



Knowledge Transfer and Its Impacts on Software Development in a Multinational Enterprise

Anyanitha Distanont

College of Innovation, Thammasat University

2 Prachan Road, Phra Barom Maha Ratchawang, Phra Nakhon, Bangkok 10200, Thailand.

Email : anyacitu@tu.ac.th

Abstract

This research study aims to investigate the factors that influence the effectiveness of knowledge transfer in the software development of a multinational enterprise. The comparison studies all factors of personnel at the headquarters in the United Kingdom and subsidiaries in Thailand and proposes ways to effectively transfer appropriate knowledge between staff in each country. The research methodology consisted of a literature review, observations, and interviews. Data collection was conducted using a set of questionnaires and analyzed using exploratory factor analysis and structural equation modeling (SEM). Research findings revealed five groups of factors that affected knowledge transfer related to software development in a multinational enterprise: internal organizational management, organizational culture, working contexts, knowledge transfer process, and people's capabilities. These findings can be applied to working plans between software development teams of transnational corporations with different working styles in terms of systems, thinking methods, attitudes, cultures, language, or even working schedules. These differences can influence collaborative work. A good plan enhances effective learning and knowledge transfer, leading to the success of the project operation.

Keywords : Knowledge transfer, Software development, Multinational enterprise



Introduction

The software industry has been growing rapidly for the past two decades. With this growth, software development corporations around the world have faced obstacles and challenges in developing software in various dimensions (Damian & Moitra, 2006; Herbsleb & Moitra, 2001). These difficulties have involved large complex software, the high cost of software development, software quality that does not meet the customers' requirements, low standard of software design, overly urgent deadlines, and innovative software (Dingsoyr & Smite, 2014). To solve these problems, software development corporations have had to expand their teams to other countries, forming multinational enterprises (MNEs) through joint ventures and investments between two companies or subsidiaries. Since 1980, MNEs have chosen to expand production in many countries due to the low cost of investment in the software industry. In 2010, the market value of outsourcing by MNEs in the information technology (IT) industry was \$32 billion. Tambe and Hitt (2010) found that 5% of work was outsourced in the IT industry in the United States in 2010, which increased to 30% in 2015. Moreover, global IT spending was estimated to top \$4.8 trillion in 2018, with the US accounting for approximately \$1.5 trillion of the market (The Computing Technology Industry Association, 2018). Many factors have influenced software development corporations' decision to become MNEs. These factors include low wages, lack of software development resource problems, closeness of the target market or customers of the companies, acquisition of experience and new knowledge from the development team in foreign countries, and utilization of follow-the-sun development to reduce working time and promote continuous development so that the corporation can deliver software to the customers in time and serve the customers' needs (Herbsleb & Moitra, 2001; Ebert & De Neve, 2001; Conchúir et al., 2009). Software development is a process based on communication and collaboration. The most critical factor for software development is knowledgeable staff who have the same understanding of the system. Therefore, the most crucial process for software development is knowledge transfer, as it causes knowledge collection and exchange among personnel and teams to produce the highest benefits (McKeough et al., 1995; Distanont et al., 2012). However, multinational software development is more complex than other forms because team members have to work collaboratively under the limitations of place, time, and culture. Many corporations have implemented several methods to solve the problem by fixing rules of knowledge transfer among personnel at headquarters and subsidiaries, such as hiring trainers from the country in which the company is based to transfer experience to the staff of the subsidiaries or technical knowledge to new employees.

Despite these efforts, software development teams, including those within MNEs, still face problems both during the development project and after project submission to customers. This research study aims to investigate the factors that affect knowledge transfer in the software development of an MNE. Factors and concepts of knowledge transfer development are



emphasized. Determining knowledge transfer methods can increase work effectiveness (Palvalin et al., 2018). By studying the factors affecting knowledge transfer between headquarters and subsidiaries, we can develop a conceptual knowledge transfer framework that is appropriate for personnel in each section and can be used as a guideline for the corporation to emphasize knowledge transfer and support the success of the software development process.

Literature Review

Software Development in Multinational Enterprises

Software development in MNEs is the production of product development and software services based in more than one foreign country in terms of multinational company establishment or outsourcing to be a part of the software development team in their own country. Factors that enhance multinational software development include low product development costs, reduction in working time limitations by utilizing time zones for longer periods of product development, access to a more significant and higher-quality labor base, the opportunity for work experience exchange and innovation in the country, and the opportunity for market and customer base access. Sahay (2003) describes three characteristics of organizational structure in multinational software development: outsourcing, alliance, and subsidiary. Camel and Agarwal (2001) similarly describe five models of multinational software development: three intra-firm and two external to the firm. The intra-firm models consist of a subsidiary, acquisition, and an offshore development center, while the two external models consist of joint venture and outsourcing. Dingsoyr and Smite (2014) concluded that software development in MNEs is managed and administered in three modes: intra-organization, inter-organization, and outsourcing. Intra-organization is related to the subsidiary arrangement in foreign countries in which the enterprise functions as administrator. The investor and software development team members are all staff at the enterprise subsidiaries. Inter-organization includes joint ventures (two companies collaboratively investing in establishing a new company) and strategic alliances (the sharing of resources, personnel, and knowledge to work and create advantageous competition in business or project). Outsourcing is the process of offering a person or external organization the power to hire employees by determining criteria and controlling all steps of employment from the policy level to the practical level.

