The Influence of Technology, Organization and Environment on Firm Performance by ERP Assimilation[1]

อิทธิพลของเทคโนโลยี องค์กร และสภาพแวดล้อมที่มีต่อผลการดำเนินงานขององค์กรจากการดูดซับของอีอาร์พี[1]

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Abstract

This research article study aimed to investigate the influence of mediator variables of Enterprise Resource Planning (ERP) assimilation between latent variables, in technological, organizational and environmental contexts, and firm performance. Data were collected from a questionnaire within the manufacturing industry in Thailand and registered with the Department of Business Development of the Ministry of Commerce. The sample group consisted of 285 companies, and the data were analyzed with a structural equation modelling technique. The results showed that the three factors of Technology-Organization-Environment (TOE), which were technological, organizational, and environmental, influenced firm performance through ERP assimilation. It was found that the organizational context had the most influence on firm performance. The findings indicated the importance of understanding technological, organizational, and environmental contexts influencing ERP assimilation to improve the efficiency of the organization. The results helped executives of the manufacturing industry in Thailand understand the meaning of the ERP system and improve performance and competitive advantages.

Keywords: TOE Framework, ERP Assimilation, Firm Performance

บทคัดย่อ

บทความวิจัยนี้ มีวัตถุประสงค์เพื่อศึกษาอิทธิพลของตัวแปรส่งผ่านของการดูดซับระบบ Enterprise Resource Planning (ERP) ระหว่างตัวแปรแฝง ได้แก่ บริบทด้านเทคโนโลยี บริบทด้านองค์กร บริบทด้านสภาพแวดล้อม และผลการดำเนินงานขององค์กร ใช้แบบสอบถามในการเก็บข้อมูลจากอุตสาหกรรมการผลิตในประเทศไทยที่จดทะเบียนกับกรมพัฒนาธุรกิจการค้า กระทรวงพาณิชย์ โดยมีกลุ่มตัวอย่างทั้งสิ้น 285 บริษัท และใช้การวิเคราะห์ข้อมูลด้วยเทคนิคสมการโครงสร้าง ผลการวิจัย พบว่า องค์ประกอบทั้งสามของ Technology-Organization-Environment (TOE) ได้แก่ บริบทด้านเทคโนโลยี บริบทด้านองค์กร และบริบทด้านสภาพแวดล้อม มีอิทธิพลต่อผลการดำเนินงานขององค์กรผ่านการดูดซับระบบ ERP โดยพบว่า บริบทด้านองค์กรมีอิทธิพลต่อผลการดำเนินงานขององค์กรมากที่สุด ผลของการวิจัยชี้ให้เห็นถึงความสำคัญของการทำความเข้าใจต่อบริบทด้านเทคโนโลยี บริบทด้านองค์กร และบริบทด้านสภาพแวดล้อมที่มีผลต่อการดูดซับระบบ ERP เพื่อทำให้การดำเนินงานขององค์กรมีประสิทธิภาพ ผลที่ได้ช่วยให้ผู้บริหารสำหรับบริษัทในอุตสาหกรรมการผลิตในประเทศไทยเข้าใจถึงความหมายของการใช้งานระบบ ERP ในการดำเนินธุรกิจเพื่อสร้างความได้เปรียบในการแข่งขัน

คำสำคัญ: กรอบแนวคิดทีโออี การดูดซับอีอาร์พี ผลการดำเนินงานขององค์กร

Introduction

From the competitiveness of the global economy and the advancement in technological development, business organizations always needed to be active for adjustment and competition in changing situations. Many organizations tried to find a business tool to help run their businesses as this tool could be a weapon to outperform their competitors. One tool that every organization chose was the information system as it could serve every function of the organization. Moreover, it could also collect and analyze information from different departments to come up with interesting information to help top executives make their decisions more precisely. In addition, the information system also supported global information exchange regardless of the number of branches. All of them could be connected and this was also true with business partners. Wamba, Gunasekaran, Akter, Dubey and Childe indicated that information systems played an important role in improving managers' performance in decision making and their advantages in business competition [1].

