Master's Dissertation 2023

Effectiveness Measurement and Evaluation of Using Interactive Videos in Knowledge Transfer:

Regarding the Detailed Design Phase of the Software Outsourcing Project between Vietnam and Japan

MAI ANH NGUYEN

Student ID Number：82134538

Supervisor: Professor Tetsuya Toma

September 2023

Graduate School of System Design and Management,

Keio University

Major in System Design and Management

SUMMARY OF MASTER'S DISSERTATION

Student Identification Number	82134538	Name	MAI ANH NGUYEN

Title

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Abstract

With the remarkable expansion of software development and the increasing demand for software outsourcing, Vietnam and Japan have emerged as strategic partners, fostering a win-win relationship. The research focuses on the challenges encountered during the knowledge transfer process between onsite and offshore teams, particularly clarifying the problems in a specific phase called "detailed design" of the software outsourcing projects. Traditional knowledge transfer tools have both pros and cons; however, they may not adequately address all issues related to the complexity of the detailed design, geographical distance, work schedules, knowledge backgrounds, and cultural differences between Vietnam and Japan. Thus, the utilization of interactive video as an additional knowledge transfer method is proposed to mitigate those problems. The research aims to analyze the effectiveness of the interactive video for knowledge sharing compared with other prevalent methods in Vietnam and Japan's software outsourcing projects. The verification experiment statistically proves that the interactive video group outperforms the traditional group regarding the ease of data tracking, the reduction of time constraints, and the comprehension capability depending on the knowledge types of the detailed design. The findings also reveal the correlation between the interpretation ability and various powerful characteristics of the interactive video. The case study validations including interview results adopt qualitative analysis in both a demo experiment and a real-world project to prove the hypothesis and provide additional insights for future research.

Keywords: Knowledge transfer, software outsourcing, detailed design, communication methods, interactive video

Table of Contents

List of figures

List of tables

Chapter 1: Introduction

Information technology plays a significant role in the development of many industries, especially in promoting global partnerships. Contributing to the enhancement of win-win relationships and the global competitiveness, the advanced software development is known as a core area of the information technology (IT) industry. The cooperation has been going beyond national borders by taking advantage of allocating IT development activities to other countries. The chapter provides an introduction to the study, including the research background, the objective, and an overview of the research structure.

1.1 Background of the study

Software outsourcing is considered as one of the most critical strategies to promote knowledge exchange and attract a large workforce. The book "Global IT outsourcing: Software development across borders" indicates that software development requires "knowledge-intensive activity", which is driven by "knowledge" and "network" connectivity. Furthermore, the global software outsourcing can occur in a fast-changing global market involving companies of all sizes between developed and developing countries (Sahay et al., 2003). Japan has a high demand for software outsourcing with developing countries due to the labor shortage triggered by the alarming rate of population decline. A recent study has revealed that Japan could encounter a shortage of over 11 million labours by 2040, leading to economic challenges due to its increasingly aging population. Additionally, there will be a rapid decline in the working-age population, and the workforce availability is projected to decrease by approximately 12% in 2040 compared to 2022 despite a ongoing demand for manpower resources (Wei & Katanuma, 2023). At the same time, the high demand for IT professionals in the IT industry stems from Japan's digital transformation efforts, the need for IT solutions in numerous industries and its strength as a global IT hub. As a result, Japan needs to collaborate with international counterparts to find solutions to the high-skilled labor shortage. Vietnam has become Japan's most preferable software outsourcing country in recent years because of its competitive advantages in the market and the outstanding quality of labor sources. The software development process in the outsourcing industry is conducted between the onsite team in Japan and the offshore team in Vietnam. Knowledge transfer between the two bridgeheads frequently faces difficulties in different stages of the development process due to numerous factors, including geography, culture, knowledge, means of communication, etc. "Detailed design" emerges as one of the most concerning stages, prominently influenced by the characteristics of the experience and working style of the two countries. Various means of communication have been utilized to improve knowledge transfer but have yet to achieve the expected results. There is a fascinating approach called "interactive video", achieving substantial recognition in the fields of advertising, education, and training. However, it has never been studied and applied at a specific stage such as detailed design in the software outsourcing projects.

1.2 Research Purpose

The objective of this paper is to highlight the obstacles encountered during knowledge transfer process between onsite and offshore teams, particularly clarifying the problems regarding detailed design comprehension in the software outsourcing projects between Vietnam and Japan. At the same time, a new method called the "interactive video", known as a supplementary communication tool for the knowledge transfer is proposed to enhance the understanding of the detailed design, as well as productivity in the workplace. Besides analyzing the relationships among the interactive functions and the interpretation capabilities, the research also aims at verifying which knowledge types are appropriate for the interactive video approach.

1.3 Research Structure

Chapter 1 delivers an introduction to the study, including the research background, the objective, and an overview of the research structure.

Chapter 2 presents the background of software outsourcing by discussing the global software outsourcing market as well as the Vietnam and Japan software outsourcing market. In addition to the market analysis regarding business aspects, existing issues and specific challenges of knowledge transfer in software outsourcing are explored to define the scope of the research.

Chapter 3 provides a comprehensive literature review of knowledge transfer approaches in the software outsourcing projects. Notably, the potential utilization of interactive videos is explored, highlighting the novelty of the research.

Chapter 4 introduces a proposal for the interactive video-based model and the corresponding research hypotheses. Furthermore, the chapter also demonstrates two types of knowledge relevant to the detailed design.

Chapter 5 describes the verification experiment, including the objectives, participants, procedures, and results of the verification project. The comparison of knowledge test scores and completion time between two different groups, correlation analysis and other findings are explored in this chapter.

Chapter 6 consists of two case studies for validation including a demo project and a real-world project. The objectives, participants, procedures, and results are analyzed by qualitative approaches, along with the discussion of the findings.

Chapter 7 offers a comprehensive discussion on the verification, validation results, and additional insights derived from the research. There are several considerations regarding the limitations of the research and multiple potential areas for future research.

Chapter 8 summarizes the entire research, highlighting the key findings and conclusions.

Chapter 2: Background of the software outsourcing market

Software development outsourcing is a contractual commitment between a client and an external service provider to delegate a specific task, process, function, or any parts of the software development activities in return for financial benefits (Kern & Willcocks, 2000). The contracts commonly occur between developed and developing countries since they can provide numerous advantages for each other.

2.1 Global software outsourcing market

Section 2.1 provides an overview of current global software outsourcing landscape, with a focus on its significance and ongoing growth trends. Additionally, the existing challenges and knowledge problems faced on the global scale are analyzed based on various pertinent factors.

2.1.1 Overview of the global software outsourcing market

The global software outsourcing market is currently witnessing remarkable growth, which could be analyzed based on statistical figures. A market report by Grand View Research reveals that the global IT professional services market amounted to around $821 billion in 2022 and is projected to experience a compounded annual growth rate acceleration of over 9% from 2023 to 2030 (Grand View Research, 2023). In the dynamic landscape of the IT outsourcing market, it is imperative to provide services to both domestic and global customers. Many client companies are willing to invest time and financial support in developing cutting-edge technologies to fight against competitors. As a result, the demand for software outsourcing has experienced substantial growth over the years, primarily driven by the forces of globalization.

2.1.2 Existing problems of the global market

Regarding collaboration issues, working in different languages, cultures, and time zones may cause miscommunication and conflict between clients and vendors (Cheng et al., 2021). Cultural differences including punctuality, indirect communication, annual leaves, national holidays, etc. are also challenges in an international working environment (Krishna et al., 2004). In addition, the inaccuracy of the project estimation may trigger an abundance of failures (Jorgensen & Grimstad, 2012). Before proceeding with outsourcing development to an offshore team, it is challenging to clarify the expected specifications, delivery time, and overall scope of the project, especially the risk of hidden costs. Furthermore, the client and vendor company may encounter unexpected security problems (Ackermann et al., 2011). Data security is problematic, even though the customer side signs a contract with the vendor side to safeguard the non-disclosure of business-sensitive data and intellectual assets. Last but not least, the complexity of knowledge transfer across countries even within an organization or among organizations stems from diverse cultures that shape individuals' cognition, interpretation, and utilization of knowledge (Easterby-Smith et al., 2008). Thus, the issues of misunderstanding customers' requirements are frequently highlighted in software outsourcing projects.

2.1.3 Problems of knowledge transfer in global software outsourcing market

Knowledge is a complex and diverse concept examined within the context of individual and organizational scale regarding various aspects such as acquisition, creation, transfer, and storage, etc. (Madsen et al., 2015). The effective knowledge transfer enables organizations to save resources, both in terms of cost and time, by avoiding the repetition of mistakes and replicating successful outcomes (Tirlea et al., 2020). Knowledge transfer plays an essential part in organizations that adopt a global approach to benefit from the diversity in knowledge, labor costs, and market accessibilities across different regions (Argote et al., 2000).

The "Schematic diagram of a general communication system" (Figure 1) illustrates conceptual framework, including crucial components in the communication process (Shannon & Weaver, 1948). The information source generates the intended message from a pool of potential messages, which could consist of written or spoken words, graphics, music, and other forms of content. The transmitter shifts the message into a signal appropriate for transmission via a communication channel such as telephone, email, radio, oral speech, etc. The receiver performs as an inverse transmitter, decoding the received signal back into a message for transmission to the target destination. Shannon emphasizes the significance of noise in the system since the occurrence of disturbance can cause distortions, mistakes, and redundant information, resulting in increased uncertainty. Similarly, another research also explores this concept and the components of communication factors in A Guide to the Project Management Body of Knowledge (PMBOK) to describe knowledge transfer of software specifications in software outsourcing projects (Matsumura et al., 2009). Four pivotal factors influencing communication effectiveness are identified, including the basic specification document, detailed design, Q&A sessions, and bug reports. The research draws attention to numerous specific noises encountered during the knowledge-transmitting process, including language barriers, ambiguous expressions, disparities in knowledge and skills, cultural differences, and variations in development processes.

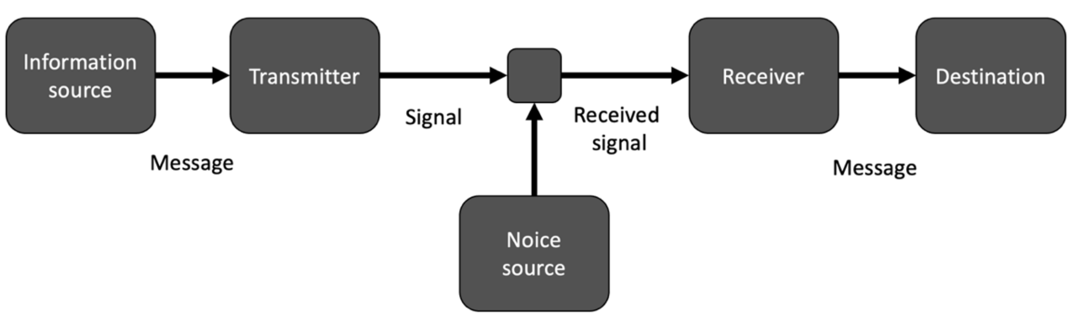

Figure 1. Schematic diagram of a general communication system (based on Shannon & Weaver, 1948)

The complexity of the knowledge should also be taken into consideration. Galbraith proved that the more complex the technology is, the more significant challenges that knowledge recipients may be encountered. Additionally, documentation is considered as a critical resource prior to the transfer process due to the possibility of the initial knowledge loss (Galbraith, 1990).

According to a qualitative study regarding knowledge transmission in IT outsourcing projects of six German clients with Indian and Russian offshore vendors, there are five key knowledge transfer challenges emerged as major concerns (Betz et al., 2010). These issues include temporal and spatial distance, language problems, specification interpretation, the absence of knowledge backflow, and uncertainty of knowledge transfer cost. The author correlated the problems identified through expert interviews with eight specific areas of activities referred from Clases/Wehner's definition as below:

- Knowledge identification

  The lack of domain knowledge within the offshore team may hinder effective knowledge transfer and impact the overall project outcomes. Furthermore, the transparency regarding the available knowledge and its location creates barriers to the knowledge retrieval, leading to inefficiencies and potential mistakes throughout the knowledge transfer process (Betz et al., 2010).

- Knowledge strategy

  Betz mentions that language problems and communication barriers cause difficulties in knowledge clarity and accuracy of information exchange between two parties. Additionally, tacit knowledge, which has not been explicitly transformed, can pose additional obstacles for recipients to comprehend it effectively. At the same time, the lack of proper control and oversight can result in the inefficient allocation of resources, the loss of intellectual assets, and difficulties in tracking and measuring the effectiveness of the knowledge transfer (Betz et al., 2010). Storti also emphasized that people are likely to absorb knowledge and information based on their own cultural perspectives (Storti, 2015). As a result, misunderstandings may occur since different cultures carry entirely distinct meanings.

- Awareness

  During long-term projects, there is a possibility of accumulating additional knowledge and information. However, the lack of transparency regarding the backflow of knowledge transfer becomes a significant issue, leading to a sense of dependency on the offshore vendor from the onsite team. Another issue is the lack of feedback regarding knowledge gaps. The onsite team supposes that the offshore team can interpret the specification, while the offshore members do not fully comprehend the requirements and does not give necessary feedback. Moreover, insufficient willingness and capabilities to share knowledge among team members may lead to the lack of collaboration and improvement in teamwork. Last but not least, knowledge acquisition is considered as means of taking advantage cause a competitive mindset rather than cooperative thinking. As a result, the barriers to facilitate knowledge transfer may hinder the collective growth of the organization (Betz et al., 2010).

- Knowledge protection

  Security and data protection emerge as prominent concerns since software outsourcing projects occurs between the client side and offshore company are located in different countries. Many countries have implemented stringent laws and regulations regarding legal safeguards in order to reduce the risk of unauthorized access and misuse. Furthermore, during the outsourcing contract, the issue of intellectual property and customer's sensitive information poses challenges for vendor companies because it is crucial to maintain trust among cooperative partners. The findings from a survey of over 300 IT company managers highlighted the significance of risks related to intellectual property rights and informational vulnerability due to the absence of regulations (Djavanshir, 2005).

- Knowledge creation

  The lack of informal communication channels in global projects due to geographical and cultural differences triggers difficulties in the spontaneous knowledge exchange. Additionally, a potential issue could arise from the absence of awareness regarding who possesses specific knowledge within the onsite team members. Thus, offshore members may struggle to identify the appropriate person to address the problem when encountering a knowledge gap (Betz et al., 2010).

- Use of IT and media

  There is a challenge in selecting what kinds of appropriate communication tools for asynchronous and synchronous knowledge transfer as well as knowledge management. Furthermore, the insufficiency of a robust broadband network structure poses a significant challenge in effectively accessing and utilizing digital resources. Another problem arises from the negative impact of latency time in video conferences, which causes delayed communication and real-time interactions, leading to decreased productivity and effectiveness in collaborative activities (Betz et al., 2010). Thus, the selection of proper communication channels performs a pivotal role in the overall success of the projects.

- Knowledge cooperation

  Firstly, the schedule and timeframe for the knowledge exchange are limited in software outsourcing projects. Secondly, the financial constraints regarding high travel expenses may restrict opportunities for face-to-face meetings. Additionally, in Asian culture, constructive criticism is not typically preferable. Last but not least, there are challenges in precisely identifying specifications and requirements (Betz et al., 2010).

- Knowledge cost appraisal

  The difficulties in temporal and spatial distances and culture and knowledge gaps require unmeasurable costs for knowledge management. The findings from expert interviews conducted for this study reveal that the communication effort between onsite and offshore teams is significantly greater in comparison with in-house or onsite scenarios. Furthermore, the experts believe that knowledge transfers between onsite and offshore members require more iterations and time. Consequently, the failure of knowledge transfer and inaccurate cost estimation may give rise to unforeseen financial problems, ultimately hindering the project's overall success (Betz et al., 2010).

2.2 Vietnam and Japan software outsourcing market

Section 2.2 illustrates a comprehensive overview of the current Vietnam and Japan's software outsourcing market, highlighting the historical background of the strategic relationship and the reason why Vietnam has emerged as a preferable software outsourcing destination for Japanese companies. Moreover, the section further analyzes prevailing obstacles, particularly focusing on the knowledge transfer problems between these two countries.

2.2.1 Overview of Vietnam and Japan software outsourcing market

Japan considers Vietnam as one of the most reliable software outsourcing countries because of many reasons. First of all, the strong relationship between the two countries was witnessed by the history. Vietnam and Japan have established diplomatic relations since 1973 (Ministry of Foreign Affairs of Japan, 2023). However, the Cambodian conflict isolated Vietnam internationally from 1979 to 1991. As a result, trade between Japan and Vietnam remained stagnant during this period. Economic sanctions against Vietnam were lifted after the Doi Moi policy initiated in 1986, and the Agreement on a Comprehensive Political Settlement of the Cambodia Conflict signed in 1991. Japan became one of the first and key investors in Vietnam since Japan saw potential prospects of Vietnam as an emerging market in a variety of important economic sectors (Do & Dinh, 2018). Furthermore, the largest portion of Official Development

Assistance (ODA) allocated to Vietnam originates from Japan, which proves the strategic partnership between the two countries (Ministry of Foreign Affairs of Japan, 2023). Japan has supported Vietnam in infrastructure development, healthcare, agriculture, education, and technology. According to Vietnam Time Reporters, Vietnam has received more than $23.5 billion of the financial aid from Japan since 1992, and more than 27,000 Vietnamese workers have been trained by JICA. Remarkably, 4.9 billion Japanese yen has been supported in technical cooperation projects, proving that Vietnam has become a promising technology hub for Japan (Vietnam Times Reporters, 2023).