Knowledge Transfer in the Software Development of Multinational Enterprises

In the MNE context, knowledge transfer is key to propelling the organization effectively (Distanont et al., 2012; Ismail et al., 2018; Jalal & Toulson, 2018). Internal knowledge of MNEs can be divided into three types: (1) technical knowledge, (2) systematic knowledge, and (3) strategic knowledge. Technical knowledge relates to the working skills and functional potential of individual workers and is created through innovative concepts and technology. It is explicit



knowledge, as it can be in the form of process and literal transfer among individuals, and it is practical knowledge with less complication (Distanont, Haapasalo, & Vaananen, 2014). Systematic knowledge is a more complex form of knowledge based on an understanding of structural connections between internal units. This type of knowledge might include guidelines for new human resource administration and would be necessary to understand the model of social relations in an organization. Systematic knowledge is thus created and used by medium-level personnel in the organization (Distanont et al., 2012). Strategic knowledge is related to organizational administration. It is based on cumulative experiences and is used to link to connected concepts (Allred, 2001; Davel, Toit, & Mearns, 2017). This type of knowledge is based on appropriate practice, observation, and adjustment or usual utilization. Therefore, it is highly complex knowledge that is created and used by the administrators of an organization (Allred, 2001). It is mostly tacit knowledge that is difficult to transfer and exchange between people, as it is related to skills, experiences, and individual expertise. As mentioned, in the business administration of MNEs, there are two dimensions of the knowledge transfer process: inter- and intra-firm knowledge transfer. This research aims to study the intra-multinational firm knowledge transfer of corporations that have subsidiaries in other countries. It specifically examines the knowledge transfer between a software development company headquartered in the United Kingdom and its subsidiary in Thailand.

Factors Affecting Knowledge Transfer in Multinational Enterprises

There are three types of factors that affect MNEs' knowledge transfer: (1) personal factors, (2) organizational factors, and (3) technological factors (Riege, 2007). Zhao et al. (2015) found that knowledge transfer in the project development process is affected by personal factors and project-level factors, as software development has limitations in terms of work, time, and budget but is based on technical knowledge and project administration (McFarlan & Wong, 2012). Organizational structure is a significant factor for knowledge transfer. An organization with a hierarchical structure usually sticks to experienced personnel with administrative positions; this means fewer opportunities to access the cumulative knowledge of others at lower levels (Moud & Abbasnejad, 2012). Distanont et al. (2014) and Goh (2002) examined the supportive factors of organizational administration as they relate to knowledge transfer between an organization and others. The authors found that administrative support is an important factor for knowledge transfer. Administrators help create a supportive environment for effective knowledge transfer enhancement, playing the role of activator and encouraging personnel to continuously exchange knowledge with their colleagues (Islam et al., 2018). Trustworthiness is another important factor for knowledge transfer (Saker et al., 2005; Riege, 2007; Goh, 2002), especially tacit knowledge developed through learning, action, and experience. If the transferor does not trust the knowledge receiver, the transfer of knowledge will be negatively affected (Distanont et al., 2014; Saker et al., 2005; Riege, 2007; Goh, 2002; Staples & Webster, 2008; Chen et al., 2014; Rahman et al., 2018).



Several studies have also examined whether collaboration affects knowledge transfer (Distanont et al., 2014; Riege, 2007; Rocha & Terra, 2009; Chen et al., 2014). They found that collaboration among team members, including personal relationships, leads to effective and successful knowledge transfer. Several researchers have found that personal relationships create knowledge transfer channels among team members, especially for tacit knowledge, which is based on knowledge-gaining experiences. Good relationships activate common interests and support new exchanges and cooperative relationships (Riege, 2007; Koloniari et al., 2019). Other important factors relate to direct knowledge transfer. These include the types of transferred knowledge, transferring channels, and the transferors and receivers. These factors affect the effectiveness and success of knowledge transfer (Distanont et al., 2014; Nidhra et al., 2013; Taweel et al., 2009; Saker et al., 2005; Zahran et al., 2011; Zhao et al., 2015; Marianne, 2013; Ko et al., 2005; West & Noel, 2009; Aurum et al. 2008; Peyman et al., 2014; Griffit & Sawyer, 2006; Noll et al., 2010).

Theoretical Synthesis

There are six groups of factors that affect the effectiveness of knowledge transfer within software development in MNEs (Figure 1): organizational management, organizational culture, knowledge transfer process, people's capability, project's task context, and people's openness. Based on the conceptual framework of this research, six hypotheses were formed:

Hypothesis 1: Organizational management is positively related to the effectiveness of knowledge transfer.

Hypothesis 2: Organizational culture is positively related to the effectiveness of knowledge transfer.

Hypothesis 3: The project's task context is positively related to the effectiveness of knowledge transfer.

Hypothesis 4: People's capability is positively related to the effectiveness of knowledge transfer.

Hypothesis 5: People's openness is positively related to the effectiveness of knowledge transfer.

Hypothesis 6: The knowledge transfer process is positively related to the effectiveness of knowledge transfer.

