Study of causal factors in the use of MIS to design wooden furniture of small and medium industries in Thailand

Charcrit Sritong[a] , Onwika Sritong[b], Pattarapon Chummee[c], Pornthep Kaewchu[d]

[a,b,c] Valaya Alongkorn Rajabhat under the Royal Patronage University, Thailand.
[d] Rajamangala University of Technology Suvarnabhumi, Thailand.
[a] charcrit@vru.ac.th

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Abstract: This integrative research aimed to study and develop a causal model of MIS-assisted wooden furniture design of small and medium industries in terms of designer competence, management, innovation and technology and cost. The operating procedure consisted of quantitative research and using stratified sampling methods from 2,898 populations. Informants were operators, owners, managers, or assignees of 240 locations. Qualitative research would select 7 target groups using the specific method of selection. Confirmation of research results was done using a focus group, with ten management experts and related experts in wood furniture design participating in the focus group. The results of the study revealed that the key factors affecting the use of MIS in the design of the wood furniture industry were designer competence factors, management factors, innovation and technology, and cost factors. These three factors directly and indirectly influenced MIS-assisted wooden furniture design for small and medium industries in Thailand. Goodness of Fit Index values: χ^2=54.80, df = 44, χ^2/df = 1.24, p-value = 0.13, CFI = 0.99, GFI = 0.96, AGFI = 0.93, SRMR = 0.04, RMSEA = 0.032

Keywords: MIS-assisted wooden furniture design, innovation and technology, cost, designer competency

1. Introduction

From a survey and interview with small and medium wood furniture entrepreneurs in Thailand, it was found that the gross income of the furniture industry from 2016-2019 tends to increase steadily. Data obtained from the Trade Statistics Center, Department of Business Economics [1] presented the export data from 2016-2019 with the following export values: 1,096.60, 1,145.30, US $ 1,185.20 million, respectively. When considering the list, it was found that the wood furniture tended to decline steadily. The export value of 2016-2019 was 348.25, 331.50, 313.10 million US dollars, respectively.

Value : Million USD

	2016	2017	2018	2019 Jan. - Feb.	2019 Jan. - Jan.
1. Furniture & Parts	1,096.60	1,145.30	*1,185.20*	*180.60*	*87.50*
1.1 Wooden Furniture	348.25	331.50	*313.10*	*51.00*	*24.90*
1.2 Metal Furniture	105.51	80.30	*84.30*	*13.70*	*7.00*
1.3 Mattresses	84.56	112.00	*131.70*	*15.40*	*7.30*
1.4 Other types of furniture	174.83	178.60	*205.10*	*30.80*	*14.80*
1.5 Furniture Parts	383.44	442.80	*451.00*	*69.60*	*33.40*

Figure in Table 1 shows furniture exports [1]

From the study of the research team by studying related research papers and from in-depth interviews about the export of wooden furniture in Thailand in terms of the proportion of furniture entrepreneurs classified by business size in 2018, it was found that in the furniture industry, there were a large number of micro-entrepreneurs, accounting for 95 percent. Figure 2 shows the proportion of entrepreneurs in the furniture industry [2], it was found that furniture industry competition required databases, technologies and innovations to help wood furniture industry designs meet customer needs.

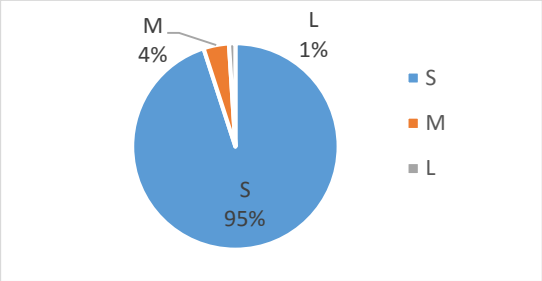

Figure 2 shows the proportion of the furniture industry in Thailand [1]

2. Research Objectives

1 To study the causal relationship of MIS-assisted wooden furniture design of small and medium industries in terms of designer competency, innovation and technology management and cost

2. To develop a causal model of MIS-assisted wooden furniture design of small and medium industries in terms of designer competency, innovative management, and technological and cost

3. Literature Review

From in-depth interviews with entrepreneurs, it was found that the small and medium wood furniture industry in Thailand found that there was still a lack of support system to help design. As a result, the style of wooden furniture in Thailand was still not suitable for foreign consumers. This may be one of the reasons for the drop in export of wooden furniture. In addition, the information or design of each furniture company in the industry was company-specific, but had not been widely collected or exchanged. The style of wooden furniture in Thailand still follows foreign countries such as countries from Europe and USA. As a result of information sharing problems in the medium and small furniture industry in Thailand, it was another problem that results in the development of wooden furniture design in Thailand not able to compete with foreign countries. The research team was therefore interested in the causal factors of the introduction of information management systems to assist in the furniture design of small and medium industries. According to the study of the research team, there are three main factors affecting the application of information management system to help the development of wooden furniture: designer competence, management of innovation and technology and cost. These 3 factors were the main factors affecting the application of information management system to help design. Details for such factors can be described as follows.