Regarding the information technology market, the number of Vietnamese software outsourcing companies is growing at an amazing rate since the demand for the ICT transformation from all over the world. Taking advantage of the population, high educational level, hard-working people, cost-effectiveness, and stability, Vietnam is an emerging and attractive hotspot for outsourcing software development. This country is known as an outsourcing destination most preferable by Japanese companies (Resorz, 2022). Accounting for 48% of the overall preference rate, Vietnam has the most significant market penetration rate in comparison with the rest of the region (Figure 2). In other words, Vietnam is leading Asia in the software outsourcing market for Japan, surpassing experienced competitors including China and India. It is expected that Vietnam and Japan's outsourcing market will grow faster in the upcoming years, contributing to the win-win relationship in economic and technical fields between these two countries.

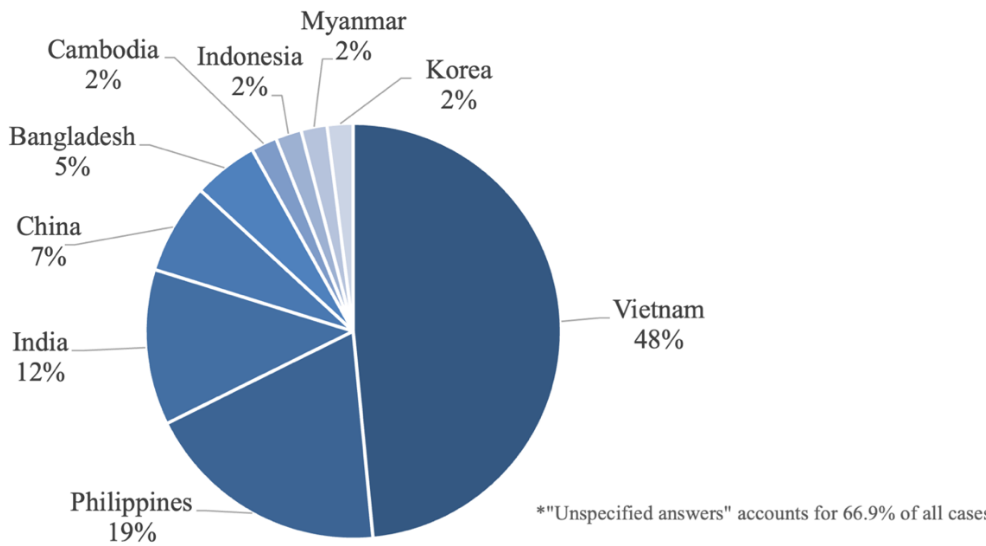

Figure 2. Offshore development consideration destinations by country ratio (excluding unspecified answers) (Resorz, 2022)

Table 1. Monthly salary of software offshore employees (Resorz, 2022)

Cost per month (ten thousand yen)	Programmer	Senior engineer	Bridge system engineer	Project manager
China	42.09	52.06	84.78	85.77
Vietnam	**31.73**	**39.88**	**51.34**	**57.94**
Phillipines	36.25	49.63	71.07	65.83
Myanmar	24.47	37.89	48.59	62.81
Bangladesh	29.64	39.64	69.64	46.07
India	34.72	51.56	67.97	83.90

According to a report on offshore services conducted in 2022, cost competitiveness is one of the major reasons Japanese companies opt for software outsourcing (Resorz, 2022). The table of monthly salaries of software offshore in the most popular countries indicates that Vietnam and Myanmar offer the most reasonable cost compared to China, Philippines, Bangladesh, and India (Table 1). However, Myanmar's political situation is unstable, and the number of high-skilled engineers speaking Japanese cannot match the demand of the Japanese market compared to Vietnam. In order to compete with other popular offshore countries, many outsourcing start-ups in

Vietnam have made an effort to reduce to cost of human resources to attract Japanese companies.

As can be seen from the table of "Comparisons among offshore-popular countries", the time difference between Vietnam and Japan is 2 hours, which is not relatively significant compared to other countries (Table 2). Furthermore, there is a fact that with the population of nearly 100 million, Vietnam’s labor workforce rate was over 76% in 2019 and remained unchanged from 2011 to 2019 (Institute of Labour Science and Social Affairs, 2022). SystemEXE indicates that the number of Vietnamese IT engineers ranked second after Indonesia in Southeast Asia with 270,000 engineers (SystemEXE, 2021). With the fast-paced development of technology, and the demand for IT professionals, many universities and technical institutes have delivered specialized courses to train roughly 55,000 IT graduates each year (M. N. Nguyen, 2022). Thus, the abundance of human resources in Vietnam shows a potential supply for the IT service sector. In contrast, Japan has been facing a severe labor shortage due to the aging population. As a well-known top technical country in the world, Japan needs to seek a large pool of young and skilled IT professionals in Vietnam. As a result, the number of Japanese learners who are Vietnamese people living in Japan has been increasing exponentially, ranked second after China and number one among Southeast Asian countries. At the same time, Vietnam witnessed an outstanding figure of 24,612 people taking the Japanese language proficiency test (JLPT) in December 2022 (Japan Foundation & JEES, 2023). It should be emphasized that the number of JLPT test examinees with N1 and N2 levels ranks at the top among Southeast Asian countries. The data indicates that Vietnamese learners aim at the highest level of Japanese proficiency, which is necessary for the Japanese working environment. Notably, Japanese clients show reluctance when it comes to collaborating with partners who communicate in foreign languages (Tran, H. H., 2021). Despite achieving moderate TOEIC average scores, Vietnam could be considered as a great choice since most Japanese companies prefer to work in their native language.

Table 2. Comparisons among offshore-popular countries

Category		China	Vietnam	Philippines	Myanmar	Bangladesh	India
Time difference *[1]		1 hour	2 hours	1 hour	2.5 hours	3 hours	3.5 hours
Population (million) *[2]		1410	98	115	54	171	1420
Number of IT graduates (thousand)		1180 *[3]	55 *[4]	77 *[3]	46 *[3]	20 *[5]	550 *[3]
Number of Japanese learners	Living in Japan *[6]	53,534	24,735	5,952	1,889	1,329	1,722
	JLPT test examinees *[7]	18,583	24,612	5,367	45,778	3,666	8,243
	N1 level examinees *[7]	5,326	3,186*	198	559	5	217
	N2 level examinees *[7]	5,904	6,748*	475	2,115	29	672

*No.1 in Southeast Asia

Sources: *[1] (Time and Date AS, 2023); *[2] (Worldbank, 2022); *[3] (Human Resocia, 2020); *[4] (M. N. Nguyen, 2022); *[5] (Jahidul, 2019); *[6] (Agency for Cultural Affairs, 2021) ; *[7] (Japan Foundation & JEES, 2023)

In terms of national character, Vietnamese people are deeply influenced by "Confucianism", which shapes their beliefs and way of life with typical traits such as benevolence, moderation, respect for elders, a studious nature, and strong self-esteem (Shirai, 2009). Another research also reveals seven good characteristics of Vietnamese people including diligence, high retention rate, ambition for self-improvement, enthusiasm for education, respect towards elders, prioritization of family values, and favorable attitude towards Japan (Sekiguchi, 2013). There is a fact that Vietnamese individuals often set ambitious goals for themselves and consistently strive for professional success. Furthermore, they consider education as a fundamental factor for advancement and personal achievement. The combination of determination and eagerness for knowledge acquisition results in learning dedication and a high level of professionalism. This mindset aligns with the ever-evolving and innovative nature of the technology sector. Noticeably, Vietnamese people harbor a genuine admiration and appreciation for the Japanese culture, technology, and made-in-Japan products. Thus, outsourcing relationships between Vietnam and Japan can foster mutual trust and continuous cultivation of a collaborative working culture.

2.2.2 Existing problems in Vietnam and Japan market

Regarding existing problems of software outsourcing between Vietnam and Japan, communication emerges as a critical concern due to differences in knowledge backgrounds, cultures, and languages. One notable issue of project failures is the obstacles to meet customers' expectations in terms of proposed design and functionality (Zhenmei, 2023). This dissatisfaction arises from unthorough comprehension of functional requirements before and during the development process. The article highlights the significance of design perception gaps between Vietnam and Japan, with an example of differences in opinions regarding modern website designs. Interestingly, Vietnamese people believe that VietJet air's website is a modern design, while Japanese people tend to consider Airbnb as a modern one.

Simultaneously, the absence of standardized practices and inadequate quality management implemented by Vietnamese vendors may escalate the knowledge gaps. In reference to Hofstede's cultural metrics, Japan has a strong tendency to minimize the uncertainty by establishing numerous rules and standards to gain a sense of security and predictability. In contrast, Vietnam's culture reflects a greater acceptance of ambiguity and high risks.

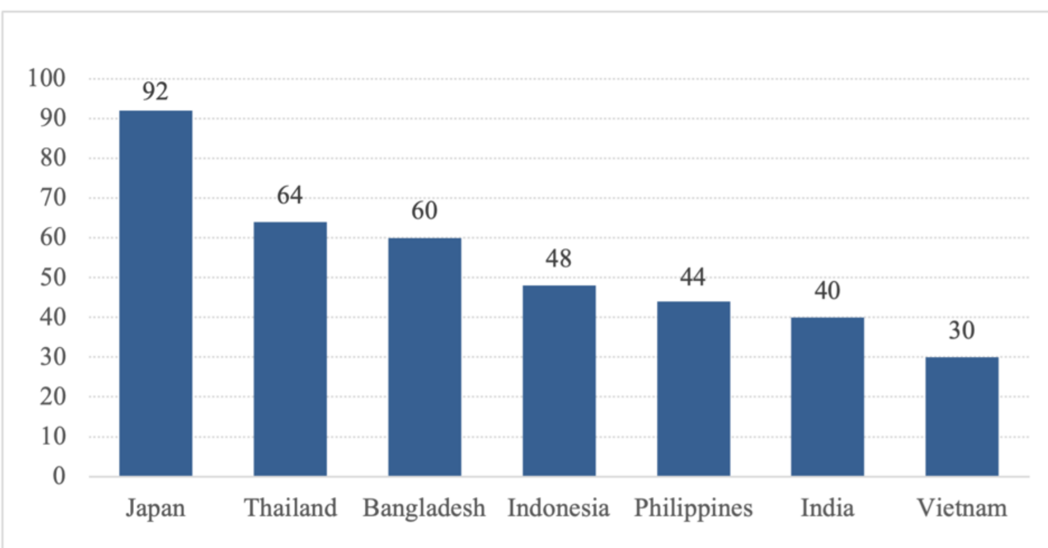

Figure 3. The comparison of uncertainty avoidance index of Japan and offshore-popular countries (Hofstede, 2011)

As can be seen from the chart (Figure 3), Japan witnesses a remarkable score of 92, ranking as the highest figure on the uncertainty avoidance index over the world, while Vietnam is considered as one of the lowest uncertainty avoidance countries compared to other offshore-popular countries (Hofstede, 2011). These cultural differences impact on working styles of outsourcing projects between Japan and Vietnam. For instance, Japanese clients prioritize adherence to deadlines and meticulous quality management. They may have strict documentation requirements with high-quality standards for long-term orientation. Therefore, various complex requirements related to the database, UX, UI, maintenance, security, integration, bug handling, and potential future expansions are required. On the other hand, Vietnamese engineers tend to underestimate the significance of sustainability and future-oriented considerations, despite their technical proficiency. Their subjective approach towards requirement comprehension from Japanese clients results in shortcomings and misunderstandings in software development processes. Rather than diligently noting and adhering to customers' requirements, they often overlook detailed requests that Japanese clients consider to be fundamental and essential. The time pressure from project managers and clients also inadvertently give rise to a culture of carelessness. Vietnamese engineers tend to prioritize the development and functionality of the technical product rather than meticulously researching customer demands and ensuring the product quality.

The geographical difference and the conflicts of meeting schedules hinder the speed of knowledge exchange and communications between two teams. As a result, necessary responses cannot be timely delivered, leading to project delays (R. Engine Inc, 2023). Furthermore, the language barrier poses a significant concern since most offshore developers in Vietnam cannot directly communicate with Japanese customers. The communication failures may increase operational expenses, contradicting the objective of Japanese companies when hiring offshore companies for the cost advantages. Thus, bridge system engineers and translators play an important role as the intermediaries to transfer the requirements and reports for both sides (Hanh, 2021).

Furthermore, Vietnam is confronted with cybersecurity issues as a considerable number of hackers actively seek weaknesses in software development processes (Hanh, 2021). Japanese clients encounter difficulties in safeguarding their security due to the geographical gap between Vietnam and Japan. The failure of prompt prevention and response measures could result in the leak of data and information, leading to negative impacts on finance and mutual trust among partner companies.

2.2.3 Problems of knowledge transfer in Vietnam and Japan software outsourcing market

"Relationships and Roles in Software Outsourcing Model" (Figure 4) is described below based on my experience while working in a Vietnam and Japan software outsourcing company. There are two main sides: the client (Japanese side) and the vendor (Vietnamese side). The customer side, also known as the client side, oversees the onsite team. They deliver requirements and knowledge to Bridge System Engineers (also called BrSE) who excel in foreign languages and technical skills. Bridge system engineer works as a connector between the vendor firm and the client company, using their technical know-how and Japanese communication proficiency to foster a smooth collaboration (T. H. Nguyen et al., 2011). The onsite team is responsible for transferring knowledge to the offshore team. Basically, the knowledge and their requirements are transferred to the team leader in the offshore team, then delivered to developers, testers, and communicators, who are in charge of translations. After finishing the tasks, the offshore team releases the development product to the onsite team to get their feedback. This release and feedback process also occurs between the bridge system engineer and the client side in order to release final products to the end user. Based on the interview results with Vietnamese engineers, knowledge transfer highlighted and circled in red on the chart between the onsite and offshore teams is the backbone of the software outsourcing process (Figure 4).

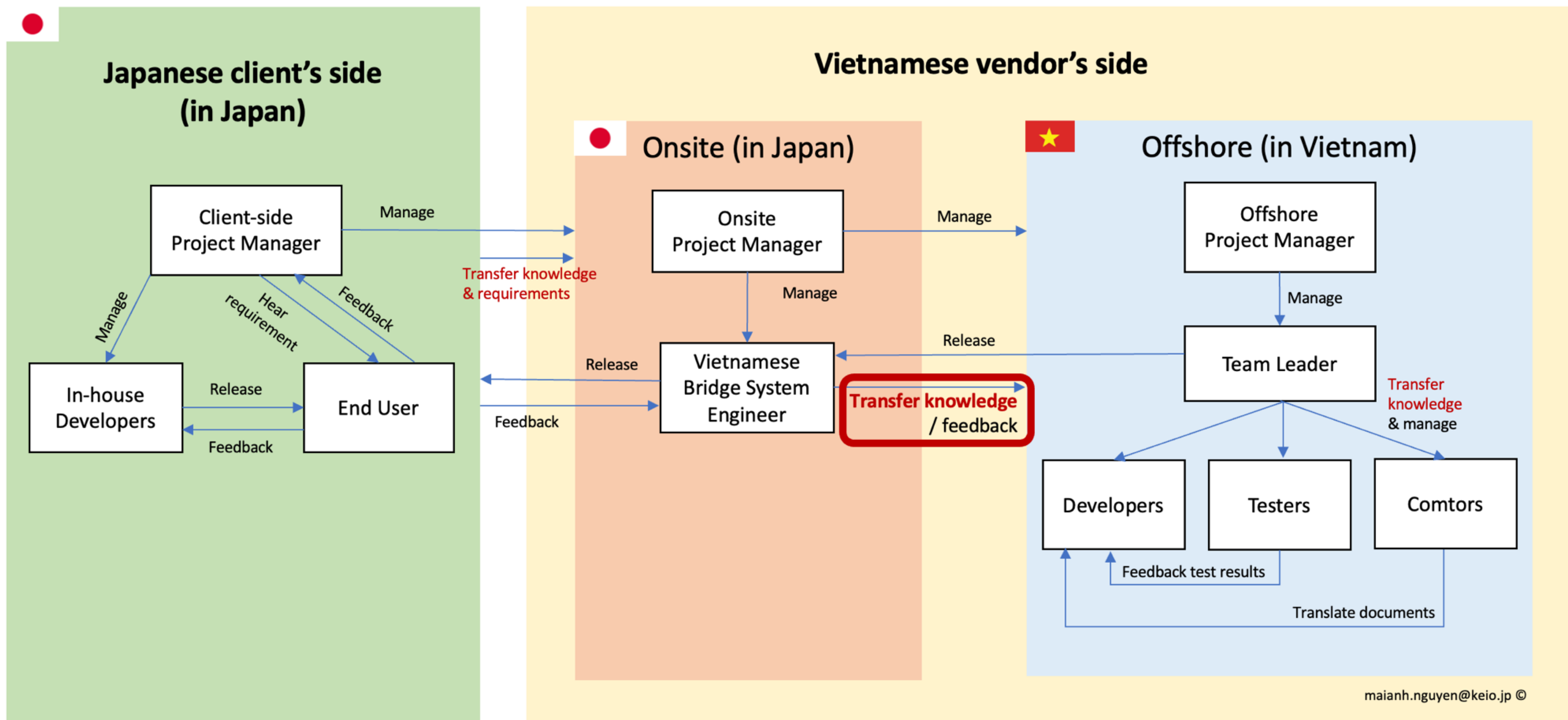

Figure 4. Relationships and roles in the software outsourcing model (Created by the author)

The nature of knowledge can be categorized into two distinct types: explicit knowledge and tacit knowledge. Detailed design specifications predominantly include explicit knowledge, which is suggested to transfer by “lean media” such as email, documentation, discussion, and forum (Salfarina et al., 2012). However, another study indicates that tacit knowledge, to some extent, arises in the knowledge transfer of the detailed design phase (Saari, 2009).