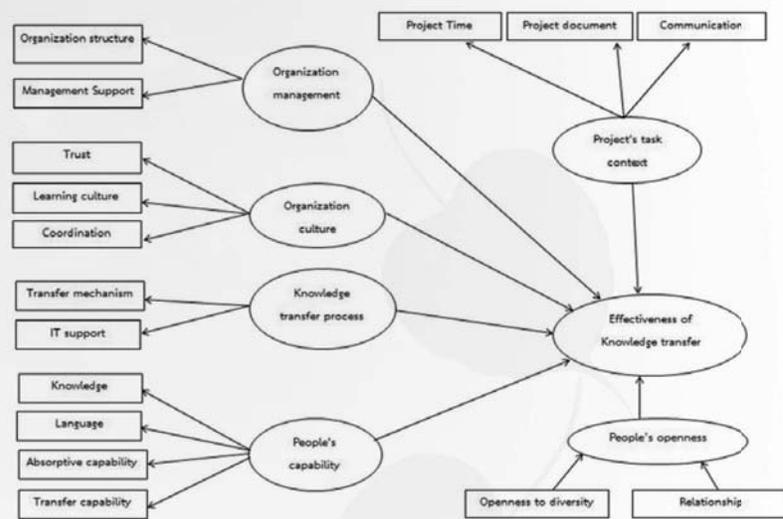


Figure 1 Research model

Research design and Methodology

Population and Sampling Method

The size of the population serves the research objectives. The population of this study included software development team personnel who worked for an MNE in Thailand and the United Kingdom. The sample size was calculated using structural equation modeling (SEM). The smallest sample size is 10–20 per variable. This study had 16 variables. Therefore, the sample size was enlarged to 200 through random sampling (Hair et al., 2010; Wolf et al., 2013; Hooper et al., 2008). The total sample was 474: 226 software developers from the MNE headquarters in the United Kingdom and 248 software developers from the MNE subsidiary in Thailand. The researcher sent the questionnaires along the line of command, requesting cooperation from top managers in the companies, who then forwarded the questionnaires down the line. As a result, 100% of the questionnaires were returned.

Data Analysis

This study explored factors affecting the effectiveness of knowledge transfer in the software development team of an MNE headquartered in the United Kingdom and its subsidiary in Thailand. This was a comparative quantitative study. First, a conceptual framework was developed based on theories, documents, articles, websites, and research related to software development, knowledge transfer, and knowledge transfer in MNEs in Thailand and other countries. Then a set of Thai questionnaires were developed that matched the research context. The questionnaire was validated through semi-structured interviews conducted with experts. After, a pilot test was done with 30 participants to test the reliability of the questionnaire using



Cronbach's alpha. The questionnaire used in this research study produced a Cronbach's alpha of 0.954, which means that it has a high level of reliability and can be used in the research.

Next, the researcher translated the questionnaire into English so that it could be used to collect data in the United Kingdom. The questionnaire was reviewed by an English-speaking consultant to check grammar and content for correctness and understandability. It was then validated a second time by Thai English experts. A pilot test was conducted with 30 participants to test reliability, producing a Cronbach's alpha of 0.981 (a high level of reliability).

The data was subsequently analyzed using exploratory factor analysis (EFA) and SEM. These methods were chosen for several reasons. First, the EFA technique was used to summarize and define a smaller set of composite factors that underlined the original variables (Hair et al., 2018). SEM was used to test the research model and the interrelationships between factors. SEM is an effective technique for conceptualizing a theoretical model, confirming relationships between variables, and gaining insight into the causal nature and strength of identified relationships. According to Hair et al. (2018), SEM provides the most appropriate and efficient estimation technique for a series of separate multiple regression equations estimated simultaneously.

Results

Reliability of the Questionnaire

The questionnaire contained 39 questions on six topics: organizational management, organizational culture, project context, people's capability, knowledge transfer process, and knowledge transfer effectiveness. Experts validated the content of both the Thai and English versions. The questionnaire was proofread by a language consultant. A pilot study was conducted with 30 participants to test the reliability of the questionnaire. The internal consistency method was used to determine Cronbach's alpha, which is acceptable when it is greater than 0.7. The Thai and English versions of the questionnaire produced Cronbach's alpha values of 0.954 and 0.981, respectively (see Tables 1 and 2). This confirmed the questionnaire's reliability and suitability for the data collection process.

Data Analysis

Table 1 Cronbach's Alpha of the Thai Questionnaire

Variable	Question	Cronbach's alpha
Organizational management	1-6	0.921
Organizational culture	7-15	0.866
Project context	16-22	0.875
People's capability	23-32	0.888
Knowledge transfer process	33-36	0.730



Table 1 Cronbach's Alpha of the Thai Questionnaire (continued)

Variable	Question	Cronbach's alpha
Knowledge transfer effectiveness	37-39	0.775
All variables	1-39	0.954

Table 2 Cronbach's Alpha of the English Questionnaire

Variables	Question	Cronbach's alpha
Organizational management	1-6	0.943
Organizational culture	7-15	0.916
Project context	16-22	0.888
People's capability	23-32	0.918
Knowledge transfer process	33-36	0.844
Knowledge transfer effectiveness	37-39	0.865
All variables	1-39	0.981
GFI	> 0.90	0.98
AGFI	> 0.90	0.94
RESEA	< 0.05	0.043

Participants

The questionnaires were validated, and a pilot test was conducted before the data were collected. The majority of participants from the Thai team were female: 135 women and 113 men. In comparison, the majority of the UK team were male: 130 men and 96 women. Ninety-nine Thai participants 99 were project managers, 80 were business analysts, and 31 were software testers. In comparison, 166 of the UK participants were project managers, 132 were business analysts, and 72 were software testers. Most participants had worked for the company for 3-4 years, with the second largest group having served more than 5 years (Table 3).