Enterprise Resource Planning (ERP) was another information system which was in global demand especially in the manufacturing industry. The ERP system connected all information and processes in the organization and ran as a single system. The ERP system was an integrated software which was flexible and highly efficient. It was designed to focus on matching every departments' operational work to supply chain operations models. Data from The Statistics Portal showed that the ERP software market continuously increased around the world [2] due to the system's ability. Although the ERP system was widely popular, there were problems of failure in the system's investment. Its causes were the organizations' management of an ERP project together with the overdue time duration of the project. The latter meant the future loss of money and profit. If the problems were not solved quickly, the organizations were likely to cut losses by launching only half of the system [3]. The failure in the ERP system investment motivated the researchers to conduct the present study to reduce the risk of such failure. On the other hand, this would increase the success rates of the ERP system investment and firm performance. Most of the previous studies were involved in the adoption of an ERP system in the organization. But there was still a lack of studies on the assimilation of the ERP system in the manufacturing industry in Thailand that will lead to the efficient performance of the organization.

The present study was conducted based on the TOE Framework by Tornatzky and Fleischer [4]. This framework was an organizational theory explaining that there were three different factors influencing the decision to adopt an innovation. They included technological, organizational, and environmental contexts. This research aimed to investigate the influence of these three factors on firm performance by ERP assimilation.

Objective

To study the influence of technological, organizational, and environmental contexts on firm performance by utilizing ERP assimilation.

Theory

1. TOE Framework

The TOE framework introduced by Tomatzky and Fleischer [4] was an organizational theory explaining the influence of three different factors on decisions to adopt an innovation. Such three components were technological, organizational, and environmental contexts.

The technological context referred to both the internal and external technologies related to the firm [4]. This included technologies in use in the firm and those which were available and related to the firm but not in use. Organizations which were technological leaders had more advantages in business competition. Technology currently available to the firm served as an important foundation for implementing the ERP system as it helped the firm be flexible to the fast-changing economy. The technology indicated that ERP implementation was influenced by both internal and external technologies [5]. Technological readiness was a main factor for ERP adoption to an organization [6]. Technological contexts affected the ERP adoption of the organization [7]. IT ability levels were the main driving force of users in the ERP system and these were related to the success of ERP system installation [8]. Therefore, factors to be studied for the technological context were IT readiness and IT ability levels.

The organizational context referred to characteristics and resources of a firm which included structural connections among staff, inter-firm communications, and the size and resources of a firm [4]. Contexts of an organization influenced the decision to use the ERP system. Top executives played an important role in encouraging staff to use the system by preparing the firm to be ready for change, supporting ERP projects, and continuously creating positive attitudes toward the system. Scholars indicated that top executives could communicate to any department the importance of new technologies and influence the firm's determination to implement such new technologies [9]. The difficulties in adopting the ERP system might arise from the users' resistance, and this might happen during the operational step. Recognizing these obstacles was, therefore, crucial. Firms with a low level of obstacle' recognition tended to accept technology more than those with a high level. As a result, support from top executives in a firm could help overcome these obstacles and acceptable complications in using information technology (IT) [10-12]. In conclusion, factors which were used to study the organizationsl context were high level management support and recognition or problems and obstacles.

The environmental context referred to the environment of an industry, competitors, customers, and the government of an organization [4]. The environmental context was an external pressure influencing technological adoption. Competitive pressure was also an important factor for technological implemetation [13]. Competition of an industry generally recognized positive outcomes of IT acceptance especially when IT was directly affected by the competition and this was a necessary strategy to introduce new technology to the market [14]. Another important factor affecting the environmental context was market uncertainty which was important to organizational planning. From the IT perspective, management needed to respond and be flexible to support IT. Therefore, it was assumed that the higher the level of market uncertainty a firm was facing, the more likelihood that they accepted IT [15]. Hence, factors to be studied for the environmental context were pressure from competition and market uncertainty.