Hall's theory indicates that Japan is at the top of high-context culture countries. Japanese communication heavily relies on non-verbal expressions and implicit meanings (Hall, 1976). Thus, the power of knowledge transfer stems from the thorough interpretation of the context, cultural norms and assumptions. The indirect communication results in ambiguity and misunderstanding, especially when people have different cultural backgrounds and knowledge gaps. The lack of precision and clarity in indirect communication may hinder the knowledge transfer of the complicated design. In addition to facilitating communication between the Japanese client and the Vietnamese team, the bridge system engineers also contribute to drafting and developing the design based on the initial requirements with the client. As a vital intermediary, they are required to enhance their comprehension of the implicit knowledge from Japanese customers and transfer it to the Vietnamese vendor effectively.

Nonaka's SECI model of knowledge creation describes a cyclical process of knowledge sharing including "socialization", "externalization", "combination", and "internalization" within organizations (Nonaka, 1994). Based on the SECI model, a Vietnamese researcher illustrates the SACS model of knowledge sharing process including "sharing", "aligning", "calibrating", and "storing" among clients, bridge system engineers, and offshore vendors in the software outsourcing context (Figure 5) (T. H. Nguyen et al., 2014).

The process is illustrated in the following textual description:

(1) Sharing: Tacit knowledge is shared from the client and vendor to the bridge system engineer.

(2) Aligning: Tacit knowledge is transformed to explicit knowledge by the bridge system engineer.

(3) Calibrating: Explicit knowledge is disseminated from the bridge system engineer to the vendor and client.

(4) Storing: Vendor and client's explicit knowledge is transformed into tacit knowledge.

The author emphasizes the knowledge transfer process from the onsite team to the offshore team, highlighting how the bridge system engineers acquire and facilitate knowledge by transforming tacit knowledge into explicit knowledge that offshore engineers can interpret.

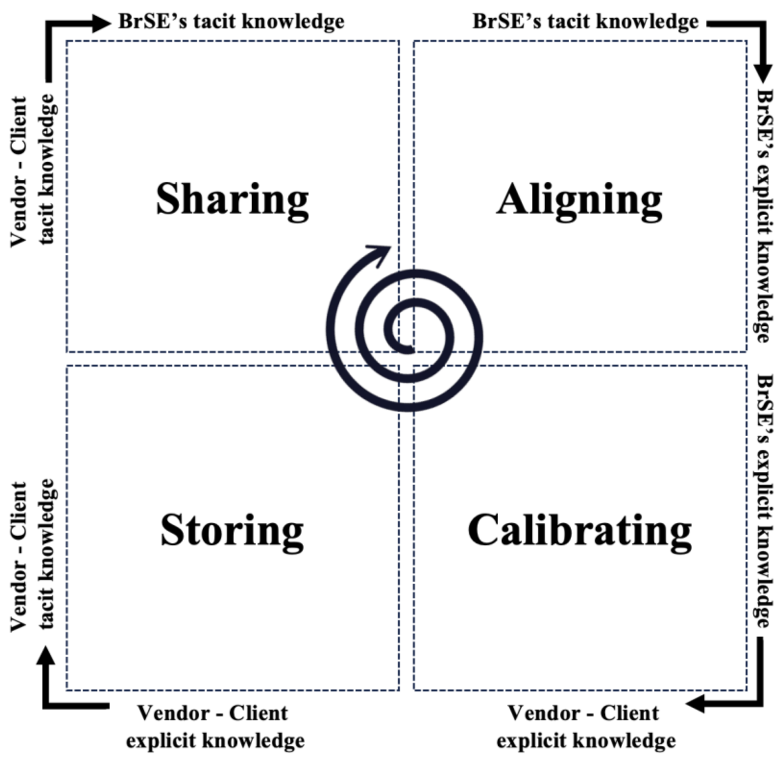

Figure 5. SACS model of knowledge-bridging process (T. H. Nguyen et al., 2014)

Due to the geographic differences between the Vietnamese vendor and Japanese client, significant knowledge gaps could be seen in various areas including business, technology, and languages (T. H. Nguyen et al., 2014). Misunderstandings can arise when intentions are not accurately conveyed due to language and cultural differences, leading to a potential impact on trust and further generating gaps among members (Nakamura, 2014). Miscommunication and lack of accurate information transmission from Japan to the offshore teams often result in numerous issues arising at later stages. This situation becomes particularly problematic when these issues arise at the end of the development process, leading to project disruptions, delays, and a deterioration in overall quality (Nakamura, 2014).

In Japan, it is widely known that people tend to apologize when making mistakes, whereas it is not a common cultural practice in Vietnam (T. H. Nguyen et al., 2011). This insight from my interview aligns with the observation obtained from a study of Vietnam and Japan outsourcing, specifically regarding this cultural aspect. Vietnamese engineers tend to defend themselves rather than offer an apology and even shift blame onto external circumstances and other people. The study also indicates that misunderstanding and ineffective knowledge sharing frequently occur between onsite and offshore teams, and the project's successful outcome heavily relies on the effectiveness of the knowledge transfer (T. H. Nguyen et al., 2011). There is an empirical study of Japanese and Vietnamese IT outsourcing companies analyzed by a framework of Szulanski (1996) regarding stickiness factors impacting the knowledge sharing process (T. H. Nguyen et al., 2011). The research could illustrate the importance of Vietnam as a strategic software outsourcing partner with Japanese companies and their difficulties in knowledge transfer between onsite and offshore members. It is suggested that the bridge system engineer can bridge the gaps in communication and cultural differences by improving their capabilities and common senses. However, it is crucial to emphasize that knowledge transfer does not only rely on efforts of the bridge system engineer. There is a need for a supportive instrument to further enhance the knowledge interpretation of the offshore team.

Researchers Ramioul and De Bruyn emphasize that even though the work processes and documents are well-prepared, unclear task boundaries, communication problems, as well as inadequate knowledge transfer might cause unexpected errors and limit the working performance. Especially in a long-distance and intercultural working environment, it is necessary to deliver tasks with standardized and formalized knowledge through comprehensive and precise communication tools and practices (Ramioul & De Bruyn, 2008).

Open-ended interviews with 17 Vietnamese engineers working in three different software outsourcing companies (two small and medium sized companies and one well-known company) regarding common problems of knowledge transfer identify their most concerning issues in the following areas.

- Knowledge gap in business, technology, and languages (T. H. Nguyen et al., 2014).

(Differences in logics and documentation in detailed design)

- Misunderstandings due to language and cultural differences, impacting trust and generating gaps among team members (Nakamura, 2014; Tran, H. H., 2021).

- Time/Distance/Schedule constraints (Nakamura, 2014).

- Large volume of knowledge (detailed designs)

These problems arise due to a combination of diverse factors aligning with the characteristics of software outsourcing projects between Vietnam and Japan. It is notable that the most critical challenge lies in comprehending the intricate requirements of the detailed design.

2.3 Research scope

In order to clarify what kinds of problems and at which stage the problems of knowledge transfer occur, the software development process should be described. The software development process includes requirement analysis, designing, coding, testing, and deployment and maintenance (Peruzzini et al., 2018). Typically, the onsite team conducts requirement analysis and designing, whereas offshore teams implement coding, testing, deployment, and maintenance (Table 3) (Gold, 2004). Other research on Vietnam and Japanese offshore projects also reveals that Vietnamese teams are often assigned to handle downstream tasks such as programming and unit testing, while they are less involved in upstream tasks such as detailed design and integration testing (Q. D. Nguyen, 2019). It is noteworthy that this research only focuses on situations where the client-side and the onsite team have already determined the design requirements, while the offshore teams are responsible for carrying out the downstream tasks mentioned above.

Table 3. A look at onshore versus offshore for each IT stage (Gold, 2004)

IT Life-cycle Stage	Primarily Onshore	Primarily Offshore	Equally Onshore and Offshore
Business partnership	Yes		
Overall IT strategy	Yes		
Application planning and design	Yes		
Business process planning and design	Yes		
Application analysis and design	Yes		
Application efficiency analysis / upgrades		Yes	
Application coding		Yes	
Application testing		Yes	
Application maintenance		Yes	
Application retirement planning			Yes

In the context of software outsourcing, it is imperative to precisely transfer the specification to offshore teams, which elevates the significance of effective communication (Nakamura, 2014). It is common knowledge that the most important stage of knowledge transfer between onsite and offshore teams in software outsourcing projects is knowledge transfer of the design including conceptual design and detailed design. The term "conceptual design" refers to a collection of written materials that comprise explanations and illustrations to show the primary design solution and the general view of the system. There are two senses of conceptual design including the conventional sense - the idea of the software is first conceptualized, and the sense of “conceptual modeling” - the invention of the fundamental software behavior's concept (Jackson, 2015). Detailed design are elements broken down into numerous classes and interfaces with detailed drawings of components, assembly drawings and other documentation (Peter Martinez, 2023). The detailed design phase determines the specific dimension of solutions and additional required information. In other words, the detailed design is the outcome of defined requirements and basic design, including the "complexity of outsourcing tasks" and "level of shared domain knowledge".

The interview results with Vietnamese engineers reveal that they have the habit of coding before the detailed design or simultaneously programming and proceeding with the detailed design in certain situations. Thus, the offshore team may demonstrate a limited proficiency in reading and understanding complex detailed design created by the others, especially the Japanese client. Therefore, it is crucial to identify specific technical instruments utilized for the knowledge management and knowledge transfer (Betz et al., 2010).

Chapter 3: Literature review of knowledge transfer methodologies

Chapter 3 presents a comprehensive literature review of potential knowledge transfer methodologies in the software outsourcing projects. A thorough pros and cons analysis of traditional approaches shreds light on the potential utilization of interactive videos. Additionally, the novelty and originality of the research are revealed in this chapter.

3.1 Potential knowledge transfer methodologies in software outsourcing

In a study regarding communication methods, three categories of knowledge-sharing activities were identified: "technology-assisted communication", "face-to-face meetings", and "training methods" (Table 4). These activities were further classified based on their level of media richness, ranging from high to low (Murray & Peyrefitte, 2007).

Table 4. The comparison of knowledge sharing activities referred from (Murray & Peyrefitte, 2007)

Comparison categories	Communication methods	Complex knowledge	Long-distance	Time flexibility	Suitable for know-how transfer
Face-to-face meetings	Informal	✓	✗	✗	✓
	Formal (seminars/conference)	✗	✗	✗	✓
Tech-assisted communication	Video conference	✓	✓	✗	✓
	Email and databank	✗	✓	✓	✗
	Telephone	✗	✓	✗	✗
Training methods	Mentoring	✓	✗	✗	✓
	Game simulation	✓	✗	✗	✓
	Role-playing	✓	✗	✗	✓
	Job rotation	✓	✗	✗	✓
	Videotape	✓	✓	✓	✗
Proposed method	Interactive video	✓	✓	✓	✓

✓: likely ✗: unlikely

The research indicates that the choice of knowledge transmission techniques is determined by the type of knowledge and information. Ackoff highlighted the differences between information and knowledge. Information derived from data comprises descriptions and responses to "WH" questions such as who, what, when, and where. On the other hand, knowledge that transforms information into instructions can be acquired through transmission through various means, including instructions and personal experiences (Ackoff, 1989). In other words, knowledge is an intricate and constantly evolving entity. In comparison with facts and information, knowledge exhibits greater depth, richness, and a strong correlation to the execution of tasks (Betz et al., 2010).

In addition to the findings of Murray and Peyrefitte's research, the "Comparison of knowledge sharing activities" table (Table 4) consists of additional dimensions of "long-distance" and "flexibility" to further explore the effectiveness of knowledge sharing approaches. These supplements aim at providing a comprehensive view of numerous methodologies in the context of remote collaboration and adaptability. The implications of long-distance communication and the need for flexibility may offer valuable insights for multiple industries as a whole, with specific relevance to the context of software outsourcing. As can be seen from the table of knowledge-sharing activities, face-to-face meetings, tech-assisted communication, and training methods possess distinct advantages in various aspects of knowledge sharing (Murray & Peyrefitte, 2007).

For instance, informal face-to-face meetings allow for spontaneous discussions on complex concepts and address uncertainties or ambiguities in a real-time environment. Direct communication enables the comprehension of explicit knowledge and fosters the mutual trust within organizations. However, face-to-face meetings may be not feasible due to the geographical problems between onsite and offshore teams. In such situations, the advantages of virtual meetings and video conferencing are more significant, particularly in outsourcing projects. This approach may offer cost-saving benefits and active engagement, thereby promoting effective collaboration for organizations. Nonetheless, differences in time zone, schedule arrangements and overtime working habits have an impact on the availability and participation of all team members. While online meetings undeniably offer numerous merits, other more flexible methods should be considered to reduce the dependence on virtual meetings.

The utilization of emails and data banks is beneficial for long-distance knowledge transfer. However, these approaches cannot be compatible to deal with complex knowledge and know-how transfer. Other training methods such as mentoring, game simulation, role-playing, and job rotation offer potential avenues for effectively sharing complex know-how knowledge with a creative approach. Even though these methods could increase participant engagement, they may not align well with the constraints of long-distance conditions and schedule conflicts. Additionally, their utilization may be limited to specific knowledge-sharing situations, such as employee training programs.

Last but not least, videotapes, known as recorded videos, have become more prevalent for knowledge sharing because of their inherent advantages regarding flexibility and accessibility in long-distance scenarios. Despite the limitations in "know-how" acquisition, users may have access to the recorded videos at their own pace and their preferred schedule. In other words, this accessibility reduces geographical barriers and enables the wide-spread dissemination of knowledge without real-time participation.

To summarize the table of "The comparison of knowledge sharing activities", none of these methods can fully align with all the unique characteristics inherent in software outsourcing projects such as the complexity of knowledge, long distance, time flexibility, and the ability of know-how transfer.

The above references primarily focus on the utilization of communication methods for various industries in general. Regarding the context of technical knowledge transfer, particularly in software outsourcing projects, other literature reviews of potential knowledge transfer approaches should be revealed. Research on the utilization of IT tools for knowledge transfer highlights their crucial roles in virtual working environment (Griffith & Sawyer, 2006). Particularly, while conducting global IT projects, the availability of up-to-date knowledge in a timely manner is essential. Furthermore, the selection of appropriate knowledge transfer tools lies in different contextual factors. The authors proposed that searchable history log, pre-recorded and edited video content and text-based search of instant video platforms could be potential for knowledge acquisition. Even though they are passive learning methods, knowledge recipients can have control over these tools, allowing them to fast forward, rewind, or skip based on their preferences. The hypothesis regarding the positive relationship between the utilization of technological tools enabling embedded access to content and the attainment of knowledge was successfully validated (Griffith & Sawyer, 2006). However, the recorded video may not be an optimal approach to facilitate know-how knowledge which involves practical skills, hands-on experiences in the context of diverse knowledge backgrounds and cultures.

A study investigating the effects of utilizing visual and text-based explanations in software design communication during in-person interactions reveals that Graphical Software Design description (GSD) used to facilitate software designs generates further dynamic dialogue, less communication control, and memory retention. Regarding the comprehension, the experiment participants attained superior outcomes when incorporating Textual Software Design description (TSD) (Jolak et al., 2020). Based on these experiment results, it can be assumed that graphical and textual design descriptions offer significant benefits in conveying and comprehending the knowledge. Although graphical and textual software design descriptions via face-to-face meetings offer a compelling approach for addressing high complexity levels with the interactive engagement, this method may trigger schedule conflicts and geographical problems in Vietnam and Japan outsourcing teams.