Table 3 Sample Data

Information	Details	Thailand (n = 248)		United Kingdom (n = 226)		Total (n = 474)	
		Number	%	Number	%	Number	%
Gender	Male	113	45.56	130	57.52	243	51.27
	Female	135	54.44	96	42.48	231	48.73



Table 3 Sample Data (continued)

Information	Details	Thailand (n = 248)		United Kingdom (n = 226)		Total (n = 474)	
		Number	%	Number	%	Number	%
Position	Software development	25	10.08	35	15.49	60	35.02
	Software tester	31	12.50	41	18.14	72	27.85
	Software analyst	13	5.24	31	13.72	44	15.18
	Project manager	99	39.92	67	29.65	166	12.66
	Business analyst	80	32.26	52	23.01	132	9.28
Years'	Less than 1 year	35	14.11	39	17.26	74	40.93
Experience	1-2 years	49	19.76	40	17.70	89	24.68
	3-4 years	112	45.16	82	36.28	194	18.78
	More than 5 years	52	20.97	65	28.76	117	15.61

Structural Equation Modeling Analysis

SEM is a statistical data analysis technique that can be used to prove research hypotheses based on related theories or rational theory models. It indicates relations using path analysis, which assesses the direct and indirect relationships between observed variables and latent variables. Confirmatory factor analysis (CFA) can be used to confirm the correctness of the structural relationships between variables if it follows what is expected and creates a perfect model for the case study. Goodness-of-fit is an indicator used to identify whether the model is appropriate. This can be created to conform to the context of the case study.

For the model to be accepted, there must be model fit, $CMIN/df < 3$, $GFI > 0.9$, $AGFI > 0.9$, and $RMSEA < 0.05$ (Hair et al., 2010). The $CMIN/df$ is the minimum sample discrepancy function divided by the degree of freedom. This index is described as a measure of fit. The index is a relative chi-square statistic for which values lower than a threshold (> 3.0) indicate an acceptable fit between the model and the dataset (Hair et al., 2010). GFI is the goodness-of-fit index, which indicates the proportion of observed covariances explained by the model-implied covariances. $GAGFI$ is the adjusted goodness-of-fit index. This adjustment assists in SEM, whereby more complex models fit the same data better than simpler models. $RMSEA$ is the root mean square error of approximation.

In the present study, model consistency was assessed by adjusting the values of the real model and the theoretical model (Hair et al., 2010). Results of the statistical analysis of participants' answers to the questionnaire are shown in Table 4 and Table 5.



Table 4 Goodness-of-fit Indices and Measure (Thai Team)

Measurement indices	Recommended value	Value
CMIN/df	< 3	1.7
GFI	> 0.90	0.98
AGFI	> 0.90	0.96
RESEA	< 0.05	0.038

Table 5 Goodness-of-fit Indices and Measure (UK Team)

Measurement indices	Recommended value	Value
CMIN/df	< 3	1.82
GFI	> 0.90	0.98
AGFI	> 0.90	0.94
RESEA	< 0.05	0.043

Regression weights were then applied to test the hypotheses by testing the *p*-value at 0.001, (***) 0.01, (**) and 0.05 (*), as shown in Table 6 and Table 7.

Table 6 Parameter Results (Thai Team)

Relationships between variables		Standardized	P-value
Organizational culture	← Peoples' capability	0.063	.001
KT Source	← Peoples' capability	0.562	.001
KT receipt	← Peoples' capability	0.678	.001
Project context	← Organizational culture	0.150	.001
Trust	← Organizational culture	0.506	.001
Coordination	← Organizational culture	0.522	.001
Learning culture	← Organizational culture	0.460	.001
Communication	← Project context	0.623	.001
Document quality	← Project context	0.169	.001
KT process	← Project context	0.330	.001
IT support	← KT process	0.370	.001
Effectiveness of KT	← KT process	0.339	.001
Transfer mechanism	← KT process	0.288	.001
Effectiveness of KT	← Organizational MM	-0.418	.013



Table 7 Parameter Results (UK Team)

Relationships between variables		Standardized	P-value
Organizational culture	← Project context	0.070	.001
Organizational structure	← Organizational MM	0.770	.001
Management support	← Organizational MM	0.870	.001
Trust	← Organizational culture	0.640	.001
Learning culture	← Organizational culture	0.720	.001
Coordinate	← Organizational culture	0.360	.001
Time	← Project context	0.760	.001
communication	← Project context	0.520	.001
Document quality	← Project context	0.440	.001
KT Receipt	← People's capability	0.830	.001
KT source	← People's capability	0.470	.001
Language	← People's capability	0.370	.001
Effectiveness of KT	← Organizational' culture	0.470	.004
Effectiveness of KT	← People's capability	0.160	.007

The results of the SEM analysis revealed that the factor that directly affected the effectiveness of knowledge transfer in the Thailand group was the knowledge transfer process (55% effective; $R^2 = 0.55$). The factor that indirectly affected the effectiveness of knowledge transfer was project context (32% effective; $R^2 = 0.32$). The factor that directly affected project context was organizational culture, which could expose project context at 5% ($R^2 = 0.05$). People's capability revealed an organizational culture factor of 13% ($R^2 = 0.13$), as shown in Figure 2.