2. ERP Assimilation

ERP assimilation referred to the process of technological dispersion to every work process of an organization so that it became operational routine [16]. ERP assimilation could be determined based on the width and depth of the ERP operation in business activities. Likewise, from previous studies, ERP assimilation referred to the boundary that an organization used the ERP system to regularly operate its business. The findings indicated that centralization, data intensity, external pressure, and recognition of advantages were clearly important for explaning operational levels of the ERP system [17]. Research methodology of ERP assimilation was developed from institutes' pressure [18]. The results indicated that confidence from and participation of of top executives were mediators for imitation and force. However, normative force had direct impact on ERP assimilation. Data from longitudinal studies showed that pressure from institutes and external partners were important factors to determine ERP assimilation [19]. Factors which were employed to study ERP assimilation were quantity and depth.

3. Firm Performance

Organizational efficiency referred to the ability of an organization to perform its duty using its resources, manpower and other factors to their fullest potential with minimum loss. Their operational goals were achieved by saving time, resources, and manpower. An organization was able to use strategies and technologies for appropriate work. The operation ran smoothly and with minimum obstacles and conflicts. Staff worked with good morale and happiness. An improvement of a firm's efficiency was a key to strategic management processes which influenced the goal of an organization [20]. Concepts about efficiency of a firm were the measurement of organizational effectiveness by various factors and it was divided into

financial and non-financial indexes [21]. Organizational efficiency was measured with growth, profit, and market share [22]. Factors to be studied for organizational efficiency were profit and market share.

Research Framework and Hypothesis

From literature review and related theories, the framework for the present study was concluded as shown in Figure 1.

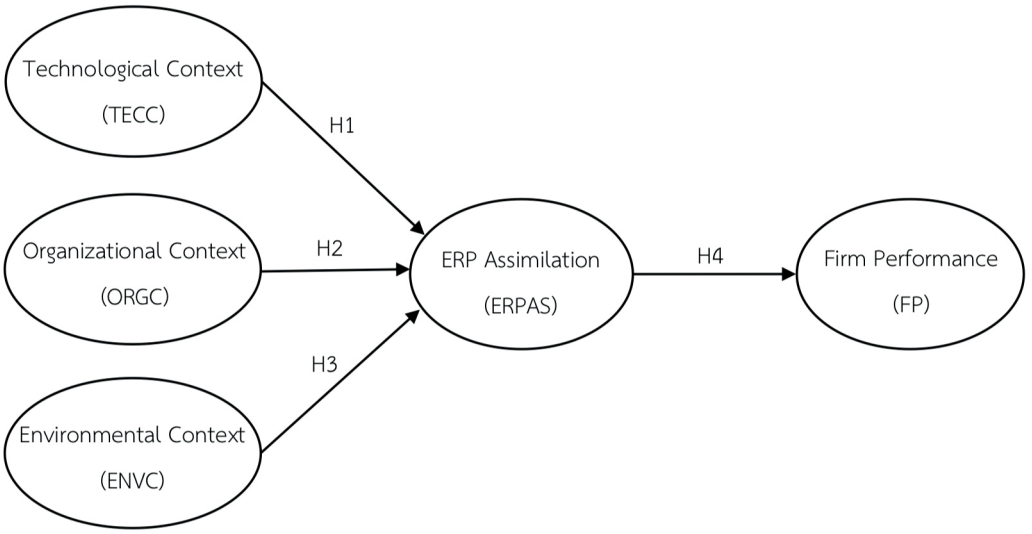


Figure 1 Research Framework

H1: There is a positive relationship between the technological context and ERP assimilation.

H2: There is a positive relationship between the organizational context and ERP assimilation.

H3: There is a positive relationship between the environmental context and ERP assimilation.

H4: ERP assimilation is a mediator for a relationship among the technological, organizational, environmental contexts, and firm performance.

Methodology

The present study was a quantitative research. The population was the manufacturing industry in Thailand. The number for the sample group was calculated by identifying the ratio of the sampling unit based on the number of parameters or variables. This was based on Bentler and Chou's formula [23] which suggested that an appropriate number of a sample group should have the ratio of 10:1 of the index. Since there were 11 questions in the

questionnaire of the present study, the minimum number of the sample group should be 110 cases. Hence, the researchers used data from not less than 110 cases for the sample group. For the present study, data from 285 companies were collected using the simple random sampling method.