Another research on Vietnam and Japan outsourcing projects reveals that the bridge system engineer can clarify the development plan regarding client's requirements and transfer knowledge by utilizing common techniques including mind mapping, videos or images simulation, note-taking, and supplement documents to clarify ambiguous communication content (T. H. Nguyen et al., 2014). Those visible techniques could be considered as one of potential communication methods between onsite and offshore team along with traditional meetings. A wide range of database and file-storing methods are used to disseminate information and knowledge such as documents, SharePoint infrastructure-based multimedia resource management system, internal network websites and wikis, etc. (Petan et al., 2014). However, the utilization of those text-based materials has drawbacks in terms of engagement and intricate explanations. Certain complex definitions and detailed requirements cannot be transferred only through those static methods. In order to address these challenges, the utilization of storytelling and recorded videos could be proposed as potential approaches. An article suggested that video-based information networks are pivotal in driving market penetration and global expansion by facilitating strategic outsourcing and offshoring practices (Kodama, 2013). These methods include rich and compelling narratives to enhance sensemaking and foster effective learning experiences (Herschel & Yermish, 2008). Other research also shows that storytelling by recorded video is a potential knowledge transfer technique in outsourcing software development projects (Wende & Schwabe, 2014).

A study regarding the storytelling as a knowledge sharing method in software offshore projects between a Vietnamese vendor and a German client company shows that the recorded video could be a potential knowledge-sharing technique (Wende & Schwabe, 2014). The client project manager demonstrated software components by sharing her screen to narrate the conventional user interactions with the internet-based application. As a result, storytelling through recorded videos was beneficial as a knowledge transfer approach in software outsourcing, prominently during the initial steps of a project. The feedback from the Vietnamese team suggested that recorded videos offer advantages over text documents by ensuring the service provider's engagement with the material. The study reveals that the traditional recorded video could be applicable in the context of early stages and suitable for structural component descriptions. However, as highlighted in the research scope section, the detailed design phase is supposed to be complicated, requiring a more thorough explanation of multiple components and their underlying logic and interrelationships than any other parts. Furthermore, detailed design may consist of both tacit knowledge and explicit knowledge. In addition to verbal communication, dynamic visualization can serve as an effective means to elucidate tacit knowledge and facilitate better interpretation. Therefore, it is important to acknowledge the limitations of traditional recorded video regarding the interactivity and the ability of intricate explanations during the knowledge transfer process in the detailed design stage.

3.2 The utilization of interactive videos

Different from the linear narrative structure of traditional videos, interactive video, also known as hyper-video, offers interactive elements as a non-linear approach to deliver knowledge and information (Petan et al., 2014). Videos are generated by interactive video applications recorded by professional cameras that can link the pop-up to the related data, internal and external resources, at the same time, enable to save and track the information in the database (Petan et al., 2014). Within an organizational context, it is estimated that the human mind stores around 42% of the knowledge, while 26% exists as paperwork, 20% is stored in electronic files, and 12% is contained in the knowledge database (Uriarte, 2008). Therefore, it is suggested to develop an interactive video-based knowledge transfer technique that can enhance the capacity of human information storage.

As described in Table 5, the main features of the interactive videos include dialoguing, controlling, manipulating, navigating, and annotating ((Moreno & Mayer, 2007), (Remdisch, 2015), (Petan et al., 2014)). Interactive videos used in long-distance and complex knowledge scenarios could include built-in assessments or quizzes to evaluate engineers' comprehension while actively engaging with the content. In order to eliminate the ambiguity in the specification document, it is vital to provide a thorough explanation to offshore teams as well as to confirm their understanding (Nakamura, 2014). Decision points enable users to determine their desired track to follow, providing a personalized and adaptable approach to consuming information (Petan et al., 2014). Furthermore, the controlling function allows users to manage the timeline at their own pace, enabling them to delve deeper into topics of interest or skim through familiar knowledge quickly. At the same time, video creators may require viewers to take specific actions to progress further in the storyline. Additionally, manipulating, navigating, and annotating functions can transform passive viewers into active participants, making it useful for complex knowledge and know-how transfer. For example, the objects on the screen can be manipulated by enabling the movement, and parameter adjustments in simulations to observe outcomes through step-by-step interactions. Navigations provide seamless and quick access to specific content via pop-ups. Annotations appearing within a designated region or time frame of the video provide additional context or information that is not presented in the original video content (Petan et al., 2014). A plethora of dynamic functions offer a user-driven and immersive journey, which revolutionizes the traditional video-watching experience. The integration of interactive functions not only strengthens the connections between the audience and the video, but also fosters a sense of creativity in knowledge in knowledge transfer. Hence, the interactive video is a potential option for conveying intricate knowledge and enabling active learning experiences.

Table 5. Main features of the interactive video referred from (Moreno & Mayer, 2007), (Remdisch, 2015), (Petan et al., 2014)

Features	Descriptions	User's possible actions	Applicable scenarios
Dialoguing	Questions and answers as well as feedback/hints are sent to users based on their input.	Interacting with Q&A pop-ups or clicking hyperlinks to get the answers and gain further information.	- Complex knowledge - Long distance
Controlling	The learning pace and the order of the video are controllable. Several actions are required to continue watching the video.	- Using pause, play buttons, skip or click on bookmarks or designated points to get access to desirable segments. - Taking action to continue the video.	- Time flexibility
Manipulating	Objects on the screen can be zoomed in/out and moved for the simulation.	Adjusting parameters or moving items in a simulation to observe outcomes.	- Complex knowledge - Know-how transfer
Navigating	Available further information is presented by pop-ups.	Clicking on pop-ups that links to internal/external pages, decision point.	- Complex knowledge - Know-how transfer
Annotating	Emphasis or additional information is highlighted or text-overlayed	Hovering the mouse cursor over the desired section of the video or clicking on the desired section of the video.	- Complex knowledge - Know-how transfer

Five research findings related to the utilization of interactive videos in knowledge sharing are discussed below:

(1) The increase in cognitive load in the interactive learning environment

According to Sweller's cognitive load theory, memory consists of three components including sensation storage, operational memory and long-lasting retention (Sweller et al., 2011). Information from the surrounding environment is captured by sensory memory and subsequently undergoes temporary storage or processing in working memory. Working memory is responsible for encoding information into long-term memory with limited capacity. The accessibility to additional information by using interactive hotspots in active learning may strengthen theoretical concepts and aid the encoding of sensory information into working memory, and subsequently into long-lasting memory (Wilkie et al., 2018).

(2) The effectiveness of interactive video regarding the attention and engagement

A study utilizes the analytics approach to examine the impact of using interactive video on students' level of attention with the aim of improving the quality of education (Geri et al., 2017). The experiment targeted at university students in Israel to provide free English language training program. The initial stage of the project involved online-based video lessons and fundamental exercises, while the second phase utilized advanced technological tools such as interactive assessment and feedback. Data from the 59 video lectures were analyzed to measure the viewing accomplishment proportion of both "short" and "long" lectures by Google Analytics.

The research on using interactive video provides empirical evidence that supports the effectiveness of integrating interactive video functionalities into online-based educational platform to extend learners' concentration and engagement regarding both academic theory and practical application. The study indicates that the utilization of interactive video resulted in a substantial enhancement in completion rates and median viewing duration for both 'long' and 'short' video lectures, accounting for over 20% (Figure 6). Additionally, the 'long' group experienced a rise in average viewing time, reaching 10.81 minutes, while the 'short' group also saw an increase to an average viewing time of 6.85 minutes (Table 6).

Table 6. Descriptive comparison of video lecture viewing (Geri et al., 2017)

Setting	Videos length (minutes)	n	Mean (minutes)	Standard deviation
Before (no interaction) Average	> = 11	29	8.87	1.95
	< 11	30	5.5	1.25
Before (no interaction) Median	> = 11	29	8.5	1.8
	< 11	30	5.7	1.26
After (interaction) Average	> = 11	29	**10.81**	2.08
	< 11	30	**6.85**	1.37
After (interaction) Median	> = 11	29	10.25	2.02
	< 11	30	7.3	1.44

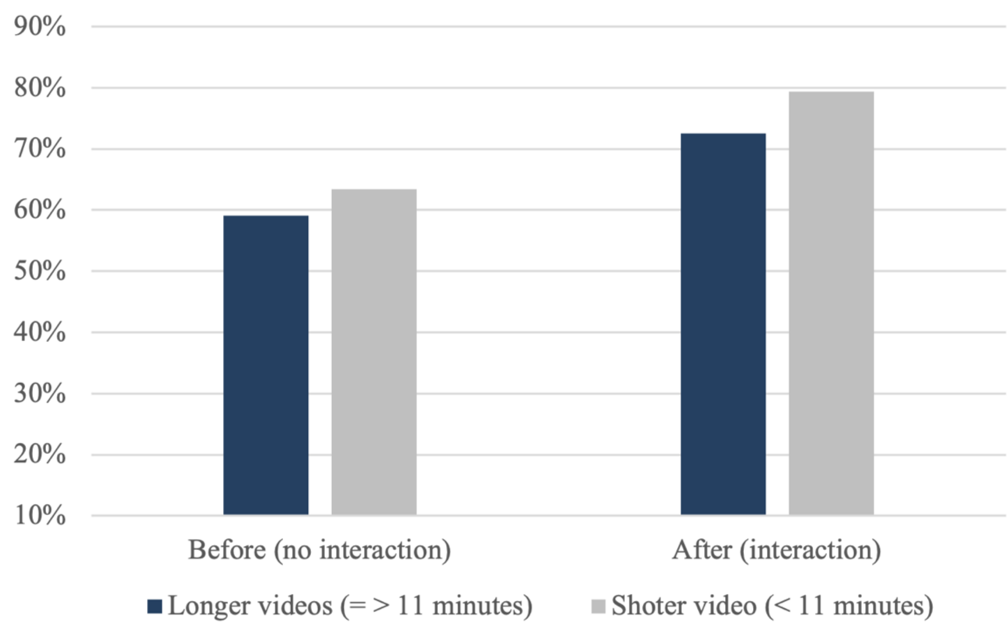

Figure 6. Video lecture viewing completion percentage (Geri et al., 2017)

(3) The enhancement of the learning experience by utilizing interactive videos

Another study aimed to create and evaluate the utilization of a prototype interactive video for second-year civil and environmental engineering students to teach a 45-minute "risk assessment" lecture in a construction management course (Cherrett et al., 2009). Students were asked to have access to an interactive video through a web link and complete the risk assessment tasks, then complete the questionnaire to assess their perception of interactive video compared to traditional lectures. The test and questionnaire results of 75 participants were recorded to conduct a statical analysis. The results reveal that a majority of students (65%) strongly agreed with the effectiveness of the interactive videos. Additionally, 75 % of participants reported that interactive video improved their overall learning experience.

(4) The application of interactive video simulations for the remote healthcare learning

The objective of the research is to compare the effectiveness of the interactive video simulation with the non-interactive video simulations in the healthcare industry (Musa et al., 2021). There were 36 undergraduate nursing students taking part in the experiment. They were assigned to two groups of people using the interactive and non-interactive video simulation. The findings revealed that the interactive group experienced superior order learning, the enhancement of teamwork, and a sense of authenticity compared to the non-interactive group. The combination of remote work and interactive engagement provided substantial satisfaction for the participants.

(5) The study on the user behaviors when using the interactive video as an advertising channel

The utilization of mobile interactive videos in the advertisement are reported to increase consumer engagement with brand, with 47% increase in the time spent interacting with the advertisement compared to the non-interactive one (MAGNA, 2017). Another research on the effectiveness of mobile interactive video in the advertisement industry was conducted by the specialist interview and qualitative analysis of the interview results. The interactive narrative positively impacts the subjective video quality assessment (SVQA), engrossment, and fulfillment.

At the same time, the SVQA also has a positive impact on the engrossment and the fulfillment (Gu et al., 2022).

3.3 Novelty of the research

The novelty of the research lies in following three new and additional values of interactive videos contributing to the software outsourcing market.

- *The practical application of interactive videos in the context of Vietnam and Japan's software outsourcing regarding the knowledge transfer of the detailed design contributes to the enhancement of the product quality and the trust between client and vendor side.*

Mentioned previous research mainly focuses on the effectiveness of interactive videos in education, healthcare, and advertisement, while only a few studies indicate the advantages of traditional recorded videos in the global IT outsourcing project. No research available can evaluate the effectiveness of those innovative knowledge transfer methods by specifically clarifying applicable scenarios not only in learning experience but also in the real-world context of Vietnam and Japan software outsourcing. The characteristic of software outsourcing projects could be seen in the contractual relationship between the Japanese client and Vietnamese vendor. Therefore, the improvements of knowledge transfer's effectiveness do not only elevate the product quality but also strengthen the trust between them.

- *The influence of utilizing interactive videos may vary in interpreting different knowledge types in the detailed design*

It is important to note that interactive videos may not be compatible with all kinds of knowledge. Previous research has primarily concentrated on examining the effectiveness of interactive videos within specific educational courses and trainings, yet it fails to indicate that the effectiveness may differ depending on types of knowledge. By conducting a comprehensive analysis, this study aims to shed light on using interactive videos for different types of detailed design knowledge shared in software outsourcing projects.

- *The value of identifying knowledge transfer problems and solutions to contribute to Vietnam and Japan software outsourcing market*

The value of this research could be referred from the need for a strategic relationship between Vietnam and Japan to reduce labor shortage and foster the economy as well as technical knowledge exchange contributing to Vietnam and Japan's strategic relationship in human resources. At the same time, it is necessary to find additional methods to address existing knowledge transfer problems due to the lack of detailed design comprehension from the offshore team. The misunderstandings could be caused by multiple reasons such as the geographic differences between the Vietnamese vendor and Japanese client, language barriers, considerable knowledge and cultural gaps ((T. H. Nguyen et al., 2014), (Nakamura, 2014)). Notably, the enormous differences in uncertainty avoidance between Vietnam and Japan should be taken into consideration when conducting software outsourcing projects (Hofstede, 2011). As mentioned about what kinds of knowledge the bridge system engineer transfers to the offshore team, the most important and complex content would be the requirement of the detailed design. Communication via videos may not be a new research area; however, the potential utilization of interactive video as well as the "interactiveness" should be examined to determine whether it can improve the knowledge transfer process and eliminate those critical challenges, especially regarding the detailed design phase of the software outsourcing projects.

Chapter 4: Proposal of interactive-video based model and hypothesis

Chapter 4 presents a proposal for the interactive video-based model and outlines the research hypothesis, along with the introduction of two different types of knowledge related to the detailed design.

4.1 Knowledge management model with interactive videos

In the context of a Japanese-Vietnamese bridge software engineering project, the Japanese customer side delivers a Japanese detailed design document to the Vietnamese bridge system engineer. Then they comprehend the material and create the interactive video for the offshore team in Vietnamese with the help of “comtors” (translators) (Figure 7). It is noted that there is no need to hire "comtors" if the bridge system engineer can deal with all translation-related tasks. The in-house knowledge server contains the “detailed design document file” and interactive videos. The offshore team accesses the document file and use the interactive videos as an additional technique of knowledge acquisition, at the same time, they still communicate with the onsite team via online meeting and chat tools (Slack/Teams).

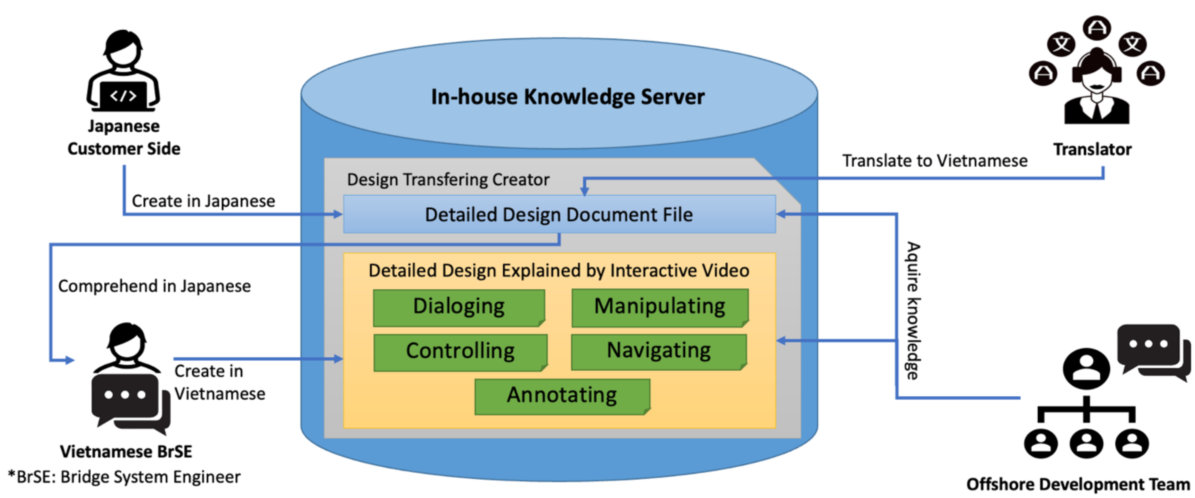

Figure 7. Knowledge management model with interactive videos (Created by the author)

- Sample flow of the interactive video

The sample flow of interactive video for the detailed design's knowledge transfer includes eight primary components: the overview of the project, user interface, structural diagrams, behavioral diagrams, input/output relationships, event process, data process, and summary. The interactive bookmark is accompanied in each major part (Figure 8). The sample contents described below the key sections contain the interactive video functions such as ①dialoging, ②controlling, ③ manipulating, ④navigating and ⑤annotating (Table 5). For example, "dialoging" includes the Q&A sections, which enable users to receive feedback and relevant information based on their responses. "Controlling" may allow people to control the content according to their preferences, at the same time, forcing users to pause or conduct designated tasks before progressing to desirable segments. "Manipulating" is utilized to describe the simulation and scenarios with the screen interactions. "Navigating" functions can add further information presented by pop-ups that links to internal or external sources. There are also interactive transitions called "Go to ... ", allowing users to navigate to designated time points in the video by selecting the corresponding hotspot. "Annotating" refers to the use of highlights or text-overlay to illustrate additional information.