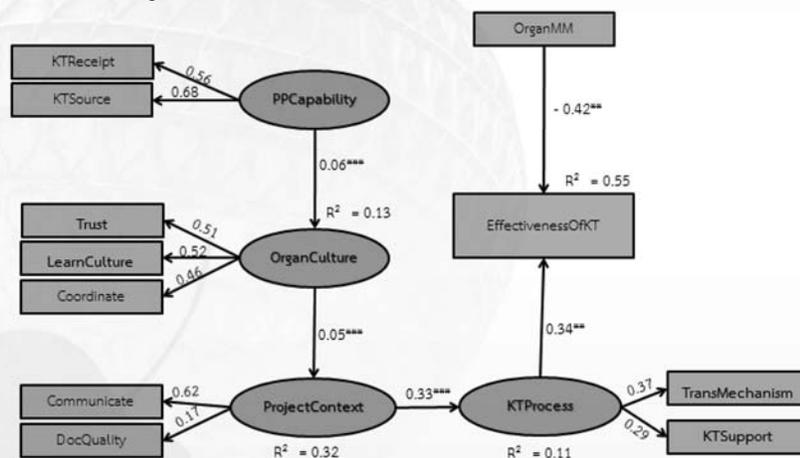


Figure 2 Summary of the relationships between variables from the Thai group.

The results of the SEM analysis revealed that the factors that directly affected the effectiveness of knowledge transfer in the UK group were organizational management, organizational culture, people's capability, and the knowledge transfer process. This could expose the effectiveness of knowledge transfer by 54% ($R^2 = 0.54$). This other factor that indirectly affected the effectiveness of knowledge transfer was project context, which showed an organizational factor of 14% ($R^2 = 0.14$).

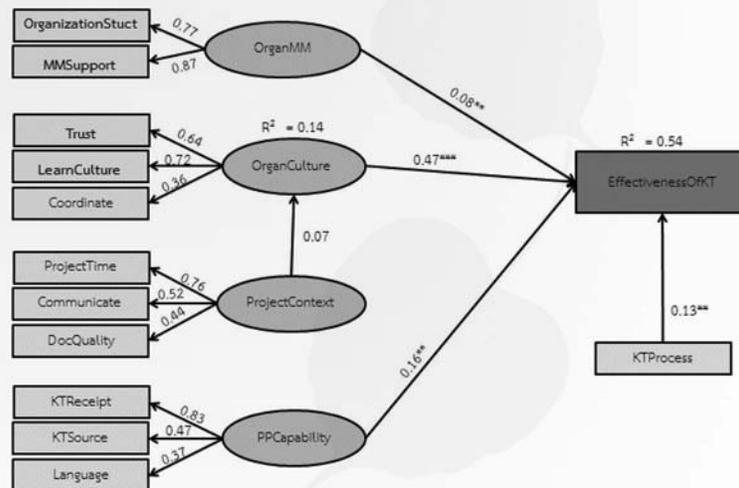


Figure 3 Summary of the relationships between variables from the UK group

Discussion and Managerial Implications

The results of the SEM analysis revealed several factors that affected the effectiveness of knowledge transfer in the software development departments of an MNE in Thailand and the United Kingdom. These factors are described below.

Organizational Management

The results revealed that, in the UK group, internal structural project factors positively affected the effectiveness of knowledge transfer, as the organization had a flat organization structure. Both the UK and Thai groups had more communication opportunities to exchange knowledge. Creation of inspiration, follow-up, and evaluation presented challenges for the UK group personnel, which encouraged more knowledge transfer. This was different from the Thai group, where internal management factors negatively affected the effectiveness of knowledge transfer because the Thai group did not like to work under as many rules, regulations, and laws. The presence of indicators, a follow-up plan, and evaluations caused a lack of politeness when the participants did not understand the points.



Some participants did not transfer their own knowledge to others; therefore, knowledge could not be utilized properly in the project. It can be concluded that internal management factors are the least important factor, which is in line with the findings of previous studies that suggested participants are pleased to exchange knowledge. The use of rules, regulations, or motivation may have little effect on the effectiveness of knowledge transfer.

Organizational Culture

Organizational culture was found to directly affect the effectiveness of knowledge transfer, and was the most important factor in the UK group. The factor was propelled by internal management in the project. Good time management and appropriate and sufficient communication in the organization facilitated opportunities for knowledge transfer. However, in the Thai group, organizational culture was propelled by people's capacity. The Thai group exhibited diverse knowledge, knowledge transfer tied to trustworthiness, and positive relationships. The findings reflect how Western organizational culture depends on good working processes, while Eastern organizational culture depends on individual capacity.

