMIN/DF = 1.335, GFI = 0.977, and RMSEA = 0.029, all of which suggest that the revised model adequately accounted for the empirical data. Figure 2 illustrates the final model.

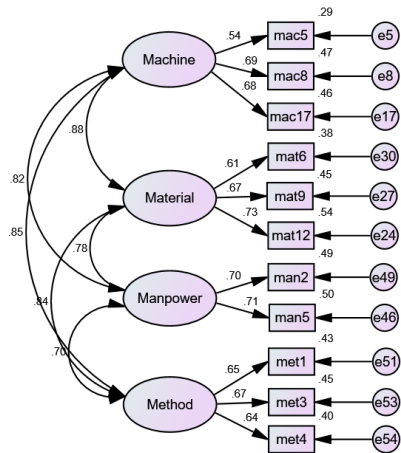


Fig. 2: Results of Confirmatory Factor Analysis (CFA) After Model Modification  
Source: created by the authors

As shown in Figure 2, the results of the confirmatory factor analysis to verify the construct validity of the measurement model after modification, revealed the following: In Machine Component, three observed variables were identified as significant indicators, ranked by factor loading: providing backup electricity for customer service during emergencies (mac8), offering internet access for customers (mac17), and having online channels for customer complaints and suggestions (mac5), with factor loadings of 0.69, 0.68, and 0.54, respectively. In the Material component, three key observed variables were identified: allocating more time for elderly tourists than regular tourists (mat12), offering herbal spa and therapeutic massage services (mat9), and including visits to natural tourist attractions for fresh air in all tour programs (mat6), with factor loadings of 0.73, 0.67, and 0.61, respectively. For the Manpower component, two observed variables stood out: staff with expertise in customer care (man5) and staff with in-depth knowledge of the tourist destination as if they were locals (man2), with factor loadings of 0.71 and 0.70. Lastly, in the Method component, the most significant observed variables were: organizing communication skill training for staff (met3), participating in tourism-related associations or organizations (met1), and utilizing various customer data to enhance customer satisfaction (met4), with factor loadings of 0.67, 0.65, and 0.64, respectively.

The researcher then proceeded to refine the model further by modifying the path diagram through the addition of arrow connections. This resulted in a Second-Order Confirmatory Factor Analysis (S-CFA) to assess the construct validity of the higher-order latent construct after model

adjustments. The analysis yielded the following fit indices:  $p = 0.089$ ,  $CMIN/DF = 1.312$ ,  $GFI = 0.976$ , and  $RMSEA = 0.028$ —indicating that the model demonstrated a good fit with the empirical data. The results are illustrated in Figure 3.

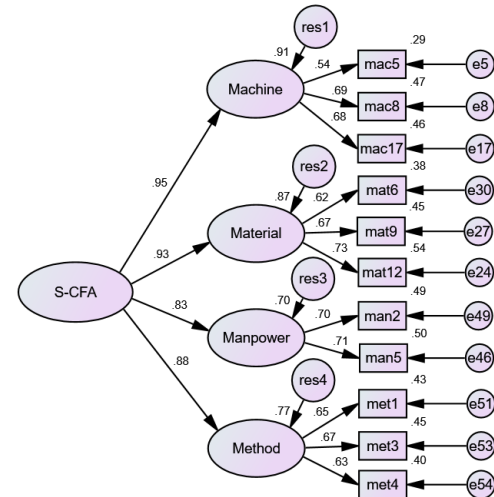


Fig. 3: Second-Order Confirmatory Factor Analysis (S-CFA) After Model Modification.  
Source: created by the authors

The standardized factor loadings for each component in the Second-Order Confirmatory Factor Analysis (S-CFA) were all positive, ranging from 0.83 to 0.95, and statistically significant at the 0.01 level, as illustrated in Figure 3. The factor loading of the Machine component was the highest at 0.95, followed by Material at 0.93, Method at 0.88, and Manpower at 0.83. Each component's reliability of measurement ( $R^2$  values) varied from 0.54 to 0.71, suggesting that all four components are valid indicators for verifying the sustainable tourism business development model. In addition, the results indicate that the model is consistent with the empirical data, which confirms its construct validity. All 11 observed variables included in the model are essential indicators of sustainable tourism business development.