Designer Competency: In interviewing 10 entrepreneurs, the researchers discovered that the main factor affecting the development of furniture design was competent designer. This was consistent with [3] - [5] with the results of the study that design personnel were the key parameters for furniture layout development and impact on marketing. Therefore, the research team had studied and found that the furniture design personnel in Thailand will use the design data based on the needs of the consumers in the market together with the current design direction. However, the design data was kept as a person and the knowledge is exchanged through [6]. The researchers also discovered that most design personnel need the ability to keep up with design innovation. This included access to technology in order to increase the design capability to compete with overseas models. The study also found that designers had expertise in information systems management in finding information to help them design. Therefore, in order to develop the design using Thailand's information management system, it was essential to develop design personnel to have additional knowledge in the area of information management system. The researcher therefore emphasized the designer competency and is the main factor in this study.

Innovation and Technology Management: The research team found that the furniture design development in Thailand by using the information management system to help design had a very important factor, namely innovation and the use of technology. This was consistent with the findings of Marques C., João, F [10], TIDD, J., Bessant, J., Pavitt, K. [16],. As the introduction of information systems to help design companies, each company in the industry needs to adapt to support innovation and technology accordingly. Moreover, from the survey and interview with entrepreneurs, it was found that SMEs in the industry had to invest and rebuild their information systems in order to support the rapidly changing innovation and technology in the past 4-5 years. Therefore, entrepreneurs must focus on innovation and technology accessibility.

Cost: The study found that for an organization to develop an information management system to help design, it was necessary to invest in various systems such as investing in software, hardware, and implementing information systems. This was consistent with the research [7] [8] that studies the cost of management to enable the development of organizations and personnel. The researchers studied the factors of investment in a study [9] [10] and found that

investment factors greatly affected innovation and technology management. The research team can conclude that investment factors influence innovation and technology management and affect the introduction of information management systems to help design as well.

4. Research scope

The researcher collected qualitative data through in-depth interviews with entrepreneurs and reviewed the concepts, theories and related research of many researchers to develop a research framework and expand the framework according to the current research results. The concept of designer competency, innovation management and technology and cost was the causal factor affecting MIS-assisted wooden furniture design of the SMEs industry. The researcher conducted the study: 1. Designer competency, based on the concept of [3], [4], [11], [12], [13], [14], [15]. 2. Innovation and technology management, based on the concept of [16], [17], [6], [10], [18], [19]. 3. Cost, according to the concept of [20], [12], [21], [8], [22], [23], [24]. 4. MIS-assisted wooden furniture design of small and medium industry according to the concept of [25], [26], [27], [28], [29].

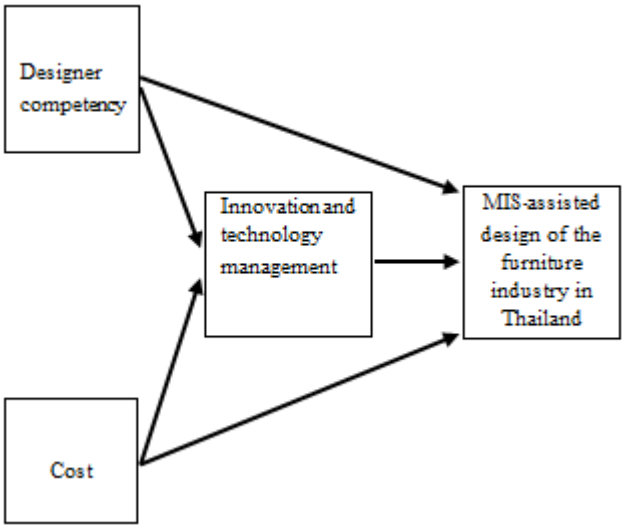

Figure 3 shows the conceptual framework of the research

5. Research Methods

This research focused on quantitative research to find answers to research using cross-sectional data collection with the details as follows:

Population and sampling

The population used in this research was business owners or business representatives who could provide information for 2,898 small and medium companies in the furniture industry in Thailand. The sample group was 240 business owners or business representatives. The sample size was determined according to the Hare et al. [30] criterion to select a sample and select it individually based on the given criteria, and then the quota sampling was randomly selected.