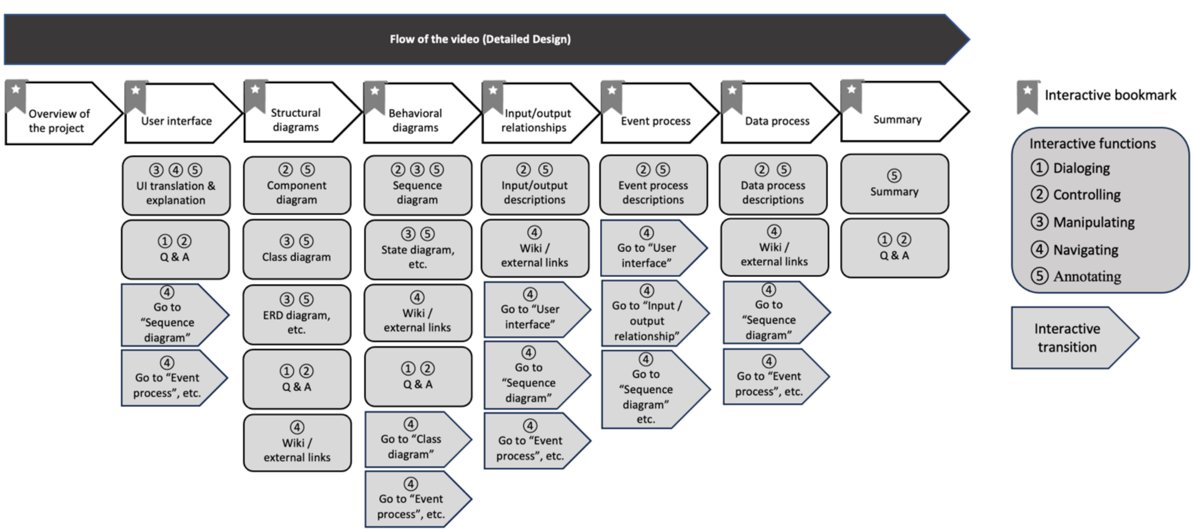

Figure 8. Sample flow of the interactive video (Created by the author)

4.2 Hypothesis

Regarding the knowledge transfer of detailed design in the Vietnam-Japan software outsourcing project, the following three hypotheses were formulated.

H1. The utilization of interactive videos can significantly improve the understanding of the requirements.

H2. The utilization of interactive videos can eliminate communication, data tracking effort, and time constraints to better the effectiveness of the knowledge transfer in comparison with ordinary methods.

H3. The effectiveness of interactive videos in knowledge transfer may vary across knowledge types in the detailed design.

4.3 Knowledge types in the detailed design

The experiment will be conducted based on the standardized "Software design notations", including "structural description" (static view) and "behavioral description" (dynamic view) described in the table 7 (IEEE, 2014).

Table 7. Software design notations (IEEE, 2014)

Structural descriptions (Static view)	Behavioral descriptions (Dynamic view)
• Architecture description languages (ADLs): textual, often formal, languages used to describe software architecture in terms of components and connectors. • Class and object diagrams: used to represent a set of classes (and objects) and their interrelationships. • Component diagrams: used to represent a set of components ("physical and replaceable part[s] of a system that [conform] to and [provide] the realization of a set of interfaces") and their interrelationships. • Class responsibility collaborator cards (CRCs): used to denote the names of components (class), their responsibilities, and their collaborating components' names. • Deployment diagrams: used to represent a set of (physical) nodes and their interrelationships, and, thus, to model the physical aspects of software. • Entity-relationship diagrams (ERDs): used to represent conceptual models of data stored in information repositories. • Interface description languages (IDLs): programming-like languages used to define the interfaces (names and types of exported operations) of software components. • Structure charts: used to describe the calling structure of programs (which modules call, and are called by, which other modules).	• Activity diagrams: used to show control flow from activity to activity. Can be used to represent concurrent activities. • Communication diagrams: used to show the interactions that occur among a group of objects; emphasis is on the objects, their links, and the messages they exchange on those links. • Data flow diagrams (DFDs): used to show data flow among elements. A data flow diagram provides "a description based on modeling the flow of information around a network of operational elements, with each element making use of or modifying the information flowing into that element". Data flows (and therefore data flow diagrams) can be used for security analysis, as they offer identification of possible paths for attack and disclosure of confidential information. • Decision tables and diagrams: used to represent complex combinations of conditions and actions. • Flowcharts: used to represent the flow of control and the associated actions to be performed. • Sequence diagrams: used to show the interactions among a group of objects, with emphasis on the time ordering of messages passed between objects. • State transition and state chart diagrams: used to show the control flow from state to state and how the behavior of a component changes based on its current state in a state machine. • Formal specification languages: textual languages that use basic notions from mathematics (for example, logic, set, sequence) to rigorously and abstractly define software component interfaces and behavior, often in terms of pre and postconditions. • Pseudo code and program design languages (PDLs): structured programming-like languages used to describe, generally at the detailed design stage, the behavior of a procedure or method.

Chapter 5: Verification

5.1 Verification objective

The experiment is designed to check the performance of the interactive video in knowledge transfer and whether it can deliver the results of H1, H2, H3 hypotheses with the quantitative and qualitative approaches.

5.2 Verification participants

The following 42 subjects were invited to the verification test.

- 1 project manager (in Vietnam)
- 1 bridge system engineer (in Japan)
- Interactive video group ("IN") (off-shore in Vietnam) includes 20 engineers (15 juniors and 5 seniors) using interactive videos and documentation materials
- Traditional/recorded video group ("TR") (off-shore in Vietnam) includes 20 engineers (15 juniors and 5 seniors) using traditional methods such as recorded videos (non-interactive) and documentation materials.

5.3 Verification procedures

The detailed design demo is a short-term testing tool development project that involves numerous intricate conditions and requires explanation with various relevant data sources.

The same bridge system engineer facilitates the knowledge sharing of a detailed design demo to two groups of Vietnamese engineers.

*Notes: "IN group" & "TR group" have the same number of participants along with the relatively same level of knowledge as well as experience evaluated by an experienced project manager based on the criteria on table 8.

Table 8. Engineer's background evaluation sheet

Criteria	Junior	Senior
Years of experience in the software outsourcing development	1-3 years	Over 4 years
Language/ framework proficiency	Proficient in one or two languages/frameworks, with some experiences in other languages.	Deep understanding of multiple languages/frameworks
Database knowledge	Basic level of knowledge in databases.	Proficient in working with databases, including design, optimization, and query performance.
Code review	Not be involved in regular code reviews or have limited involvement.	Actively participates in code reviews, providing feedback and suggestions to improve code quality.
Project management experience	Limited or no experience in project management.	Experience in project management, including leading a technical team, coordinating tasks, and ensuring project success.
Architecting skills	Limited or no experience in architectural design and developing solutions based on guidance.	Proficient in architecting software solutions and making design decisions

Group members independently watch the videos and conduct requirement analysis by themselves within 1 hour. After that, they have to take a multiple-choice knowledge test (12 structural description questions and 12 behavioral description questions) on the provided system. The test should be completed within a maximum duration of 20 minutes.

Some examples of the UI interactive video design are shown in Figure 9~11, and the flow of the sequence diagram in Figure 12~17. It should be noted that actual local languages were used in the figures.

Figure 9. Interactive video: Annotating, controlling, navigating functions.

Figure 10. Interactive video: Manipulating functions to describe scenarios.

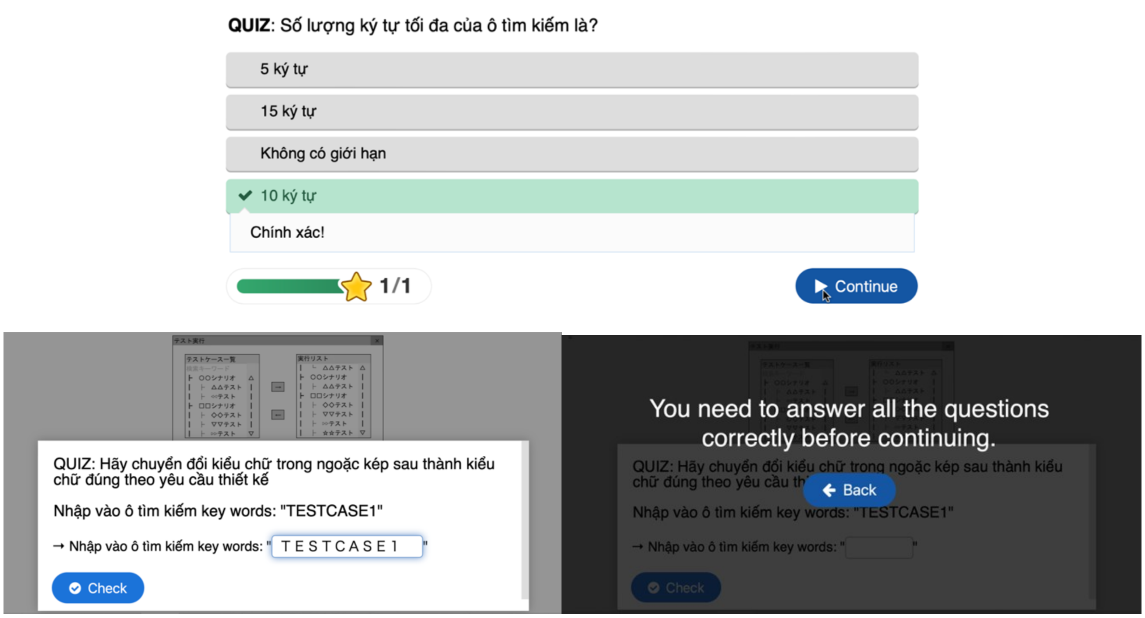

Figure 11. Interactive video: "Controlling", "dialoging" functions with the quiz and feedback.

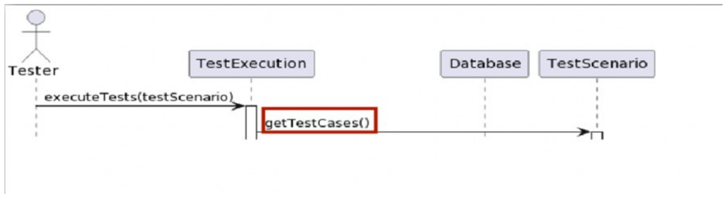

Figure 12. Step 1: "Manipulating" function.

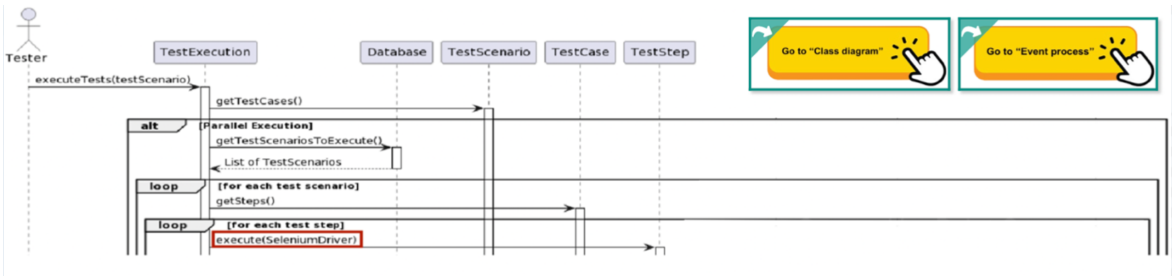

Figure 13. Step 2: "Navigating", and "manipulating" functions.

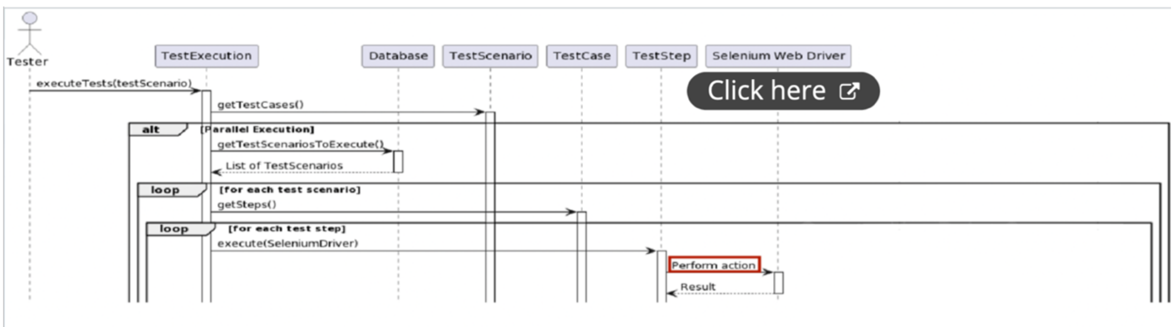

Figure 14. Step 3: "Navigating", and "manipulating" functions.

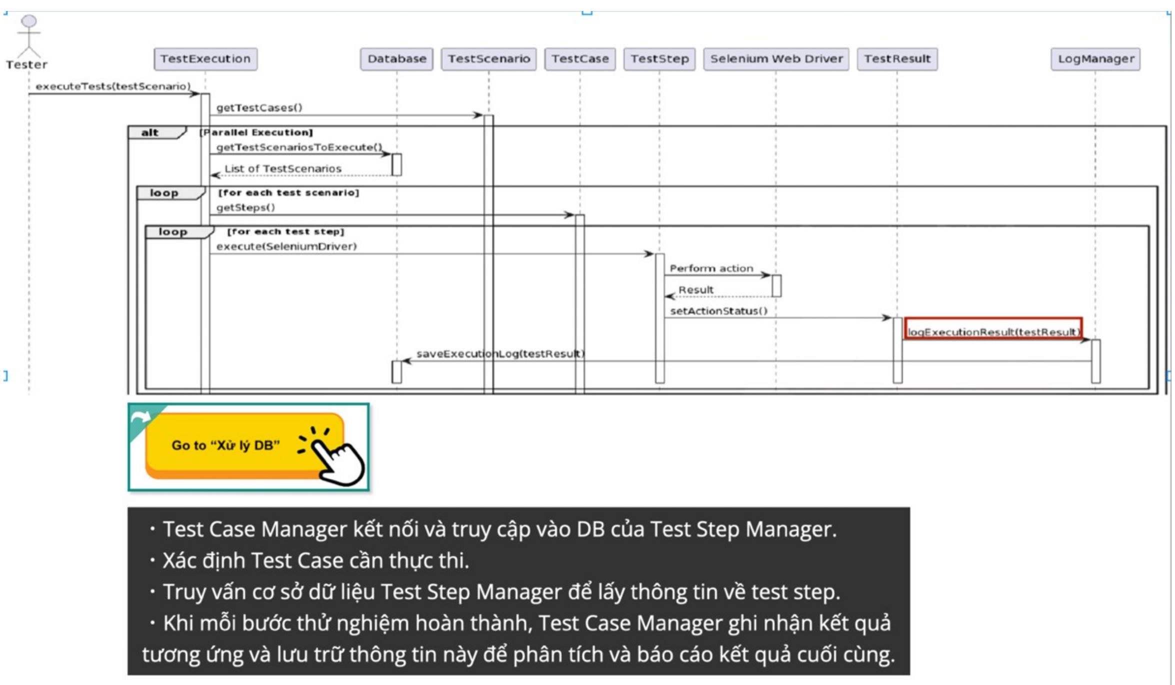

Figure 15. Step 4: "Annotating", "navigating", and "manipulating" functions.