Project Context

The findings also showed that the project context directly affected the effectiveness of knowledge transfer. The UK group felt that the project context affected organizational culture, but the Thai group thought that communication among project members, quality, accessibility, and usable project documents affected knowledge transfer depending on the type of knowledge and software development process (Zho et al., 2013), as people will have more knowledge and understanding towards software development. However, previous studies have found that project context directly affects the effectiveness of knowledge transfer, as personnel in the software development process spend most of their time on project development, thus reducing communication (Akan et al., 2012). They also found that project documents are essential for the future application of project knowledge.

People's Capability

The participants in the UK group stated that people's capacity directly affected the effectiveness of knowledge transfer. If personnel have a similar knowledge level in transferring and receiving appropriate knowledge, this can benefit project development and outcomes. The transferor should have the capacity to teach, screen, and arrange knowledge in a way that helps receivers understand its objectives and details. They can also help develop the necessary software using complex knowledge that can be more easily understood. Moreover, the receiver should have systematic thoughts, an intention to receive the knowledge, and the capacity for knowledge integration in their own work, representing real usefulness.

In comparison, participants in the Thai group thought that people's capacity indirectly affected knowledge transfer and felt it was a factor that propelled organizational culture. Capacity



was the most important factor in the Thai participants' opinions. However, the UK group thought that people's capacity was only moderately important. The findings also revealed that effective knowledge transfer depended on knowledge receiving for the UK group but on transferring capacity for the Thai group.

Knowledge Transfer Process

Both the Thai and UK groups felt the knowledge transfer process directly affected the effectiveness of knowledge transfer, as the participants were part of the same working process under the same knowledge transfer model. However, this is less important compared to the findings of previous research that explored the basic structure and IT used to support knowledge transfer within organizations in the IT era, especially in organizations with personnel from many countries working together. IT is an important tool that can connect personnel who work in different places and time zones, allowing them to exchange knowledge effectively. In addition, knowledge transfer methods should be appropriate for the types of knowledge and working processes involved in the project. The research findings reflect how a lack of personal attention can lead to a failure to invest in knowledge transfer. Finally, an important factor that propels the process is that knowledge transfer might not be useful for software development projects.

Conclusions and Recommendations

Research results can be applied as a guideline for effective knowledge transfer in software development corporations by considering the following factors.

Organizational Management

In organizational management, administrators should reinforce international knowledge transfer as a part of the organizational strategy to create a competitive advantage by encouraging communication between personnel in different countries, allowing them to share their understanding and awareness of knowledge transfer. The top administrator should specify the duties of administrators in each section in each country, such as the business development department, system development department, and system investigation department. They should highlight practical ways to transfer knowledge in the same plan, assign specific people to be knowledge transfer partners, and conduct follow-up activities and evaluations based on a fixed timeline. The findings reveal that the organization should adjust the internal management of the personnel in the Thai subsidiary, as there was a negative relationship between internal management and the effectiveness of knowledge transfer. The Thai team had applied cross-working duties, but these did not enhance knowledge transfer; therefore, administrators should study whether this type of work presents problems. Soft skill training should be provided to personnel from different departments with different work experiences to facilitate the exchange of knowledge and experiences.



Administrative Support

The personnel in the Thai subsidiary should adjust the follow-up activities and evaluation of knowledge transfer to focus on teamwork rather than on the individual level. The results revealed that the personnel had good relationships but would not transfer their knowledge to others. Group evaluations cause less concern, and Thai people enjoy working in a group. Group evaluations enhance knowledge transfer among personnel. Administrators should evaluate personnel collaboratively to encourage knowledge transfer.

Organizational Culture

The findings showed that organizational culture is important for knowledge transfer among personnel in both the United Kingdom and Thailand. To encourage a good organizational culture, it is necessary to develop people's capacity. To do this, administrators should adjust operations as follows:

Capacity of Knowledge Transfer. To develop capacity, the organization should provide soft skill training of necessary skills by specifying time for the transferor to prepare themselves before transferring knowledge. The receiver should evaluate the transferor so that there will be development in the future.

Capacity of Knowledge Receiver. The administrator should assign the receiver to study the related knowledge in advance and prepare themselves before receiving the knowledge. In the meeting, the administrator should clearly specify the objectives of the meeting, which knowledge should be focused on, and which points should be understood. They should also launch a post-test after the knowledge transfer process to see if the transferor has successfully transferred the knowledge. If there are any questions, the transferor can address them in the meeting.

Project Context

Participants in the UK group stated that project context was a factor that enhanced organizational culture. The administrator should adjust the operation as follows:

Time. Before beginning the project, the administrator should assign a project manager, summarize the focus knowledge for development, and evaluate the knowledge the personnel received through the development process. If the personnel are less skillful, more time should be provided for knowledge transfer. Providing sufficient time to transfer different types of knowledge between personnel will facilitate working operations, allowing the organization to address customers' needs and have fewer errors.

Communication. The communication model is usually organized by the project manager. Therefore, the administrator should assign someone in each country to evaluate which communication model is appropriate for each project. The project manager should be a



middleman who divides their time between each sector to access and solve problems in the project development process.

Project Documents. The administrator should assign personnel to investigate each other's project documents, such as business developers, quality assurance system developers, or system developers/analysts. There should also be an updated database. The administrator should manage the system so that project documents can be easily searched since project documents are important for future knowledge transfer. The administrator should also arrange the time to record the knowledge gained from project development and transfer it to others who will develop it in the future. The model and purposes of the recording should be specified. Any related people can make a record, including business developers and system analysts, or transferring test system, which enables people to access various knowledge.