The instrument used to collect data was a questionnaire which was divided into four parts: (1) six questions on information about technological, organizational and environmental contexts, (2) three questions on ERP system operation, (3) two questions on performance results of an organization, and (4) five questions on general information about the informants. All the questions were asked on a 7-point Likert scale.

Data were collected around August 2019. The questionnaire was validated by six experts. The content validity was conducted using the Index of Item – Object Congruence (IOC). The data were then collected with a preliminary questionnaire from a sample group of 30 companies. Cronbach's alpha coefficient was calculated with an acceptable reliability coefficient of higher than 0.7 for a reliable questionnaire. From the analysis, it was found that the reliability rates of all five variables in the questionnaire passed the minimum required criteria, which was between 0.955-0.958. After that, the main research data were collected from a sample group of 285 companies. The data were analyzed using descriptive analysis. Structural equation modelling (PLS-SEM type) was used to analyze the data related to the confirmation of the hypothesis.

Results

1. General Data Analysis

From general data analysis, the majority of the companies in the sample group were foreign companies, which accounted for 64.20 per cent. Companies which had run their businesses for more than 15 years were accounted for 51.90 per cent. Most of the respondents were department managers, which accounted for 38.60 per cent, and those managers who had worked in the organizations for 6-10 years accounted for 30.20 per cent.

2. Results of Structural Equation Modeling

2.1 Assessment of Measurement Model

Factor loading analysis showed that every latent variable had composite reliability of more than 0.7 and Cronbach's alpha of more than 0.7. It could then be concluded that all latent variables in the model were reliable [24]. In addition, convergent validity showed that every latent variable had AVE of more than 0.50. Therefore, it could be concluded that there was a related validity among manifest variables under the same latent variables in every latent variable of the model [25], and that all manifest variables in the model were reliable, as presented in table 1.

Table 1 Factor Loading, R^2, Composite Reliability (CR), and Average Variance Extracted (AVE)

Variable	Factor Loading	R^2	CR	AVE
TECC			0.836	0.718
TechR	0.840	0.706		
ITcap	0.855	0.731		
ORGC			0.862	0.757
TopM	0.875	0.766		
PerB	0.865	0.748		
ENVC			0.738	0.586
ComP	0.815	0.664		
Trap	0.712	0.507		
ERPAS			0.914	0.781
Volu	0.786	0.618		
Dive	0.923	0.852		
Dept	0.934	0.872		
FP			0.923	0.857
Prof	0.965	0.931		
MktS	0.885	0.783		

From discriminant validity analysis, it was found that the square root of AVE of each latent variable was more than the correlation between those latent variables and other variables in the model. Moreover, cross loading of each manifest variable and latent variable under the same manifest variable was highest when compared to cross loading of that manifest variable and other latent variables in the model. It was then concluded that all latent variables of the model had discriminant validity and were measured with accurate manifest variables [26], as shown in table 2.

Table 2 Discriminant Validity

	TECC	ORGC	ENVC	ERPAS	FP
TECC	0.718				
ORGC	0.391	0.757			
ENVC	0.383	0.428	0.586		
ERPAS	0.219	0.472	0.350	0.781	
FP	0.204	0.287	0.309	0.428	0.857

2.2 Assessment of Structural Model

In structural equation modelling, a multicollinearity test was needed to make sure that each predicted component had no statistically significance relation. Variance inflation factors (VIF) should be lower than 5.00 [27]. The VIF of each predicted component should be between 1.13-3.32 in accordance with the criteria. This meant that the structural equation modelling of the present study did not have any problems with multicollinearity from external sources.

Results from the structural equation modelling and effect size showed that ERP assimilation (ERPAS) influenced firm performance (FP) (p = 0.746) at the significant level of 0.001. The organizational context (ORGC) had the most influence on ERPAS (p = 0.500), followed by that of the environmental context (ENVC) on ERPAS (p = 0.374) and that of the technological context (TECC) on ERPAS (p = 0.226), respectively, at the significant level of 0.001, as presented in table 3 and figure 2.

