

# Factors Influencing the Adoption of Cloud Computing for Thai SME Businesses

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**Abstract:** This study investigates the various factors affecting the adoption of cloud computing in Thai SMEs by evaluating and contrasting the significance of these adoption factors. A comprehensive sample consisting of 384 SMEs from Northeast Thailand participated in the study by responding to detailed questionnaires that were designed for robust data collection. We employ various statistical approaches, including T and F tests, which incorporate ANOVA and MANOVA procedures, to examine the gathered data. The analysis results indicate an agreement among SMEs on the benefits that information technology provides to their business operations. This encompasses elements such as swift access to critical information, enhanced time efficiency in many procedures, and increased data accuracy, all of which are vital for effective corporate administration. Additionally, SMEs demonstrate a positive perception of cloud applications, particularly in areas such as problem-solving capabilities, data storage solutions, and their alignment with the specific operational needs of businesses. Furthermore, the diverse experiences and backgrounds of SME owners in Thailand play a crucial role in shaping their perceptions and attitudes toward the adoption of Information and Communication Technology (ICT), as well as their overall use of cloud computing. This dynamic interplay between individual experiences and technological adoption highlights the complexity of integrating cloud computing into the operational framework of SMEs throughout the region.

**Keywords:** Cloud Computing, Adoption, SMEs

## Introduction

Over the years, cloud computing has become vital for businesses and households around the world. It has revolutionized the way end users deliver and use IT solutions. The adoption of cloud computing offers numerous advantages to organizations, including cost savings, improved flexibility, and straightforward access to data (Gangwar *et al.*, 2015). Small and medium enterprises (SMEs) represent the majority of businesses globally and are crucial to economic development (Jayeola *et al.*, 2022). To enhance competitiveness and performance, SMEs should utilize cost-effective Information Technology (IT). Cloud computing is a technology that can enhance the operations of SMEs.

SMEs are now turning to cloud adoption to reduce costs, increase efficiency, and reach wider markets, enabling them to access, store, and manage data on demand. These technological improvements provide SMEs with the opportunity to effectively compete in an

increasingly competitive market (Ruslaini and Napitupulu, 2024). However, previous studies have identified a range of factors that influence the adoption of cloud computing in organizations. Cloud computing has a notable impact on SMEs, including limited capital, a shortage of skilled labor, and inadequate IT infrastructure (Nuskiya, 2017). Furthermore, SMEs still have difficulties managing information security and assessing risks. These problems require careful consideration before using new technologies (Nguyen and Liaw, 2022).

SMEs have been widely recognized as vital contributions to a nation's economic advancement. In Thailand, they represent a substantial segment of many industries, particularly the industrial sector, which comprises 93.8% of all businesses. Small firms constitute 76.0% of SMEs and medium-sized enterprises comprise 17.8%. Approximately 90% of industrial establishments in Thailand are small and SMEs collectively employ around 868,000 individuals, constituting 38.9% of the total workforce (Chittithaworn *et al.*, 2011).

SMEs in Thailand are increasingly adopting cloud computing for business management. However, a major challenge lies in their limited knowledge of privacy and data security in cloud environments, leaving them exposed to potential security risks (Khan and Al-Yasiri, 2016). This study explores the adoption of cloud computing by SMEs, aiming to offer valuable insights for both SMEs and service providers.

This study investigates the factors that influence the adoption of cloud computing among SMEs in northeast Thailand. The research framework outlines the relationship between independent variables related to SMEs, including entrepreneurs' personal information (gender, age, marital status, education, work experience, income, and type of business) and factors affecting cloud computing adoption to support their operations. The dependent variable examines how these factors impact the adoption of cloud computing applications by SMEs in the region. Figure (1) illustrates a conceptual research model.