Knowledge Transfer Process

The findings showed that the knowledge transfer process was almost the least important factor in knowledge transfer, although it was still required.

Technology. The organization currently emphasizes investment in IT to enhance personnel training in both Thailand and the United Kingdom; however, the knowledge base used to store knowledge only represents business knowledge rather than technical knowledge or precise knowledge. Although the knowledge recording system is good, the necessary internal understanding is insufficient for project development. Therefore, the administrator should specify the types of necessary knowledge used for project development that present the greatest benefit.

Knowledge Transfer Methods. Organizations that promote software usually lack knowledge transfer objectives and evaluations. The administrator should specify the types of knowledge gained in the process of each knowledge transfer method, such as a business design walkthrough, and how the transferred knowledge can be utilized. Organizing these allows personnel in each sector to develop an understanding of the necessary knowledge that can be used in project development and can be applied to obtain the most benefits.

In summary, this study investigated the knowledge transfer of software development teams of an MNE headquartered in the United Kingdom and its subsidiary in Thailand. Five factors were found to affect knowledge transfer in the corporation: organizational management, organizational culture, project context, knowledge transfer process, and people's capability. The findings showed that the only factor that directly affected the effectiveness of knowledge transfer was the knowledge transfer process. Participants from the UK group stated that three factors directly affected the effectiveness of knowledge transfer: organizational culture, people's capability, and organizational management. Organizational culture had the most significant direct impact on the effectiveness of knowledge transfer and was dependent on people's capacity.



References

- Akan, H., Izbirak, G., Kaspar, C., Kaya, C., Aydin, S., Demircan, N., Bucaktepe, P., Özer, C., Aahin, H., & Hayran, O. (2012). Knowledge and attitudes towards complementary and alternative medicine among medical students in Turkey. *The Official Journal of the International Society for Complementary Medicine Research*, 12(115), 1–7.
- Allred, B. (2001). Enabling knowledge creation: How to unlock the mystery of tacit knowledge and release the power of innovation. *The Academy of Management Executive*, 15(1), 161–162.
- Aurum, A., Daneshgar, F., & Ward, J. (2008). Investigating knowledge management practices in software development organisations – An Australian experience. *Information and Software Technology*, 50(6), 511–533.
- Carmel, E., & Agarwal, R. (2001). Tactical approaches for alleviating distance in global software development. *IEEE Software*, 18(2), 22–29.
- Child, J., & Rodrigues, S. (1996). The role of social identity in the international transfer of knowledge through joint ventures. In S.R. Clegg and G. Palmer (Eds.), *The politics of management knowledge* (pp. 46–68). London: SAGE Publishing.
- Chen, C.-J., Hsiao, Y.-C., & Chu, M.-A. (2014). Transfer mechanisms and knowledge transfer: The cooperative competency perspective. *Journal of Business Research*, 67(12), 2531–2541.
- Conchúir, E., Olsson, H. H., Ågerfalk, P. J., & Fitzgerald, B. (2009). Benefits of global software development: Exploring the unexplored. *Software Process Improvement and Practice*, 14, 201–212.
- Damian, D., & Moitra, D. (2006). Guest editors' introduction: Global software development: How far have we come?. *IEEE Software*, 23(5), 17–19.
- Davel, R., Du Toit, A. S. A., & Mearns, M. (2017). Understanding knowledge networks through social network analysis. *International Journal of Knowledge Management*, 13(2), 1–17.
- Dingsøyr, T., & Smite, D. (2014). Managing knowledge in global software development projects. *IEEE IT Professional*, 16(1), 22–29.
- Distanont, A., Haapasalo, H., Rassameethes, B., & Lin, B. (2012). Knowledge transfer pattern in collaborative product development. *International Journal of Intercultural Information Management*, 3(1), 59–81.
- Distanont, A., Haapasalo, H., Kamolvej, T., & Meeampol, S. (2012). Interaction patterns in collaborative product development (CPD). *International Journal of Synergy and Research*, 1(2), 21–43.
- Distanont, A., Haapasalo, H., Vaananen, M., & Lehto, J. (2012). The engagement between knowledge transfer and requirements engineering. *International Journal of Management, Knowledge and Learning*, 1(2), 131–156.