Table 3 The standard indirect, direct, and total effect of model

Dependent Variable	Effect	Independent Variable			
		TECC	ORGC	ENVC	ERPAS
ERP Assimilation (ERPAS)	DE	.226	.500	.374	
	IE				
	TE	.226	.500	.374	
Firm Performance (FP)	DE				.746
	IE	.169	.373	.279	
	TE	.169	.373	.279	.746

Remark: DE = Direct Effect, IE = Indirect Effect, TE = Total Effect

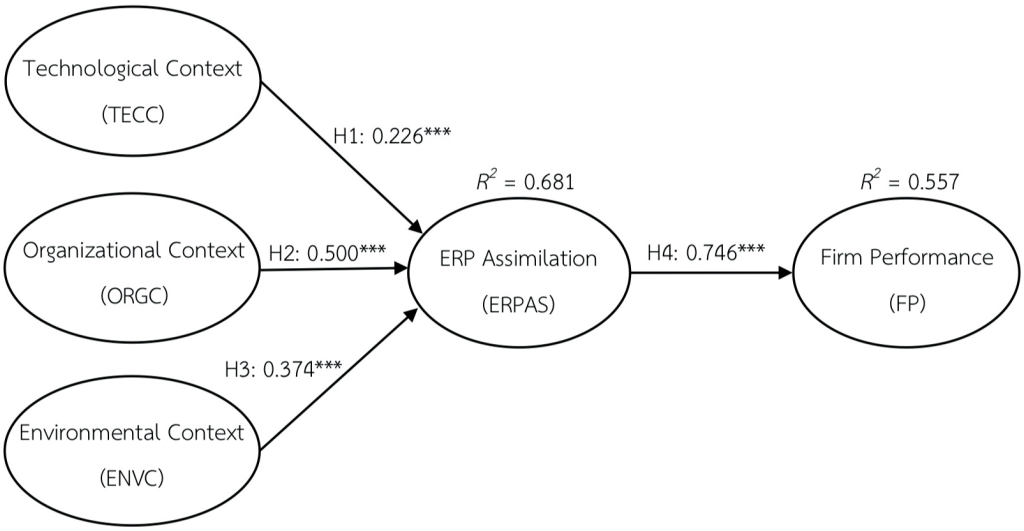


Figure 2 Research Model Results

Remark: *** = p-value < 0.001

As shown in Figure 2, the coefficient of determination (R^2) of the model indicated that the model accurately predicted firm performance at 55.7 per cent and the ERP assimilation at 68.1 per cent.

Discussion

The findings indicated that ERP assimilation affected firm performance. This was in line with Xu, Ou and Fan's study [28], which found that ERP assimilation influenced firm performance. Likewise, Chang and Seow's study [29] showed that ERP assimilation acted as a mediator between the TOE framework and firm performance. Data from the present study suggested that there were three factors which an organization had to be aware of and focus on when adopting an ERP system. They were (1) giving importance to ERP system operation in every department 2) giving importance to ERP system operation until covering all business processes, and 3) giving importance to ERP system operation until a routine is established. If an organization could push and normalize the use of an ERP system to staff in the organization, it would not be difficult to bring the organization success and be advantageous in business competition. To achieve these three outcomes, the organization needed to consider all three aspects under the theory of the TOE framework which were 1) technological context 2) organizational context, and 3) environmental context.

These three aspects showed that three different components affected the decision to adopt an innovation. Data from the present study indicated that all the three components

affected ERP assimilation. This was in accordance with a study by Xu, Ou and Fan [28] which investigated the antecedents of ERP assimilation and its impact on ERP value with a TOE-based model and empirical test. The findings suggested that the three contexts of an organization affected the ERP assimilation and the organizational context had the most influence on ERP assimilation. A study by Pudjianto, Zo, Ciganek, and Rho [30], which explored the determinants of E-Government assimilation in Indonesia with an empirical investigation using a TOE framework, also found that all three contexts affected E-government assimilation.