### Cloud Computing Models

Cloud computing combines internet-based services with technologies including virtualization, distributed and parallel systems, multicore processors, and grid computing (Rajkumar *et al.*, 2009). The National Institute of Standards and Technology (NIST) defines cloud computing as a concept that offers ubiquitous, easy, and on-demand network access to a shared pool of programmable computing resources (Mell and Grance, 2011). Previous studies have defined three primary service models for cloud computing (Gupta *et al.*, 2013; Alkawsy *et al.*, 2015), as stated below:

1. Software-as-a-Service (SaaS) is a cloud computing paradigm that facilitates access to software applications, such as CRM or ERP, through the Internet or web-based platforms. With SaaS, corporations oversee applications, runtime environments, operating systems, middleware, and data instead of the foundational infrastructure
2. Platform-as-a-Service (PaaS) is a cloud platform that offers access to hardware and software resources via the Internet, mostly for application development. The third-party provider manages the infrastructure, alleviating developers from installation duties and minimizing expenses, enabling enterprises to create apps without overseeing the foundational network, storage, and servers
3. Infrastructure-as-a-Service (IaaS) is a cloud paradigm that offers enterprises immediate access to IT infrastructure resources via the Internet. A primary advantage of IaaS is the capacity to readily modify resources to align with particular needs and capabilities

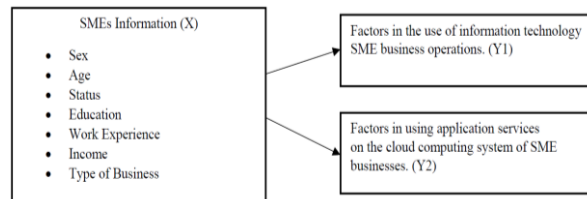


Fig. 1: The conceptual framework models

Small and medium-sized enterprises can utilize cloud services from three main sources, customized to their budgets, resources, and business type. SaaS divides itself from traditional IT solutions by reducing the necessity for software downloads and installations (Khajeh-Hosseini *et al.*, 2012). PaaS allows IT professionals and businesses to easily create and implement web applications utilizing third-party infrastructure (Raut *et al.*, 2017). IaaS provides storage, processing, networking, and additional computing resources according to customer specifications, enabling efficient software application deployment (Bruque-Cámara *et al.*, 2016).

### Cloud Computing Service

Cloud Computing is categorized into four types based on in-hosting location:

1. The public cloud offers a vendor-managed shared infrastructure, with clients lacking visibility regarding its location. Access is provided through the Internet and users have expenses only for the duration of their service usage
2. The private cloud provides a dedicated infrastructure for an individual enterprise, facilitating customized control of resources and applications. Complement security and governance by restricting access to approved individuals
3. The hybrid cloud integrates public and private clouds, connecting a private cloud to external services. This model offers a secure approach to data and application management, facilitating internet access and permitting enterprises to leverage supplementary public cloud resources as required.
4. The community cloud contains a shared infrastructure employed by organizations within a certain community, which may be hosted by a third party or a member of the community

Cloud adoption had already increased rapidly before COVID-19 and the pandemic further accelerated this trend. According to the Flexera (2021) State of the Cloud Report, 99% of the respondents use at least one public or private cloud, with 97% using at least one public cloud, 80% using at least one private cloud, and 78% using hybrid clouds (Flexera, 2021). Adopting cloud computing boosts competitiveness and provides significant advantages, allowing SMEs to effectively compete with larger corporations.

### Hypothesis

The study explored factors that influence the use of cloud computing among SMEs in northeastern Thailand, examining three hypotheses related to the adoption of cloud computing technologies and services, as well as how owner information affects this adoption. The research hypotheses were as follows:

- H1: The adoption of cloud computing has a positive correlation with different sectors of SMEs
- H2: The adoption of cloud computing services is positively correlation with different sectors of SMEs
- H3: The adoption of cloud computing and cloud computing services is positively correlation with gender, age, status, educational level, work experience, income, and types of business

### Materials and Methods

#### Methods for Sample Selection

This study selected the sample from the 748,805 SMEs in Thailand, collecting data from April 1 to June 30, 2024. Based on Krejcie and Morgan (1970), this study distributed a total of 384 questionnaires, resulting in 135 complete responses and a response rate of 35.16%. Aaker *et al.* (2001) suggest that a response rate above 20% is generally acceptable, indicating that the data collected are sufficient for effective analysis.