## 5 Discussion

The findings of the Confirmatory Factor Analysis of Sustainable Tourism Business Development revealed that the confirmatory factor model of sustainable tourism business development was consistent with empirical data. Results from both first-order and second-order confirmatory factor analyses demonstrated that the model had construct validity, and all 11 observed variables were identified as

significant indicators of the key components involved in enhancing inventory management efficiency within the tourism industry. The discussion of the results can be presented in the following points:

1) The machine had the highest factor loading among all components. This implies that tourism business operators can make a substantial contribution to the enhancement of customer experience and service quality by investing in machinery and related technologies. For example, the integration of Artificial Intelligence (AI) into operations, such as [19] Including artificial intelligence into hotel management, offers a revolutionary approach to approaching guest services, operational effectiveness, and corporate intelligence. In this method, a feedback loop is established, in which continuous operating data assists systems in becoming even more intelligent. By simultaneously reducing labor costs and environmental impact and reporting significant improvements in operational efficiency, guest satisfaction metrics, and revenue optimization, companies that implement these AI-driven systems establish a new paradigm for competitive advantage in the hotel sector. [20] The utilization of Machine Learning (ML) has afforded hotels the ability to evaluate and enhance their performance, and contemporary tourism is evolving in accordance with technological capabilities, beginning with the search for information on a particular travel destination. This research makes a valuable contribution to the literature on tourism and technology by elucidating the application of ML in the advancement of tourism. It aims to predict future business conditions, revenue, challenges, and the current trend of tourist demand.

For each component, the most significant observed variable was identified in the following points:

2) The variable "Provision of backup electricity for customer service during emergencies" within the Machine component. This finding aligns with the research of [21]. The biggest challenge for tourism enterprises is the erratic electricity supply. Before making a reservation at a small business that lacks backup power in the form of solar, inverters, and/or generators, tourists inquire about the availability of such power. Most enterprises indicated that tourists were shunning booking with them, preferring establishments with power backup. As a consequence, revenue and business are diminished. The majority of businesses expressed

their desire to invest in solar technology; however, the start-up costs are significantly higher than their resources, as a result of the liquidity constraints imposed by COVID-19. Additionally, users of generators expressed their dissatisfaction with the elevated expenses associated with diesel purchases, which are necessary to mitigate the effects of load shedding. Equipment was also reported to be damaged by electricity outages, which resulted in additional expenses for businesses.

3) The Material component contains the variable "Allocating more time for senior tourists to visit destinations compared to general tourists." The sustainable development of the tourism industry is significantly influenced by the importance of elderly tourism services, quality management, and technology integration, [22]. In addition, [23] stated that the Service Quality component is the most significant component of the hotel business management for elderly tourists in the central region of Thailand. It demonstrates the significance of service quality for elderly tourists, which should be the primary focus of hotel business operators.

4) The variable "Staff are knowledgeable and skilled in customer care" is a critical component of the Manpower component. Hospitality industry properties must prioritize their customers' needs, requirements, and expectations to improve the company's image. In pursuit of a sustainable competitive advantage, service quality has been identified as a critical factor. This aligns with the study conducted by [24]. Customer satisfaction is positively correlated with four of the service quality dimensions (empathy, responsiveness, assurance, and tangible) in this study, while reliability has a negative correlation with customer satisfaction.

5) The variable "Providing staff with training in effective communication skills" is located within the Method component. Hotels have traditionally prioritized verbal communication as their primary method of disseminating their sustainable practices, [25]. This is consistent with [26]. The results of this investigation suggest that there are numerous concerns that should be addressed by hotels when employing this form of communication. Hotels are required to demonstrate comparable outcomes in their reports or other written materials, as well as to employ persuasive communication positively. Customers may be perplexed as to what the hotel has accomplished and what actions they should take if hotels use a variety of sustainability-related terms. Customers may be unable to comply with the hotel's sustainability

recommendations if they are not given clear information about the hotel's sustainability progress. Finally, the quality of the customer's leisure and travel experience may be compromised if negative words are used more frequently than positive ones. Consequently, verbal communication is essential; however, it should be conducted with care and direction. Furthermore, [27], in the hospitality sector, this investigation investigates the correlation between employee training and service quality. The study investigated the effects of perceived access to training and perceived support for training on service quality in the hospitality industry. The results of this investigation indicate a substantial correlation between the quality of service, the extent of support for training, and the perception of the benefits of training among employees.

## 6 Conclusion

1) The findings of this study identified the key components of sustainable tourism business development based on the 4M theoretical framework. Therefore, organizational leaders can apply this model in practice. Particular attention should be given to the Machine component, which showed the highest factor loading among the four components. This indicates that investment in machines or relevant technologies by tourism operators provides tangible benefits to customers and enhances the overall service experience.

2) The findings also indicate that the successful implementation of sustainable tourism business development necessitates the genuine support of organizational leadership and the positive engagement of operational staff. The tourism industry is a service-oriented business, and the only way to achieve meaningful outcomes is through the cooperation of employees and the commitment of the leadership.

### Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the authors used LanguageTool in order to modify a few phrases in the abstract and introduction sections to enhance academic quality. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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### **Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)**

- Prahuschai Ramart carried out the conceptualization, methodology, project administration, resources, visualization, writing, and editing.
- Rungroj Subanjui has implemented the methodology, investigation, and review.

All authors discussed the results and contributed to the manuscript.

### **Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself**

No funding was received for conducting this study.

### **Conflict of Interest**

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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