This research was a quantitative research using questionnaires. There were procedures for creating and examining a causal model of MIS-assisted wooden furniture design for small and medium industries in Thailand as follows:

1. In-depth interviews with entrepreneurs and studies of documents and research related to the causal relationship in order to obtain the conceptual framework of a hypothesis, the hypothesis was examined and adjusted by in-depth interviews with 7 experts using purposive sampling.

2. Examination of the consistency of the hypothetical model with the empirical data to study direct, indirect and overall influences, the researcher created a 5-level questionnaire to collect the data of the sample.

Research Tools

The research instrument was a 5-level and 5-part test: general information of respondents, 5 items, designer competency, 9 items, cost of 9 items, innovation and technology management, 9 items and MIS-assisted design of the furniture industry in Thailand, 9 items, totaling 41 questions. The questionnaire was examined for the content validity by the IOC technique by 5 experts, and it was then tested and used to determine the classification between

0.60-1.00 [32]. The reliability of the tool was determined using the Cronbach's alpha coefficient, the reliability of the designer competency = 0.90, cost = 0.85, innovation and technology = 0.90, MIS-assisted design of the furniture industry in Thailand = 0.90, totaling 0.93.

Data collection

Researcher conducted the data manually collected during July - September 2020.

6. Data analysis

Quantitative data analysis consists of analysis, congruence checking of theoretical causal relationship models obtained from empirical data using statistical programs.

7. Research Results

1. According to the study of the causal relationship of MIS-assisted wooden furniture design of the furniture industry in Thailand, in terms of designer competency, cost and innovation and technology, there are 2 external and 2 internal latent variables and 12 observable variables. The study found that the designer competency and innovation and technology were causal factors with direct influence.

In Thailand, MIS-assisted wooden furniture design was the most used and followed by cost. Also designer competency indirectly influenced MIS-assisted design of the furniture industry in Thailand through mediator variable, that is, innovation and technology.

2. The MIS-assisted wooden furniture design causal relationship research model of the furniture industry in Thailand was consistent with the empirical data based on Chi-Square (χ^2) = 54.80, Degrees of Freedom (df) = 44, Population (p) = 0.127, Goodness of Fit (GFI) = 0.96, Adjusted Goodness of Fit Index (AGFI) = 0.93, Root Mean Square Residual (RMR) = 0.0091 and Root Mean Square Error of Approximation (RMSEA) = 0.032, where the relative chi-square value (χ^2/ df) = 1.6, which is less than 2. Size analysis of direct and indirect influence of components within the model revealed that designer competency had direct influence on innovation and technology and MIS-assisted design of the furniture industry in Thailand had influence size = 0.72 and 0.55 respectively. In addition, cost had a direct influence on innovation and technology and MIS-assisted wooden furniture design of the furniture industry in Thailand had influence size = 0.29 and 0.24 respectively. This designer Competency and cost also had a significant indirect influence on MIS-assisted design of the furniture industry in Thailand and influence size = 0.72 and 0.29 respectively. All of them were statistically significant at the .01 level. In addition, the predictive coefficient (R2) of the internal latent variable structure equation was found to be = 0.97, indicating that the variance in the model can describe the variability of MIS-assisted design of the furniture industry in Thailand at 97% as shown in Figure 4 and Table 1.