#### Research Tools

The questionnaire consists of four sections:

- Section 1: General information about SMEs
- Section 2: Opinions on factors that influence the use of information technology to support SME operations
- Section 3: Opinions on factors influencing the use of cloud computing in business by SMEs
- Section 4: A comparative analysis of factors affecting the use of information technology and cloud computing in small businesses, differentiated by gender, age, status, education level, work experience, average monthly income, and type of business

#### Research Statistics and Data Collection

This study analyzes the questionnaire data in six steps:

- Step 1 offers an overview of the information about SMEs through descriptive statistics, reporting frequency and percentage values
- Steps 2 and 3 assess feedback on factors influencing SMEs' cloud computing, calculating means and standard deviations
- Steps 4 and 5 compare the feedback on these factors in SMEs categorized by gender, age, education, work experience, average monthly income, and type of business, utilizing statistical methods such as independent t-tests, ANOVA, and

MANOVA for evaluation

- Step 6 examines the relationships and impacts of these factors on cloud computing for SMEs using multiple correlation and regression analysis

### Results and Discussion

This study investigates the factors that influence the adoption of cloud computing among Thai SMEs. Table (1) shows that 67.41% of business entrepreneurs are men, predominantly aged 31-35 (47.41%) and 25-30 (28.14%). Most have a bachelor's degree or lower (87.41%), with 10.37% holding a master's degree. In terms of work experience, 52.60% have 5-10 years and 29.63% have 11-15 years. 66% earn more than 50,000 baht monthly, while 21.47% earn between 40,001 and 50,000 baht. The majority operate in distribution (48.15%) and manufacturing (42.22%). In general, most SMEs in Northeastern Thailand are run by men aged 31-35 years, married, with a bachelor's degree or less, 5-10 years of work experience, and an income exceeding 50,000 baht, primarily in the business and distribution sectors.

**Table 1:** General information from SMEs

Information	Quantity	Percentage
.1 Gender		
1.1 Male	91	67.41
1.2 Female	44	32.59
Total	135	100.00
.2 Age		
2.1 Less than 25 years	7	5.19
2.2 25-30 years	38	28.14
2.3 31-35 years	64	47.41
2.4 36-40 years	23	17.04
2.5 more than 40 years	3	2.22
Total	135	100.00
.3 Status		
3.1 Single	35	25.92
3.2 Married	93	68.89
3.3 Widowed/divorced	7	5.19
Total	135	100.00
4. Education level		
4.1 Bachelor's degree or lower	118	87.41
4.2 Master's degree	14	10.37
4.3 Higher than master's degree	3	2.22
Total	135	100.00
5. Work experience		
5.1 Less than 5 years	18	13.33
5.2 5-10 years	71	52.60
5.3 11-15 years	40	29.63
5.4 more than 15 years	6	4.44
Total	135	100.00
6. Average monthly income		
6.1 Less than 30,000	6	4.45
6.2 30,001-40,000 baht	10	7.41
6.3 40,001-50,000 baht	29	21.47
6.4 More than 50,000 baht	90	66.67
Total	135	100.00
.7 Type of business		
7.1 Manufacturing business	57	42.22
7.2 Distribution business	65	48.15
7.3 Service Business	13	9.63
Total	135	100.00

Table (2) shows the influence of gender on opinions on the use of information technology for business support and cloud computing services. The results indicate that SMEs have similar perspectives on these factors ( $p>0.05$ ).

Table (3) describes the factors that affect the use of information technology for business support and cloud computing services. The results show that SMEs of different ages have varying opinions about this technology, but there is no significant difference in the adoption of cloud service adoption ( $p>0.05$ ).

A pairwise comparison of means, with a significance level of 0.025, revealed that SME owners with 11-15 years of experience, as well as those with more than 15 years, have significantly different perspectives on the factors that influence IT usage in operations compared to those with less than 5 years of experience (Table 4). This suggests that more experienced entrepreneurs are more likely to adopt cloud technology. A univariate test also confirmed that business operators with varying levels of experience have significantly different views on the determinants of IT usage at the same significance level of 0.025 (Table 5).