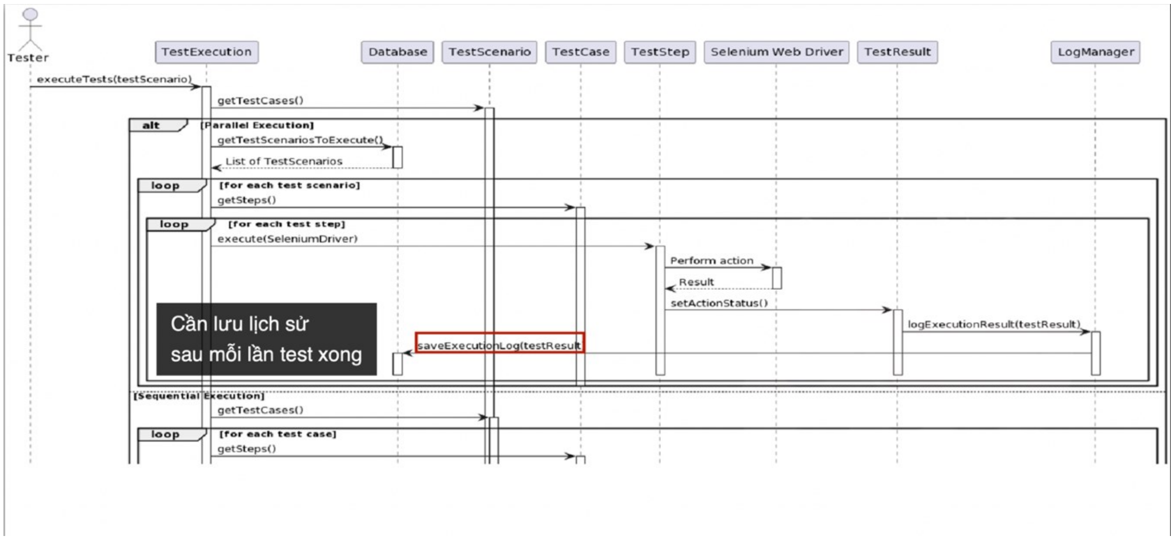

Figure 16. Step 5: "Annotating", and "manipulating" functions.

Figure 17. Step 6: "Annotating", "navigating", and "manipulating" functions.

The verification contents include the following three categories, and the list of survey contents is described in table 9.

- Knowledge acquisition test designed based on "Software design notations" (structural description and behavioral description) (IEEE, 2014).

(The result includes scores for each type of knowledge test and the overall score).

- Completion time of the knowledge test.

- Survey regarding their experience in knowledge acquisition.

Table 9. List of survey content for verification

Question ID	Personal questions	Answers
P1	ID number	-
P2	Age	1. Under 25 2. From 25 to 30 3. Over 30
P3	Gender	1. Male 2. Female
P4	What is your background?	1. Junior 2. Senior

Question ID	Questions related to knowledge transfer	Criteria
Q1	Comfort in the work environment and watching videos (stable internet connection, comfortable workspace, clear audio and video transmission)	1. Very low 2. Low 3. Moderate 4. High 5. Very high
Q2	Usefulness of the learning method in describing and explaining complex issues	
Q3	Ease of quick search and grasp of rich information	
Q4	The interest and engagement in the learning process	
Q5	Curiosity to learn more knowledge	
Q6	Level of concentration while using that learning method	
Q7	Ability to remember content after using that method	

5.4 Verification result

5.4.1 Comparison of the knowledge test scores between "IN" and "TR" groups

The independent sample t-test (SPSS) was implemented to compare the knowledge test results of two groups. This statistical analysis method can compare the differences in means between two distinct and unrelated groups on the same continuous and dependent variable. Independent variables are group "IN" and group "TR". The dependent variable is the test score.

As demonstrated by the statistical findings (Table 10), the group using the interactive video has slightly higher average scores on the structural description test (with unsubstantial differences), behavioral description test and overall test than the one using the recorded video.

The independent samples test table (Table 11) includes Levene's test for equality of variances and the statistical t-test of mean equality. All of the "sig." values in Levene's test are above 0.05, which meets the statistical assumption of homogeneity. In other words, the distributions of the data collected in each group are comparable and similar.

Regarding the structural description test, there is no notable distinction in the test scores between the "IN" group and the "TR" group since the two-side p-value is 0.226 > 0.05 (Table 11). Hence, no significant differences were observed in the understanding of structural descriptions between the two teams. On the other hand, the two-sided p-value (0.011) in the behavioral description test falls below the significance level of 0.05. Hence, a statistically significant difference could be seen in the knowledge comprehension of behavioral description between the "IN" group and the "TR" group.

The two-sided p-value (0.021) for the overall test score is below the significance level of 0.05. This finding suggests a substantial variance in the overall score between the two teams. Thus, the acquisition of knowledge in detailed design through interactive videos is superior to the traditional method of using recorded videos in general.

Table 10. Group statistic of the test scores between "IN" and "TR" (SPSS)

	Participant group	N	Mean	Std . deviation	Std . error mean
Structural test	"IN"	20	10.90	1.021	0.228
	"TR"	20	10.55	0.759	0.170
Behavioral test	"IN"	20	10.55	0.999	0.223
	"TR"	20	9.65	1.137	0.254
Overal test score	"IN"	20	21.45	1.638	0.366
	"TR"	20	20.20	1.642	0.367

Table 11. Independent samples t-test for the test score (SPSS)

		Levene's test of equality of variances		t-test for equality of means					
						Significance		Mean	Std. error
		F	Sig .	t	df	One-sided p	Two-sided p	difference	difference
Structural test score	Equal variances assumed	1.445	0.237	1.230	38	0.113	**0.226**	0.350	0.284
	Equal variances not assumed			1.230	35.093	0.113	0.227	0.350	0.284
Behavioral test score	Equal variances assumed	0.154	0.697	2.660	38	0.006	**0.011**	0.900	0.338
	Equal variances not assumed			2.660	37.380	0.006	0.011	0.900	0.338
Overal test score	Equal variances assumed	0.302	0.586	2.411	38	0.010	**0.021**	1.250	0.518
	Equal variances not assumed			2.411	38.000	0.010	0.021	1.250	0.518

5.4.2 Comparison of the knowledge test completion time between "IN" and "TR" groups

The group statistics table (Table 12) indicates the average test completion time of "IN" team (16.65 minutes) is lower than that of "TR" team (17.95 minutes). In other words, on average the interactive video group completed the knowledge test faster than the traditional group.

The independent sample t-test (SPSS) was conducted to evaluate the differences in the test completion time between the two groups. As evident from the table of independent samples test (Table 13), the significance level of Levene's test for equality of variances exceeds 0.05. Thus, the findings suggest the consistency and similarity, in other words, there is no significant distinction in the variances. The t-test for equality of means indicates that two-sided p is 0.020, which falls below the significance level of 0.05. Therefore, the comprehension and test performance speed of the group using interactive videos is superior to the traditional team.

Table 12. Group statistic of the test completion time between "IN" and "TR" (SPSS)

	Group	N	Mean	Std. Deviation	Std. Error Mean
Test completion time	"IN"	20	**16.65**	1.785	0.399
	"TR"	20	**17.95**	1.605	0.359

Table 13. Independent samples t-test for the test completion time (SPSS)

		Levene's test of equality of variances				t-test for equality of means			
						Significance		Mean difference	Std . error difference
		F	Sig .	t	df	One-sided p	Two-sided p		
Test completion time	Equal variances assumed	0.112	0.740	-2.422	38	0.010	**0.020**	-1.300	0.537
	Equal variances not assumed			-2.422	37.578	0.010	0.020	-1.300	0.537

5.4.3 Comparison of the survey results between "IN" and "TR" groups

The group statistic table reveals that the mean values of the "IN" group in Q2, Q3, Q4, Q5, Q6, Q7 is higher than those of the "TR" group. However, "IN" group exhibits a lower average value in Q1 compared to the "TR" group (Table 14).

The significance level of Levene's test for equality of variances is above 0.05 (Table 15). Therefore, the figures refer to the statistical assumption of homogeneity among dependent variables. The t-test for equality of means indicates that two-sided p values of Q2, Q3, Q4, Q6, Q7 are 0.018, 0.005, 0.045, 0.027, and 0.002 respectively, which falls below the significance level of 0.05. Thus, there are statistically significant distinction between "IN" group and "TR" group in those survey results. In other words, interactive video team shows a better experience in the usefulness of knowledge transfer tool in describing and explaining complex issues, the ease of quick searching and data tracking, the engagement, the concentration ability and the knowledge retention. However, two-sided p values of Q1 (0.442) and Q5 (0.164) exceed 0.05, indicating no difference between two teams regarding the comfort in the work environment and watching videos, as well as the learning curiosity.

Table 14. Group statistic of survey results between "IN" and "TR" (SPSS)

Survey questions	Method	N	Mean	Std. Deviation	Std. Error Mean
Q1	"IN"	20	4.30	0.865	0.193
	"TR"	20	4.50	0.761	0.170
Q2	"IN"	20	3.75	1.020	0.228
	"TR"	20	3.05	0.759	0.170
Q3	"IN"	20	3.55	0.887	0.198
	"TR"	20	2.80	0.696	0.156
Q4	"IN"	20	3.45	0.887	0.198
	"TR"	20	2.90	0.788	0.176
Q5	"IN"	20	3.30	0.865	0.193
	"TR"	20	2.95	0.686	0.153
Q6	"IN"	20	3.70	0.923	0.206
	"TR"	20	3.10	0.718	0.161
Q7	"IN"	20	3.95	0.826	0.185
	"TR"	20	3.15	0.671	0.150

Table 15. Independent samples t-test for the survey results (SPSS)

		Levene's Test for Equality of Variances		t-test for Equality of Means					
				Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	One-Sided p	Two-Sided p			Lower	Upper
Q1	Equal variances assumed	1.119	0.297	0.221	**0.442**	-0.200	0.258	-0.721	0.321
	Equal variances not assumed			0.221	0.442	-0.200	0.258	-0.722	0.322
Q2	Equal variances assumed	3.977	0.053	0.009	**0.018**	0.700	0.284	0.125	1.275
	Equal variances not assumed			0.009	0.019	0.700	0.284	0.123	1.277
Q3	Equal variances assumed	2.07	0.158	0.003	**0.005**	0.750	0.252	0.24	1.260
	Equal variances not assumed			0.003	0.005	0.750	0.252	0.239	1.261
Q4	Equal variances assumed	0.585	0.449	0.023	**0.045**	0.550	0.265	0.013	1.087
	Equal variances not assumed			0.023	0.045	0.550	0.265	0.013	1.087
Q5	Equal variances assumed	1.927	0.173	0.082	**0.164**	0.350	0.247	-0.150	0.85
	Equal variances not assumed			0.082	0.165	0.350	0.247	-0.151	0.851
Q6	Equal variances assumed	2.135	0.152	0.014	**0.027**	0.600	0.262	0.070	1.130
	Equal variances not assumed			0.014	0.028	0.600	0.262	0.069	1.131
Q7	Equal variances assumed	1.225	0.275	<.001	**0.002**	0.800	0.238	0.318	1.282
	Equal variances not assumed			<.001	0.002	0.800	0.238	0.318	1.282

5.4.4 Correlation analysis

The relationships between two continuous variables are illustrated by matching the row and the column of the table 15. The "Pearson Correlation" represents the magnitude and the actual correlation strength, while the "sig. (2-tailded)" value refers to the significance of the correlation. The Pearson correlation coefficients presented in the second row of the table demonstrate the correlation between the overall test score of the group utilizing the interactive video and the survey results.

Notably, the correlation coefficients for the overall test score and Q2, Q3, Q6, and Q7 are 0.607**, 0.582**, 0.546*, and 0.563** respectively. The findings suggest a positive association between these continuous variables. At the same time, the p-values of the overall test score of the group using the interactive video and survey results are recorded as 0.005, 0.007, 0.013, and 0.010 (<0.05) for the respective survey items Q2, Q3, Q6, and Q7. Therefore, the two continuous variables have a statistically significant bivariate association. On the other hand, the overall score does not have a significant correlation with Q1, Q4, and Q5 since the p-values all exceed 0.05. It is noted that even though the p-value of Q4 is greater than 0.05, the marginal difference between 0.05 and 0.057 is not substantial. Thus, there is still an indication of a potential bivariate association between Q4 and the overall test score.

In terms of the correlation among the survey results, the Pearson correlation numbers of Q2, Q3 with Q7 are respectively 0.610** and 0.543*, demonstrating moderate positive correlations among them. Notably, the Pearson correlation figure of Q6 and Q7 is 0.739**, implying a high positive correlation between them. The "sig." values are 0.004, 0.013, <0.001 respectively between Q2 and Q7, Q3 and Q7, as well as Q6 and Q7. These figures indicate the significant associations among those survey result items.

Table 16. Correlations of the overall test score and survey results (SPSS)

		Overall test score	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Overall test score	Pearson Correlation	1	0.271	0.607**	0.582**	0.433	0.309	0.546*	0.563**
	Sig. (2-tailed)		0.247	**0.005**	**0.007**	0.057	0.186	**0.013**	**0.010**
Q1	Pearson Correlation	0.271	1	0.090	0.391	0.089	0.296	0.316	0.243
	Sig. (2-tailed)	0.247		0.707	0.088	0.708	0.205	0.174	0.301
Q2	Pearson Correlation	0.607**	0.090	1	0.393	0.364	0.090	0.419	0.610**
	Sig. (2-tailed)	**0.005**	0.707		0.087	0.115	0.707	0.066	**0.004**
Q3	Pearson Correlation	0.582**	0.391	0.393	1	0.070	0.117	0.405	0.543*
	Sig. (2-tailed)	**0.007**	0.088	0.087		0.769	0.624	0.077	**0.013**
Q4	Pearson Correlation	0.433	0.089	0.364	0.07	1	0.089	0.109	0.032
	Sig. (2-tailed)	0.057	0.708	0.115	0.769		0.708	0.647	0.892
Q5	Pearson Correlation	0.309	0.296	0.090	0.117	0.089	1	0.251	0.096
	Sig. (2-tailed)	0.186	0.205	0.707	0.624	0.708		0.287	0.688
Q6	Pearson Correlation	0.546*	0.316	0.419	0.405	0.109	0.251	1	0.739**
	Sig. (2-tailed)	**0.013**	0.174	0.066	0.077	0.647	0.287		**<0.001**
Q7	Pearson Correlation	0.563**	0.243	0.610**	0.543*	0.032	0.096	0.739**	1
	Sig. (2-tailed)	**0.010**	0.301	**0.004**	**0.013**	0.892	0.688	**<0.001**	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

c. Listwise N=20

5.4.5 Other findings

The multiple regression analysis is conducted to examine the relationships and impacts between the overall test score and other independent variables. As evident from the "ANOVA[a] in the regression model" (Table 17), the "sig." value (0.051) exceeds the significant figure of 0.05. Consequently, there is insufficient evidence to indicate a significant linear relationship between the overall test score and independent variables (background, method, gender, and age). In other words, the regression model does not adequately fit the data. According to the "Coefficients" analysis (Table 18), "sig." values of "Age" (0.671) and "Gender" (0.254) are significantly greater than 0.05, indicating their lack of substantial associations with the knowledge test score. Similarly, "Background" accounts for a "sig." value of 0.075, which is greater than the standardized 5% level. However, the marginal difference between 0.05 and 0.075 is not substantial. Hence, a potential association between the background and the overall test score is considered somewhat meaningful. This implication can be seen in the "Group statistics of overall test score by backgrounds" table (Table 19). The means of the senior's overall test score is significantly higher than the means of the junior's overall test score. Additionally, the "Method" variable presents a "sig." value (0.030) below 0.05, which results in a significant association with the knowledge test score.

Table 17. ANOVA[a] in the regression model (SPSS)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	27.225	4	6.806	2.631	**0.051**[b]
Residual	90.55	35	2.587		
Total	117.775	39			

a. Dependent Variable: Overall test score

b. Predictors: (Constant), Background, Method, Gender, Age

Table 18. Coefficients[a] in the regression model (SPSS)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	22.164	1.266		17.513	<0.001	19.595	24.733		
Age	-0.158	0.368	-0.075	-0.429	**0.671**	-0.904	0.589	0.710	1.409
Gender	-0.767	0.661	-0.179	-1.161	**0.254**	-2.109	0.575	0.925	1.081
Method	-1.165	0.514	-0.340	-2.268	**0.030**	-2.208	-0.122	0.980	1.020
Background	1.288	0.701	0.325	1.837	**0.075**	-0.135	2.711	0.702	1.425

a. Dependent variable: Overall test score

Table 19. Group statistics of overall test score by backgrounds (SPSS)

	Background	N	Mean	Std. deviation	Std. error mean
Overall test score	Junior	30	20.57	1.813	0.331
	Senior	10	21.60	1.265	0.400

5.5 Discussion

Independent samples t-test for the test score of two teams reveals that two teams saw no significant difference in interpreting the structural description. On the other hand, the "IN" team utilizing interactive videos had a better understanding of behavioral description than the "TR" team utilizing traditional knowledge transfer method such as the recorded video. Furthermore, regarding the overall score, the interactive video team's performance significantly overwhelmed the recorded video team. Thus, interactive video users are likely to have a better understanding of detailed design than the other team. At the same time, the time efficiency of knowledge acquisition by the interactive video could be statistically proved because the test completion time of the "IN" team was faster than the "TR" team. Additionally, independent samples t-test for survey results between two groups indicates that the utilization of interactive videos outperformed the traditional methods in describing and explaining complex issues, data tracking, enhancing the engagement, the concentration ability and the knowledge retention.