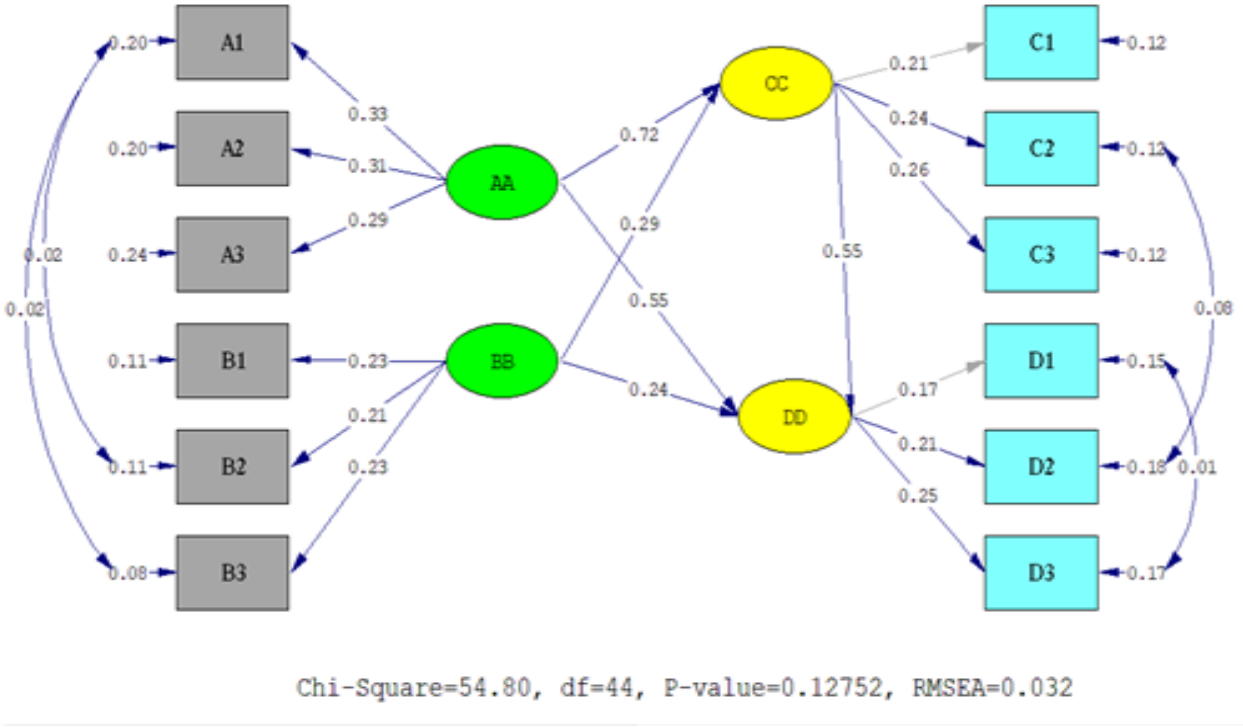

Figure 4 shows the MIS-assisted design factor model of small and medium industry in Thailand.

Symbols and acronyms used in data analysis.

1. **Exogenous Latent Variable**

AA represents designer competency measured from 3 observable variables: A1 = experience, A2 = learning and practicing and A3 = design skills and techniques.

BB represents cost, measured from 3 observable variables: B1 software = Cost, B = Hardware Cost and B3 = Information system cost.

2. **Endogenous Latent Variable**

CC represents innovation management and technology, measured from three observable variables: C1 = Process Innovation, C2 = Technology Acceptance, C3 = Technology Access.

DD represents the use of MIS to assist in the design of the furniture industry in Thailand, measured from 3 observable variables: D1 = furniture model is internationally accepted, D2 = upgrading furniture design in Thailand and D3 exchange of design information.

Table 1 shows the results of the analysis of the influence of MIS-assisted wooden factors of the furniture industry in Thailand.

Cause factor							
Effect factor	R^2	Innovation and technology management			MIS-assisted design of the furniture industry in Thailand		
		0.57			0.97		
		DE	IE	TE	DE	IE	TE
designer competency		0.72	0.00	0.72	0.55	0.396	0.946
Cost		0.29	0.00	0.29	0.24	0.159	0.399
Innovation and technology management		N/A	N/A	N/A	0.55	0.00	0.55

8. Conclusion

From the MIS-assisted design study of the causal factors of the SMEs industry in Thailand, it was found that the designer competency and management, innovation and technology are the causal factors that have the most direct influence on MIS-assisted design of the furniture industry in Thailand, and followed by the cost. Also a designer competency and cost also indirectly influenced MIS-assisted design of the furniture industry in Thailand through mediator variable that is innovative and technological management. The details could be summarized as follows.

1. Designer competency was a factor that positively influences MIS-assisted design of the furniture industry in Thailand with a coefficient of influence = 0.55. For this factor, the research team found that most of the designer competency in Thailand was from self-learning, either through talking to others, reading books or studying via the internet. These methods were thought to build on experience, learning and practice, as well as design skills and techniques. Designers needed to use their knowledge to develop unique and unique products and services. As a result, the furniture designs were more focused on responding to the needs of the market and customers. The nature of the design by the designer required an orderly management, storage and dissemination system because information was vital to the designer's design. Therefore, studies of researchers could indicate that designer competency has a significant direct influence on MIS-assisted design of the furniture industry in Thailand. Moreover, designer competency had the idea that every piece of furniture in Thailand had to be designed with craftsmanship that were refined, beautiful and unique in Thailand along with the modern design combined with the integration of local wisdom to create a unique identity. In addition, there was also self-learning in furniture development such as mixing paints for wood painting or extending the life of raw materials in production, then continue to develop to make the product more attractive and create demand for customers continuously. Moreover, the transfer of knowledge received to the members of the organization was the creation of knowledge to last forever, which was consistent with the results of a study [32] [33] that found, designer competency had direct influence on the development of products and services.