- Distanont, A., Haapasalo, H., & Vaananen, M. (2014). Organising knowledge transfer in requirements engineering over organizational interfaces. *International Journal of Innovation and Learning*, 15(1), 41-64.
- Ebert, C., & De Neve, P. (2001). Surviving global software development. *IEEE Software*, 18(2), 62-69.
- Goh, S. (2002). Managing effective knowledge transfer: An integrative framework and some practice implications. *Journal of Knowledge Management*, 6(1), 23-30.
- Griffit, T., & Sawyer, J. (2006). Supporting technologies and organizational practices for the transfer of knowledge in virtual environments. *Group Decision and Negotiation*, 15(4), 407-423.
- Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Prentice-Hall, Inc.
- Herbsleb, J. D., & Moitra, D. (2001). Global software development. *IEEE Software*, 18(2), 16-20.
- Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, 6(1), 53-60.
- Ismail, M., Hamzah, S., & Bebenroth, R. (2018). Differentiating knowledge transfer and technology transfer: What should an organizational manager need to know?. *European Journal of Training and Development*, 42(9), 611-628.
- Islam, M., Jasimuddin, S., & Hasan, I. (2018). Determinants that influence knowledge sharing: An integrated literature review. *International Journal of Knowledge Management Studies*, 9(4), 363-380.
- Jalal, H. A., & Toulson, P. (2018). Knowledge sharing and organisational culture: The hidden moderator for competitive advantage. *International Journal of Knowledge Management Studies*, 9(4), 325-341.
- Ko, D-G., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations. *MIS Quarterly*, 29(1), 59-85.
- Koloniari, M., Vraimaki, E., & Fassoulis, K. (2019). Factors affecting knowledge creation in academic libraries. *Journal of Librarianship and Information Science*, 51(1), 20-33.
- Marianne, K. (2013). Knowledge sharing barriers of acquisitioned growth: A case study from a software company. *International Journal of Engineering Business Management*, 5(8), 18-29.
- McKeough, A., Lupart, J., & Marini, A. (1995). *Teaching for transfer: Fostering generalization in learning*. Washington: Lawrence Erlbaum Associates, Inc.
- McFarlan, F.W., & Wong, J. (2012). China's growing it services and software industry: Challenges and implications. *MIS Quarterly Executive*, 11(1), 1-9.
- Moud, H. I., & Abbasnejad, B. (2012). Factors affecting knowledge transfer in project based organizations. *1th International Conference of the Asia Chapter & 2nd Conference of the MENA Chapter of the Academy of Human Resource Development & 10th International Conference on Knowledge, Economy and Management*, Istanbul, Turkey.



- Nidhra, S., Yanamadala, M., Afzal, W., & Torkar, R. (2013). Knowledge transfer challenges and mitigation strategies in global software development—A systematic literature review and industrial validation. *International Journal of Information Management*, 33(2), 333–355.
- Noll, J., Beecham, S., & Richardson, I. (2010). Global software development and collaboration: Barriers and solutions. *ACM Inroads*, 1(3), 66–78.
- Palvalin, M., Vuori, V., & Helander, N. (2018). The relation between knowledge transfer and productivity in knowledge work. *Journal of Knowledge Management Research & Practice*, 16(1), 118–125.
- Peyman, A., Zahedi, M. R., & Hosein, S. H. (2014). A conceptual framework to address barriers to knowledge management in project-based organizations. *Education, Business and Society: Contemporary Middle Eastern Issues*, 7(2/3), 98-119.
- Rahman, M., Moonesar, I., Hossain, M., & Islam, M. (2018). Influence of organizational culture on knowledge transfer: Evidence from the government of Dubai. *Journal of Public Affairs*, 18, 1–13.
- Riege, A. (2007). Actions to overcome knowledge transfer barriers in MNCs. *Journal of Knowledge Management*, 11(1), 48–67.
- Rocha, T., & Terra, J. C. (2009). MNC knowledge transfer, global integration, and local responsiveness in Brazilian subsidiaries. *Internext – Revista Eletrônica de Negócios Internacionais*, São Paulo, 4(1), 20–39.
- Sahay, S. (2003). Global software alliances: The challenge of standardization. *Scandinavian Journal of Information Systems*, 15, 3–21.
- Saker, S., Saker, S., Nicholson, D. B., & Joshi, K. D. (2005). Knowledge transfer in virtual systems development teams: An exploratory study of four key enablers. *IEEE Transactions on Professional Communication*, 48(2), 201–218.
- Spender, J. C. (1996). Organizational knowledge, learning, and memory: Three concepts in search of a theory. *Journal of Organizational Change Management*, 9(1), 63–78.
- Staples, D. S., & Webster, J. (2008). Exploring the effects of trust, task interdependence and virtualness on knowledge sharing in teams. *Information System Journal*, 18, 617–640.
- Taweel, A., Delaney, B., Arvanitis, T. N., & Zhao, L. (2009). Communication, knowledge and coordination management in globally distributed software development. *4th IEEE International Conference on Global Software Engineering*, 13-16 Jul 2009, Limerick, Ireland: IEEE Publisher.
- The Computing Technology Industry Association. (2018). *IT Industry Outlook 2018*. Retrieved August 8, 2019, from The Computing Technology Industry Association Website: <https://www.comptia.org/resources/it-industry-trends-analysis>.



- West, G. P., and Noel, T. W. (2009). The impact of knowledge resources on new venture performance. *Journal of Small Business Management*, 47(1), 1–22.
- Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety. *Educational and Psychological Measurement*, 76(6), 913–934.
- Zahran, A. S., Hackney, R., & Ozkan, S. (2011). Factors impacting knowledge transfer success in information systems outsourcing. *Journal of Enterprise Information Management*, 24(5), 455–468.
- Zhao, D., Zuo, M., & Deng, X. (2015). Examining the factors influencing cross-project knowledge transfer: An empirical study of IT services firms in China. *International Journal of Project Management*, 33(2), 325–340.
- Zho, M., Zhao, D., & Gao, P. (2013). Models for describing knowledge transfer mechanisms. *Scientific Journal of Management Science and Engineering*, 3(3), 63–72.