The findings based on the correlation analysis in the interactive video team indicate that four following factors have a significantly positive tendency with the understanding of the detailed design:

Q2. Usefulness of the learning method in describing and explaining complex issues

Q3. Ease of quick search and grasp of rich information

Q6. Level of concentration while using that learning method

Q7. Ability to remember content after using that method

The relationships between memorizing ability and the concentration level were highly close, at the same time, having a positive correlation with the abilities of comprehending complex issues, and the information tracking. The combination of five typical functions of the interactive video including: dialoguing, controlling, manipulating, navigating, and annotating could stimulate active interactions, which can reinforce the retention of the information and knowledge. The detailed descriptions with numerous navigations in a systematic way were able to strengthen their memory connections. For example, filling in the blank pop-up questions with feedback could stimulate the memory recall knowledge and assist in identifying any gaps and uncertainties to confirm the interpretation of the test report generation process. Therefore, the utilization of interactive video could save time and effort for the engineer team to interpret the detailed design in a software outsourcing project.

Besides the complexity of the detailed design, engineers may challenge the differences in knowledge and cultural gaps in the software outsourcing domain between Vietnam and Japan. For instance, the Vietnamese offshore team using traditional methods was likely to have the wrong answers to the question about the order of saving log data into the database. Japanese customers required that the history data need to store after executing each step since they realized the importance of data storage for future bug detections, troubleshooting and data management, etc. However, some Vietnamese engineers thought that it was time-consuming and cost-inefficient. They subjectively supposed that the storage of log data should be proceeded only after conducting all the test executions. The findings align with the distinctive national characteristics that Vietnam is among the lowest uncertainty avoidance countries in contrast with Japan which has the highest uncertainty avoidance score. Interactive video could enhance the importance of data storage by forcing user to stop at the appointed time, highlighting the key process, showing pop-up annotations, and describing the sequence diagram in the scenarios (Figure 16). Thus, to somewhat extent, interactive video teams could avoid the preconception and important specification missing.

No evidence suggests the relationships between the knowledge acquisition capability and comfort in the work environment/watching videos, as well as the curiosity of learning new things. There might be a slight degree of correlation between the engagement and the overall test scores, but the statistical analysis does not provide statistical evidence to prove its significance. Furthermore, gender and age demonstrate no significant association with the knowledge test score, while the background of the participants somewhat has an impact on the ability of knowledge acquisition.

Chapter 6: Validation case studies

Chapter 6 presents the experiments of both a demo project and a real-world project in order to prove the application of interactive videos in the knowledge transfer regarding the detailed design of software outsourcing projects. The descriptions include the validation objectives, participants, necessary procedures, experiment results and the discussion.

6.1 Demo project

The demo project serves as a practical experiment to assess the effectiveness of the interactive video as a knowledge sharing tool, providing valuable insights for potential application scenarios.

6.1.1 Validation objective of the demo project

The experiment is designed to evaluate the performance of the interactive video in knowledge transfer and whether it can deliver the results of the H1, H2, and H3 hypotheses.

6.1.2 Validation participants of the demo project

The following 9 subjects were invited to the demo validation experiment.

- 1 project manager (in Vietnam)
- 1 bridge system engineer (in Japan)
- 1 tester
- Team A (the off-shore in Vietnam) includes 3 offshore developers using interactive videos, online meetings, documents, and chat tools.
- Team B (the off-shore in Vietnam) includes 3 offshore developers using traditional methods such as online meetings, documents, and chat tools.

6.1.3 Validation procedures of the demo project

The detailed design demo (same as the verification demo project) is a short-term testing tool development project that involves numerous intricate conditions and requires explanation with various relevant data sources.

The bridge system engineer conducts knowledge transfer of a detailed design demo to Vietnamese engineer teams (A & B) in order to compare the effectiveness of using interactive video with other traditional methods.

After the knowledge acquisition process, each team handles requirement analysis and product development based on the requirements.

*Notes: Teams A and B have the same number of participants and the relatively same level of knowledge as well as experience (evaluated by an experienced project manager).

Validation contents include the following six categories.

- Completion time during knowledge acquisition (man hours) and development process
- Q&A frequency
- The ability of knowledge acquisition
- Project performance
- Product quality
- Interviews regarding their experience in knowledge acquisition.

6.1.4 Validation result of the demo project

This section presents the analysis and discussion of working performance outcomes and the working evaluation of the interactive video team and traditional team based on the qualitative approach.

a) Working performance results

The following analysis of working performance outcomes consists of working hours and bug handling descriptions.

- Working hours

The bridge system engineer in team A spent 1.5 hours creating the interactive video, while team B did not invest time in that work (Figure 18). However, the bridge system engineer in team A invested only half the amount of time in conducting online meetings compared to team B. Team A required less amount of time for Q&A communication in comparision with team B. Due to the extra effort put into video creation, the total working hours of the bridge system engineer in team A were approximately 8% higher than those of team B.

Regarding the offshore engineers' work (Figure 19), team A spent 1.5 hours watching the interactive video, while team B did not have to allocate any time for this task. On the other hand, in comparison with team B, team A invested less time in online meetings, requirement analysis, and development as well as bug fixing time. As a result, there is a significant variance in the working hours between team A (15.75 hours) and team B (18 hours)'s developers.

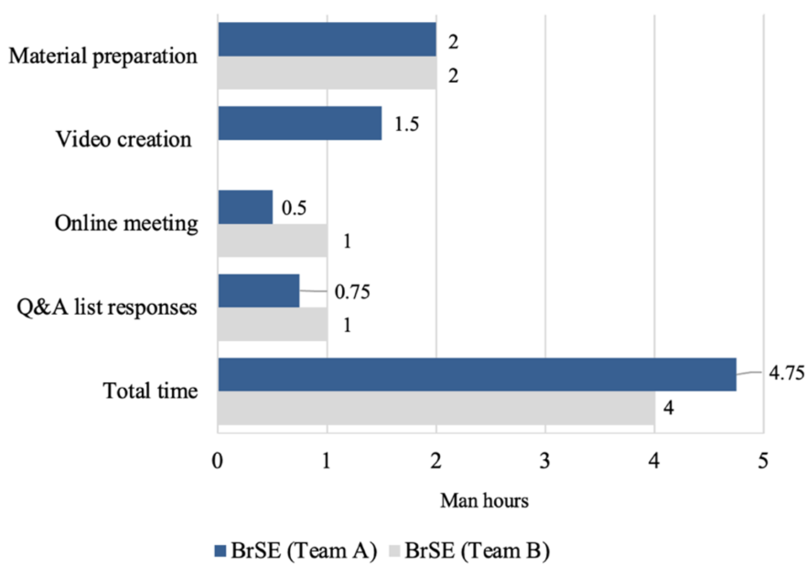

Figure 18. Bridge system engineer's working time in the demo project

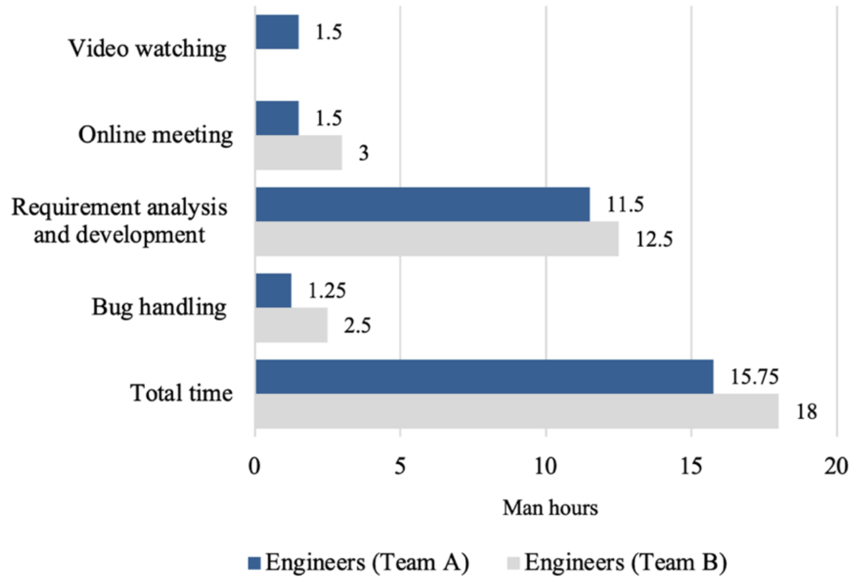

Figure 19. Offshore engineer's working time in the demo project

Table 20. Bug descriptions of the verification demo project

Team	Bug No.	Level of bug	Bug description	Debugging time (hours)
Team A	A1	Level 2	Error in the "time specification" field.	0.5
	A2	Level 3	Error in executing at the specified time: Incorrect time zone	0.75
	Total debugging time			**1.25**
Team B	B1	Level 1	UI errors on the Japanese language screen.	0.25
	B2	Level 2	Error in the "time specification" field	0.5
	B3	Level 2	Display error of the "x" button	0.5
	B4	Level 5	Error related to parallel execution in the test execution module due to improper resource management and synchronization (backlog issue).	1.25
	Total debugging time			**2.5**

Table 21. Bug evaluation sheet

Severity Level (Score range)	Description
Low (1-2)	Bugs with a minor impact on the system or application functionality.
	These bugs may cause cosmetic issues, minor inconveniences, or non-critical errors that do not significantly affect the system.
	They can be addressed during regular maintenance or future updates.
Moderate (3-4)	Bugs with a medium impact on the system or application functionality.
	These bugs may affect specific features or workflows, resulting in reduced efficiency or usability.
	They should be addressed within a reasonable timeframe to optimize the system's performance and user satisfaction.
High (5-6)	Bugs that have a substantial impact on the system or application functionality.
	These bugs may cause severe errors, data inconsistencies, or security issues.
	They require urgent attention and prompt resolution to maintain the system's reliability and user experience.
Critical (7-8)	Bugs with the highest severity level that have a critical impact on the system or application functionality.
	These bugs can lead to system failures, loss of data, security breaches, or significant malfunctions in functionality.
	Urgent attention and resolution are required to ensure the system's stability and usability.
Blocker (9-10)	Bugs that completely block the system's functionality or render it unusable.
	These bugs may result in critical failures, prevent core features from functioning, or pose severe security risks.
	They demand immediate action and resolution to restore the system's core functionality and prevent any major disruptions.

- Bug descriptions

As can be seen from the tables of bug descriptions (Table 20) and bug evaluation sheet (Table 21), team A triggered two bugs of levels 2 and 3, while team B caused totally four bugs including one bug of level 1, two bugs of level 2, and one significant bug of level 5. Both team A and team B experienced the same bug of level 2 (A1 and B2), which is the error in the "time specification" field. Users should not have been allowed to select the time in the past. The designer supposed that it might be common knowledge to set the time only from the present to the future. This bug was caused because there was no explanation about this requirement for both teams. Additionally, team A created a mistake in setting the time zone. The error resulted from the carelessness of verifying the time zone setting function. Therefore, all team A's bugs stem from the shortcoming in the detailed design and developing performance. On the other hand, besides the bug B2, team B triggered the other three bugs that arose from the misunderstanding of requirements as well as knowledge and cultural gaps regarding behavioral descriptions. For example, there was a bug in the user interface that the Japanese client required the search bar to allow for the input of less than ten full-width Japanese characters. However, Vietnamese engineers did not know about the existence of Japanese full-with or half-width characters. Team B missed this important explanation, while team A could interact with the input of Japanese full-with on the search bar by answering the filling the blank question in the interactive video (Figure 11). They could not skip the question since the video requested them to answer all questions before continuing to play the next content.

The bug B3 was caused by the preconception of Vietnamese engineer team. The client required the "x" button displays in all situations except after the results of testing execution (OK: Passed / NG: Failed) appeared. Thus, team B interpreted that the "x" button is utilized only when the test is running (R: running) and did not consider the situation that the test is prepared before running (NC: not completed). Team A did not cause any related bugs thanks to the scenarios on the interactive video, which described the flow of using the "x" button and all possible situations (Figure 10).

Japanese client thought carefully about the deadlock case, which could cause by the parallel executions. However, Vietnamese engineers in team B lacked experience in simultaneously executing multiple tests. Therefore, they did not pay attention to the possibility of deadlock scenarios, which occurred when two or more tests were trying to access the same resources at the same time but had to wait for other resources to be released by other tests. As a result, there was a halt in the test execution process, which impacted the overall test execution process. Team A did not experience this error because they already understood possible deadlock situations while watching and interacting with the interactive video. There was an annotation pop-up as a warning on the screen and a further explanation of parallel test execution (Figure 17). Additionally, the scenario description by the interactive video could emphasize the difference between independent sequential execution and parallel execution while interacting with the database.

b) Working evaluation

The following analysis of the working evaluation is conducted based on the team interview with open-ended questions and the project manager's assessments.

- Team interview

The interview table illustrates the ideas and comments on the knowledge transfer and acquisition process from two teams (Table 22). Team A showed the satisfaction in utilizing the interactive video as an additional knowledge transfer method to acquire knowledge of both structural and behavioral descriptions of the detailed design, while team B had difficulties in understanding the Japanese client's requirements because of the differences in logic and knowledge gaps. Regarding the ability of data tracking, team A experienced the flexibility in seeking necessary information and knowledge on the videos with navigating functions, whereas the large amount of related information makes it challenging for team B to follow. The interactions with the video screen fostered team A's engagement in knowledge acquisition. On the other hand, although the utilization of communication tools such as the recorded video did not have a positive impact on their engagement, team B believed that the communications among team members could raise their interest in teamwork. Therefore, team B invested more time than team A in communications to clarify the requirements.

Table 22. Team interview on the demo validation project

Interview questions	Team A	Team B
1. Describe your level of understanding regarding structural and behavioral descriptions.	The structural descriptions were not difficult because they were presented in a clear manner. Some complex and tricky behavioral descriptions can often be challenging to grasp. However, interactive video could systematically emphasize important requirements and help us understand them better.	There was no problem for us to acquire the knowledge of structural descriptions. However, Japanese client's intricate requirements and logics were sometimes difficult to understand.
2. What do you think about your ability of data and information tracking?	Interactive videos allowed us to track data and information at our own pace, making the searching process faster.	We had to search for the relevant links and information in the document files. Sometimes, it was difficult for us to find the knowledge that is described by the bridge system engineer.
3. Describe your level of interest and engagement in the learning process.	It was definitely better than reading lengthy descriptions by ourselves because we could take interactions with the screen.	There was nothing new, but we got used to this knowledge transfer method. Only when communicating with the team members, could we find it more engaging.
4. Describe your curiosity to acquire additional knowledge while using those methods.	To some extent interactive video raised our curiosity because we followed the external links described in the video for more information.	We had numerous questions about the detailed design with related knowledge. Therefore, we conducted extensive searches for relevant knowledge on the internet by ourselves.
5. Is there a high frequency of communication among team members?	We watched the video before the online meeting and discussion. Therefore, we accumulated a huge amount of knowledge beforehand. We asked the bridge system engineer many questions and confirmed our understanding related to the descriptions. However, our communication was somewhat limited since we already knew what to do.	We had extensive discussions because some of us did not clearly understand the requirements. Communication helped us address our doubts and fostered a collaborative environment.

(cont.)

Table 22. Team interview on the demo validation project (cont.)

6. Describe your concentration level when using that knowledge transfer method.	Watching interactive videos could enhance our concentration because we had to interact with the screen and complete all the required steps to finish the video.	The concentration level was moderate. Some of us felt sleepy when reading large amounts of material.
7. How well are you able to retain content after using those knowledge transfer methods?	The concentration and the interactions with the screen while reading and listening to the descriptions helped us memorize the flows and the content easily.	By reading materials and listening to the bridge system engineer's explanation, we could passively retain the content in our short-term memory. However, there were many detailed and complex descriptions so that we have to read and ask repeatedly.
8. Do you believe that the knowledge transfer materials can be reused for related projects?	The interactive videos could be beneficial for other related projects because they allow us and others to access and track the information easily.	The materials by documents could be used to apply to other related projects. We took some notes of the bridge system engineers' explanation. However, the content was not stored in detailed and systematically organized.

Both team A and team B mentioned that they could increase their curiosity for different reasons. While the related link hotspots navigated team A to find more information, team B showed their enthusiasm in searching for new knowledge to confirm their understanding.

Regarding the concentration and retention level of knowledge, team A found that interactive video was a supportive tool to raise their attention and recall the knowledge actively. However, team B could not fully keep their concentration and memorize all of the complex descriptions while reading the materials and conducting meetings. As a result, team B had to put effort into asking related questions repeatedly and confirming their understanding with the bridge system engineers and their team members. In terms of the reusability, both team A and team B's materials could be beneficial for other related projects. However, team A may have more advantages in sharing relevant explanations systematically created by the bridge system engineer.