2. The management, innovation and technology factors were a direct positive influence on MIS-assisted design of the furniture industry in Thailand with a coefficient of influence = 0.55. The concept of management, innovation and technology contributed to the implementation, emphasizing the form of management of production and delivery of products to the hands of the customer and make a difference in the production of unique products. In addition, new production techniques were introduced into the production process, which could produce furniture at a low cost but still maintain the quality according to customer requirements. The innovation and technology management of the furniture business consisted of: 1) Process innovation was driven by competency in creating diversity and increasing the usability of the product, for example, designs that combine several types of materials to extend their lifespan longer than those made from a single material. In addition to extending the product's life, it could also add beauty to the product or use innovation to increase distribution channels by selling products online. In addition, innovation and technology management improved production quality in order to build more trust among customers. 2) Process innovation was an important tool for creating a competitive advantage for entrepreneurs, at the same time, entrepreneurship was a key mechanism for creating innovation. Process innovation was carried out by using various design techniques and assisting in production to enable rapid production or to be able to manufacture products that meet customer needs, for example, the introduction of Quality Function Deployment (QFD) techniques to help develop product models by focusing on customer needs and tailoring them to meet those needs [15]. It was also necessary to manage innovation and technology for entrepreneurs to become innovators [34]. This would contribute to economic growth. In addition, the study found that creating innovation in products, both in the design and development of new products, required innovation and technology, as they were both extremely important factors in the performance of an organization. Managing innovation and technology meant not only new product technology, but also the shift of traditional operating technologies to new ones. Organizations must always strive to create opportunities and conditions that lead to innovation by bringing them together in response to complex market demands by constantly establishing the rules of quality at the highest level.

3. The study found that cost was a direct positive influence on MIS-assisted design of the small and medium furniture industry in Thailand with a coefficient of influence = 0.24, which found that cost had the least influence. Most furniture industry entrepreneurs needed to invest in software hardware and information systems, which were fundamental and must-have companies. Designers need to use such factors in order to design furniture to meet customer needs. Therefore, it made entrepreneurs view that such factors had the least influence in MIS-assisted design. Instead, they focused on designer competency and management, innovation and technology. But from an in-depth study by interviewing entrepreneurs, it was found that focusing on the cost factor that was less but could not be ruled out because it was an essential element Because if they were absent they will not be able to compete with their competitors, which was consistent with the results of studies [5] [7].

From the study of relations between the parties, it was a study that emphasizes the nature of giving importance to all parties in the organization. The function of MIS-assisted wooden furniture design was a manner of sharing assistance and knowledge transfer between them. In addition, furniture entrepreneurs in Thailand should provide designers with opportunities to develop their skills and expertise and to participate in trainings with government and private sectors. This was consistent with the results of the study [7] found that organizations that focus on bringing innovation into the production of products and services improve competitiveness and could be regarded as responding to the ever-changing needs of customers. The push for MIS-assisted design of the furniture industry in Thailand was a preparation for the competition that may arise. Focusing on innovation and technology management would generate new ideas in product design, innovation or new manufacturing techniques that will affect sales generation and innovation development. Therefore, it could be concluded that the form of the structural equation of the research was consistent with the empirical data and it is knowledge that can be practically significant.

9. Suggestions

1. Entrepreneurs and small and medium furniture businesses in Thailand must develop themselves competency in knowledge, creativity, skills and practice to be proficient in management and technology to be used in the development of new innovations.

2. Small and medium-sized furniture entrepreneurs in Thailand should focus on market research to find ways to develop and design products that are suitable for the market such as beauty, contemporaryism, uniqueness and quality.

3. Government agencies should promote the protection of intellectual property in furniture and home decoration businesses.

4. The government should support private individuals to invest in the furniture manufacturing industry for export in accordance with the industrial development policy for export. Moreover, the state should create incentives to invest in the furniture manufacturing industry, support the development of modern machinery into the production process and promote joint investment with foreign countries for large-scale production units.

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