Based on objective studies, the research found that the technological context, organizational context, and environmental context influence the organization's performance through ERP assimilation. The three contexts are important factors that will cause ERP assimilation within the organization, which leads to effective performance.

The technological context is an important factor contributing to ERP assimilation. The organization must consider two factors: 1) technological readiness, which referred to technological infrastructure (e.g. hardware, software, and ICT networks) and technological adoption in manufacturing processes, and 2) IT capability level, which referred to an organization's emphasis on IT ability and standardized software. Organizations with technology readiness and IT capabilities can easily lead to the ERP assimilation. ERP assimilation will allow the organization to adapt according to the changing circumstances of the economy. It can also compete with business competitors and help create a competitive advantage. Therefore, the technological context influences the performance of the organization through ERP assimilation.

The organizational context plays an important part in ERP assimilation. The organization must consider two factors: 1) top management support, which referred to the role of top executives who focus on setting goals, follow up with ERP projects, and be involved in the ERP system, and 2) perceived barriers, where an organization should place importance on the complexity of the ERP system and resistance from staff against change. The important thing is to reassure employees that using the ERP system is not too difficult for them. Top management support will be an important mechanism to drive ERP assimilation to lead to effective performance. Therefore, the organizational context influences the performance of the organization through ERP assimilation.

The environmental context is another important context for ERP assimilation. The organization must consider two factors: 1) competitive pressure, where the organization should consider pressure from the industry when using the ERP system as a standard of the industry and business competition in the same industry, and 2) market uncertainty, where an organization should consider the uncertainty of marketing competition and the ability to

predict customer demand. Due to competitive pressure and market uncertainty, it is a challenge that all organizations face in a competitive economy. The adoption of the ERP system reduces the pressures faced by the organization and helps to provide flexibility in corporate planning, enabling the organization to cope with market uncertainty. Therefore, the environmental context influences the performance of the organization through ERP assimilation.

This study concluded that the technological context, organizational context, and environmental context influence the performance of the manufacturing industry in Thailand through ERP assimilation. If the manufacturing industry in Thailand wants to succeed in implementing ERP systems to lead to efficient performance. Factors to keep in mind are as follows: 1) technology readiness, 2) IT capability level, 3) top management support, 4) perceived barriers, 5) competitive pressure, and 6) market uncertainty Careful consideration of these six factors by the organization would help the operation of the ERP system be successful, which would lead to efficient performance, create opportunities, and gain competitive advantages.

Recommendations

1. Recommendations for Future Applications

Results from the present study would improve executives' understanding of the use of the ERP system to create advantages in business competition. This could be achieved by the following guidelines:

1.1 An organization should implement technologies in their operations, especially those in the manufacturing sector. Technological infrastructure, such as hardware, software, and IT networks, should be adjusted to be ready for adoption of the ERP system. However, the ERP system should be adopted as a component of the organization's original system to help blend the ERP system into the organization's overall operation.

1.2 Since the ERP system is complicated, it might cause some resistance from staff. To reduce such resistance, an organization should ensure that the staff understand how to use the ERP system. In addition, top executives of the organization should play a role in setting goals and following up on ERP projects.

1.3 An organization should place importance on the operation of the ERP system to every department to cover all its business processes. Staff should also be encouraged to familiarize themselves with the ERP system until it becomes routine. This would better the organization's performance, and increase the organizations' profit, and market share.

2. Recommendations for Future Research

2.1 Mixed methods research is recommended for future study by employing both quantitative and qualitative research. The research could be conducted mainly with the quantitative method and is supported by qualitative methods for more extensive and in-depth data.

2.2 Further studies on other factors under the TOE framework, which are expected to affect ERP assimilation, are suggested. This would yield in depth and diverse information that could lead to ERP assimilation and later to firm performance. Examples of such factors are internet skills, technical know-how, financial resources, human resources, and industry environment.

2.3 As the present study was conducted only with the manufacturing industry, further studies with other industries are recommended as organizational structure and culture of each industry are different. Moreover, necessary information for the adoption of the ERP system of each industry differs from industry to industry. Further studies on other industries would give diverse and useful information both for the industries themselves and the country in the future.

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