The research findings about the factors that influence cloud computing adoption in SMEs are summarized as follows:

1. Most SME owners are male, aged 31-35, married, hold a bachelor's degree or less, have 5-10 years of work experience, and earn more than 50,000 baht monthly, primarily in distribution businesses
2. SMEs express strong opinions on the factors that affect the use of information technology for operational support, emphasizing quick access to information, the ability to focus on other tasks, and the provision of accurate and reliable data
3. There is a significant consensus on the benefits of cloud computing for SMEs, including independent

problem solving, the replacement of traditional data collection methods, and the adaptability of cloud systems to their work styles

4. SMEs with 11-15 years of experience or more have more favorable views on using information technology for business operations compared to those with less than 5 years of experience
5. A comparison of factors that influence the use of information technology and the adoption of cloud computing in demographics such as gender, age, marital status, level of education, average income, and type of business that SMEs in Northeast Thailand generally have positive views on these technologies for operational support

**Table 2:** Comparing opinions across different genders

Comparison	male		female		t	p-value
	$\bar{X}$	SD	$\bar{X}$	SD		
Factors in the use of information technology SMEs business operations	4.17	0.46	4.13	0.34	0.502	0.616
Factors in using application services on the cloud computing system of SME business overall	4.14	0.47	4.10	0.37	0.855	0.394
	4.15	0.46	4.11	0.35	0.682	0.496

**Table 3:** Comparing opinions across different ages

Source of variability	df	SS	MS	F	p-value
Between groups	4	4.673	1.168	0.568	0.249
Within the group	130	20.067	0.154		
Total	134	24.739			

**Table 4:** Comparing opinions across different work experience

Work experience	$\bar{X}$	<5 years	y 10-5ears	y 15-11ears	>y 15ears
<5 years	4.15	-	0.491	0.010*	0.022 *
y 10-5ears	4.22		-	0.144	0.171
y 15 -11ears	4.36			-	0.936
>y 15 ears	4.37				-

\* Statistically significant at the 0.025 level

**Table 5:** Comparison of the average differences between groups

Univariate test		SS	df	MS	F	p-value
Dependent variable						
Factors in the use of information technology SMEs business operations	Contrast error	2.227	2	1.114	6.625	*0.002
Factors in using application services on the cloud computing system of SME business	Contrast error	1.022	2	0.511	3.273	0.042
		14.678	132	0.156		

\* Statistically significant at the 0.025 level

## Research Contribution

This research examines the factors that influence the adoption of cloud computing among SMEs in Thailand, based on a survey of 384 SMEs. Using rigorous statistical methods, the study identifies key benefits, such as rapid information access, improved efficiency, and improved data accuracy, that are vital for effective business management. It finds that SMEs generally have a positive view of cloud applications, particularly in terms of problem-solving and data storage. Furthermore, the diverse backgrounds of SME owners significantly affect their attitudes toward adopting Information and Communication Technology (ICT). The interplay between individual experiences and organizational needs underscores the complexities of integrating cloud computing. The study provides practical insights for policymakers and technology providers to support the adoption of ICT among SMEs, thus contributing to the literature on cloud computing in emerging markets. Ultimately, it improves understanding of the challenges SMEs face in technological transformation and lays the groundwork for future research in this field.

## Conclusion

SMEs in northeastern Thailand acknowledge the vital role of information technology in their operations, emphasizing the need for complete, accurate, and timely information for effective decision-making. This underscores the importance of integrating IT as a tool for developing efficient policies and measures. Hamner and Qazi (2009) point out that technology acceptance in the workplace, shaped by personal beliefs and organizational factors, affects perceived ease of use and future technology adoption. Moreover, SME owners recognize the significant benefits of cloud computing, noting that cloud storage systems save time and money, are stable and accessible, and offer convenient data storage solutions. However, opinions on using information technology to support entrepreneurship vary among Thai SMEs, largely due to differences in work experience. Increased work experience enhances knowledge, which entrepreneurs can leverage for more effective management of their operations.

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## Author's Contributions

**Arisaphat Suttidee:** Led the conceptualization and development of the project, formulated the research plan, designed the methodology, collected and analyzed data, assessed performance, and authored the manuscript.

**Charuay Savithi:** Provided substantial support in the development of the work, conducted a thorough review of the final manuscript, and served as the corresponding author for the publication of this study.

## Ethics

This study constitutes a notable and novel addition to the scholarly community. This study is totally original and has not been submitted or published anywhere. The writers have carefully reviewed and fulfilled all criteria for this study while complying with ethical research guidelines. Participants received a data privacy and consent form before completing the survey. The Institutional Review Board (IRB) of Maharakham University provided ethical approval for this investigation.

## Data Availability

The data supporting the findings of this study are available upon request by contacting the author via email at charuay.savithi@gmail.com.

## Conflicts of Interest

The authors declare no conflicts of interest related to this study.

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