- Team evaluation by the project manager

Table 23. Team evaluation by the project manager in the demo project

Criteria (Score: 1-5)	Description	Team A	Team B
Requirement Understanding	Demonstrate a clear understanding of project requirements and objectives.	5	3
	Apply the requirements effectively in the development process.	4	3
	Ask relevant questions to clarify any ambiguities in the requirements.	4	4
	Effective analyze the requirements with a team	4	3
	Average score	**4.25**	**3.25**
Code Performance	Write clean, efficient, and well-structured code.	4	4
	Follow coding standards and best practices.	5	5
	Implement appropriate error handling and exception management.	4	3
	Optimize code for performance and scalability.	4	4
	Average score	**4.25**	**4**
Time Management	Effectively plan and allocate time for various project activities among team members	5	3
	Effectively manage time and prioritizes tasks.	4	4
	Adapt to handle unexpected bugs accordingly.	4	3
	Meet the estimated deadline	5	3
	Average score	**4.5**	**3.25**
Product Quality	Produce high-quality deliverables that meet the defined standards.	5	4
	Minimize the occurrence of bugs.	4	3
	Follow quality assurance processes and conducts regular code reviews.	4	4
	Ensure the product meets functional, performance, and usability requirements.	5	4
	Average score	**4.5**	**3.75**

The project manager evaluated team performance based on the criteria (scores range from 1 to 5) described in the Table 23. The code performance of groups A and B is almost the same with the overall scores of 4.25 and 4 respectively. However, team A had a better understanding of the requirements than team B. At the same time, team A predominately conducts better time management than team B. There is also a slight difference in the product quality score between team A (4.5 score) and team B (3.75 score).

6.1.5 Discussion of the demo project

The demo project's findings indicate that even though the bridge system engineer in team A had to spend more time on the video-creating task, the offshore team A using the interactive video could eventually conduct the demo project faster than team B using traditional methods. Since team A already comprehended the requirements of the detailed design, redundant Q&A frequency was less than team B. Team B triggered several severe bugs due to misunderstandings and oversights of the specifications, especially regarding behavioral descriptions, while team A only caused minor bugs in their development process because of their carelessness in verification but not because of their misunderstandings. Thanks to the high ability of knowledge acquisition, team A could reduce the effort in requirement analysis and troubleshooting time due to intricate bugs. The interview results with engineers also revealed that interactive videos were advantageous to enhance their understanding of the behavioral descriptions, whereas there was no significant improvement in acquiring knowledge of the structural descriptions. In the context of Vietnam and Japan software outsourcing, the Vietnamese offshore team is unlikely to fully comprehend Japanese client's requirements due to the knowledge and cultural gaps. Rather than paying attention to all detailed specifications, Vietnamese engineers have a subjective way of thinking, leading to a mismatch with the Japanese client's requirements in ensuring the specifications and quality standards. Compared to traditional methods in knowledge transfer, interactive videos could further reduce these difficulties by allowing users to interact with the content. The benefits include the active engagement, flexibility in information tracking, the ability to understand complicated descriptions, concentration level and long-term retainment. As a result, team A showed superior project performance as well as product quality compared to team B.

6.2 Real-world project

The validation of a real-world project can examine the practical effectiveness of the interactive video in knowledge transfer based on its performance in real-time scenarios. The insights obtained from the validation of a real-world project can contribute to improving future implementation strategies and optimizing this knowledge-sharing method.

6.2.1 Validation objective of the real-world project

The experiment is designed to examine whether knowledge transfer with interactive videos in the detailed design phase in a real-world project can meet users' and end users' real-world needs in a real-world Vietnam and Japan outsourcing project by evaluating project performance and conducting in-depth interviews.

6.2.2 Validation participants of the real-world project

The following 11 subjects attended the real-world validation project.

- Japanese client
- Onsite team (1 bridge system engineer)
- Offshore team (1 project manager, 6 developers, 2 testers)

6.2.3 Validation procedures of the real-world project

The software outsourcing team conducts a short-term "File management" development module in a task management project by using interactive videos as an additional method for knowledge transfer of the detailed design.

The following contents are conducted in the validation experiment.

- Project completion time in comparison with the estimated plan (man hours)
- Project manager's evaluation
- In-depth interviews with the onsite bridge system engineer, offshore team, and project manager regarding the effectiveness of the interactive videos in knowledge transfer.
- Customer evaluation for the final product

Three interview questions are listed as below.

1. What are the advantages of using interactive in the project (requirement understanding, the ease of utilization, and why?)
2. Have you encountered any challenges when utilizing the interactive video? Please give me some examples with reasons.
3. Based on your experience, what recommendations or suggestions would you offer to improve the effectiveness of the interactive videos?

6.2.4 Validation result of the real-world project

This section demonstrates the qualitative analysis and discussion of working performance outcomes and the working evaluation in a real-world project when using the interactive video as an additional method.

a) Work performance results

The following analysis of working performance outcomes consists of working hours and bug handling descriptions.

- Working time

Regarding the working time (Figure 20 and Table 24), the bridge system engineer was expected to complete the tasks in 24 hours, but he spent 26 hours in reality. Thus, there was a slight delay of 2 hours in comparison with the estimated plan. The overall time consumption was affected by additional 4 hours allocated to the interactive video creation. On the other hand, the development team including 6 members finished their tasks within 224 hours, completing them 16 hours earlier than the initial estimation (Figure 20 and Table 25). The data suggests that developers performed a significant efficiency and productivity in their work. At the same time project manager and testers also were able to complete their tasks ahead of schedule with minor deviations from the estimation.

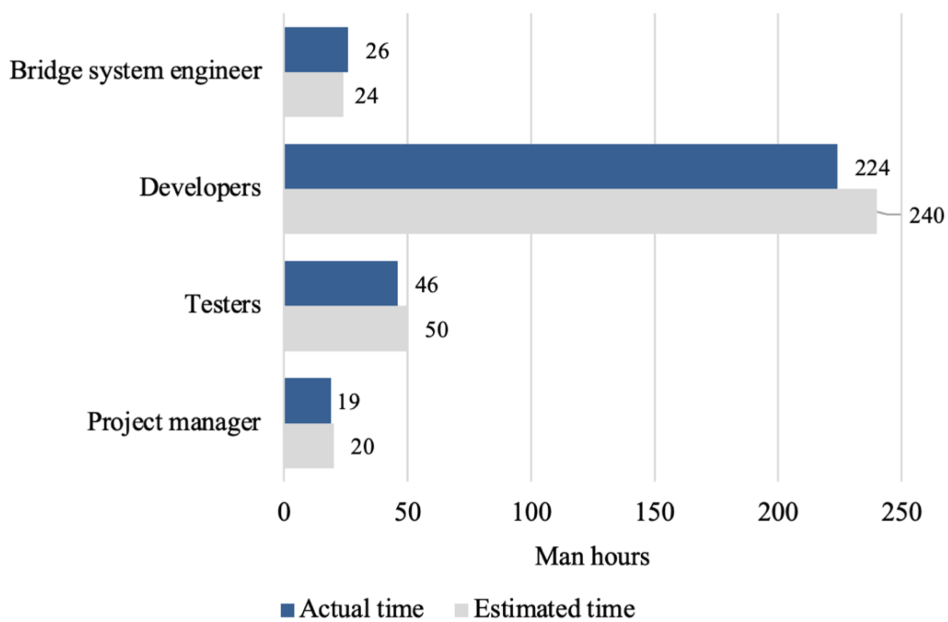

Figure 20. Comparison of actual working time and estimated working time in the real-world project.

Table 24. Bridge system engineer's working time

BrSE's work	Working hours (Man hours)
Material preparation	14
Video creation	4
Online meeting	5
Q&A responses	3
Total working hours	**26**

Table 25. Engineers' working time

Engineers' work		Working hours (Man hours)
Development	Video watching	12
	Online meeting	30
	Requirement analysis & development	166
Bug handling	Bug fixing time	16
Total time		**224**

- Bug descriptions

There were three bugs including level 2, level 3, and level 4, which took 16 hours for the bug handling task in total (Table 21 and Table 26). There were two bugs related to the time response efficiency and file uploading. The slow response error was attributed to the programming performance, while the file uploading bug was triggered by the ambiguous specifications. Initially, the detailed design did not specify the requirement for multiple file uploads. Moreover, the misalignment and text positioning were caused by the lack of double-checking and quality assurance in different devices. Hence, there was no evidence of requirement's misunderstandings. However, the lack of coding performance, the ambiguity of specification, and the oversights during the development process triggered the occurrence of these three bugs.

Table 26. List of bug descriptions

Bug No.	Level of bug	Bug description	Debugging time (hours)
1	Level 3	Slow response time: Inefficient algorithms for processing, resulting in poor performance and slow response times.	6
2	Level 4	Cannot upload multiple files at the same time.	8
3	Level 2	IU bugs: The texts and images are not properly aligned or positioned within designated containers and layout.	2

b) Working evaluation

The following analysis of the working evaluation is conducted based on the team interview with open-ended questions, the project manager's assessments and client's comments.

- Team interview

Regarding the advantages of using the interactive video in the project, team members highlighted their engagement with the diverse functions, which allow navigation, information tracking, and comprehension control at their own pace (Table 27). At the same time, this knowledge transfer tool could enhance and confirm their memorization as well as their understanding of descriptions with complex flows and data relationships caused by the gap between personal understanding and customer expectations. Consequently, they could minimize additional efforts and time to ask the bridge system engineer and the project manager many repetitive questions. However, some team members encountered difficulties in controlling the video since the abundance of pop-ups might result in feelings of overwhelmed or a sense of chaos. This problem could arise from their limited prior experience in using interactive video platforms. Notably, engineers suggested that there was no need to utilize the interactive video for structural descriptions of the detailed design.

Table 27. Offshore engineers' comments

Offshore engineers' comments	The utilization of interactive videos was highly engaging. I enjoyed using it before online meetings to acquire knowledge efficiently.
	The functions of interactive video are powerful. I could navigate, control the knowledge comprehension and track the information at my own pace.
	Interactive videos significantly improved my understanding of complex process flows, data relationships, and components, etc. However, some descriptions regarding the static descriptions were redundant.
	I could easily memorize the design's descriptions and confirm my understanding by engaging with the knowledge on the screen.
	I did not ask the bridge system engineer and project manager redundant questions because I could play the video beforehand and whenever I want to confirm the knowledge.
	I recognized some knowledge gaps between my understanding and customers' knowledge and expectations while watching the video.
	There were a large number of navigations on the screen. At first, it was hard for me to control the video because I did not get used to using it. After playing the videos several times, I got to understand and well controlled it.

Table 28. Bridge system engineer's comments

BrSE's comments	While creating the video, I could better enhance my understanding of the design because I needed to outline the explanation plan and manipulate the screen to create the desired interactions.
	Offshore engineers showed their enthusiasm in the discussion on the detailed design in the online meeting. They asked me many relevant questions about the design.
	It was challenging and time-consuming for me to create the interactive video for the first time in this project. It would have been better to have additional training on how to use it before conducting the knowledge transfer.

The interview results indicated that the bridge system engineer realized the interactive video allowed for a better comprehension of the detailed design not only for engineers but also for himself because it required him to create the outline of explanation as well as multiple interactions (Table 28). After watching the video, the discussion with the engineers seemed more efficient since they asked various relevant questions. However, the bridge system engineer highlighted two notable concerns in relation to the time consumption for the interactive video creation and the lack of prior training on how to use it.

- Team evaluation by the project manager

The project manager provided a positive assessment of the team's requirement understanding and the time management (Table 29). However, there were several bugs caused by the code performance. The overall product quality scored 4.25 out of 5, which indicated that the team delivered a high level of product quality and met customer standards as well as requirements. The utilization of the interactive video had a favorable impact on the schedule flexibility and the reduction of redundant meetings. The project manager emphasized his considerations of the cost and management system when using this knowledge transfer method (Table 30). He recommended that the company develop a knowledge transfer management system to allow for better coordination of a resource library including training materials, documentation, interactive videos, etc. Additionally, the cost of system development and maintenance of interactive video resources should be taken into consideration. In order to minimize the cost, the project manager highlighted the opportunities for the reuse of interactive contents in various related projects.

Table 29. Team evaluation by the project manager in the real-world project

Criteria	Description	Score (1-5)
Requirement Understanding	Demonstrate a clear understanding of project requirements and objectives.	5
	Apply the requirements effectively in the development process.	5
	Ask relevant questions to clarify any ambiguities in the requirements.	4
	Effective analyze the requirements with a team	4
	Average score	4.5
Code Performance	Write clean, efficient, and well-structured code.	3
	Follow coding standards and best practices.	4
	Implement appropriate error handling and exception management.	4
	Optimize code for performance and scalability.	4
	Average score	3.75
Time Management	Effectively plan and allocate time for various project activities among team members	5
	Effectively manage time and prioritizes tasks.	4
	Adapt to handle unexpected bugs accordingly.	5
	Meet the estimated deadline	5
	Average score	4.75
Product Quality	Produce high-quality deliverables that meet the defined standards.	4
	Minimize the occurrence of bugs.	4
	Follow quality assurance processes and conducts regular code reviews.	4
	Ensure the product meets functional, performance, and usability requirements.	5
	Average score	4.25

Table 30. Project manager's comments

Project manager's comments	The bridge system engineer did a great job in knowledge transfer. That is the reason why the offshore team worked more efficiently to deliver the desired product quality.
	It was more flexible for me to arrange the schedule because of the significant reduction in buffer online meetings.
	Despite encountering several bugs during the development process, the offshore team demonstrated a deep understanding of the client's requirements. The time management and the overall product quality were highly evaluated by the client.
	It is essential to develop a knowledge transfer management system to manage knowledge transfer resources. Furthermore, the cost of utilizing and maintaining interactive videos should be carefully calculated. If multiple related projects are undertaken, the resources could be effectively reused, leading to the cost efficiency.

- Customer evaluation

The Japanese client commonly has criticisms regarding the gaps in product quality standards, the time commitment, and the misunderstanding of their requirements. However, this project received positive feedback from the customer regarding the product quality and adherence to the timelines. Remarkably, the Vietnamese vendor had a profound understanding of their detailed design requirements that were beyond their expectations. Although the project manager reported a few minor errors in the development process, the Vietnamese team could promptly address the problems and provide effective solutions.

6.2.5 Discussion of the real-world project

The real-world project revealed the effectiveness of utilizing the interactive video as an additional method in knowledge transfer of the detailed design from the bridge system engineer to the offshore team. The qualitative analysis of the project outcome and the in-depth interview results show that the interactive video influences the successful completion of the "file management tool" project. The evaluations provided the evidence of the time efficiency, the enhancement of knowledge comprehension ability and the engagement, which affect their development performance. Although there were several bugs during the development process, it should be emphasized that all of these bugs primarily stemmed from ambiguous specifications, and technical oversights, which could be ultimately solved. Thus, it is evident that the misunderstanding regarding the detailed design requirements did not exist in this project. The Japanese customer, so-called the end user, also expressed their satisfaction with the time commitment and the final product quality. Regarding the drawbacks, the cost and effort for video creation as well as the development of the knowledge management system should be considered.

Chapter 7: Discussion

Discussion chapter presents a comprehensive implication of the verification, and validation results, along with additional insights obtained from the research. Furthermore, the limitations and suggestions for future research are mentioned to provide potential avenues for improvement and applications.

7.1 Discussion

The section provides a cohesive discussion on the verification and validation results based on three proposed hypotheses as well as additional insights obtained from the experiments.

7.1.1 Verification and validation results

Verification and case study validation results could prove the hypotheses below:

- *H1. Regarding the knowledge transfer of detailed design in the Vietnam-Japan software outsourcing project, the utilization of interactive videos can significantly improve the understanding of the requirements.*

The verification experiment indicated that the group utilizing interactive video and materials outperformed the other group using traditional methods such as recorded video and materials in the knowledge test with higher overall test scores.

Regarding the validation in the demo project, the interactive video team overwhelmed the traditional team in comprehending the detailed design's specifications. The evidence could be supported by the evaluation of the project manager regarding the two team's performance. The team using interactive video did not encounter severe bugs related to the requirement misunderstanding compared to the other team. Additionally, the interview results indicated that the interactive video team showed the confidence in their requirement understanding, whereas the Japanese client's intricate requirements and logic posed challenges for the non-interactive video team. The validation in a real-world project using the interactive video also demonstrated the team's exceptional requirement analysis and comprehension evaluated by the project manager and Japanese client.

- *H2. The utilization of interactive videos can eliminate communication, data tracking efforts and time constraints to better the effectiveness of the knowledge transfer.*

The result of the test completion time showed that the interactive video team could analyze the requirements and complete the test faster than the other team. In other words, interactive video could contribute to the reduction of time constraints in the knowledge acquisition. The survey data analysis also suggests that interactive videos are more effective than the traditional method such as recorded videos in reducing the effort required for data tracking and information retrieval. Additionally, the correlation analysis conducted in the verification experiment revealed a significantly positive tendency between the overall test score and the advantages of using interactive videos such as the usefulness of explaining intricated issues, the ease of data tracking, the ability of concentration and memorization. However, there was no evidence of eliminating communication effort in the verification experiment.

The validation experiments proved that the offshore team was able to reduce the completion time compared to the traditional team and the estimated plan by utilizing interactive video as an additional knowledge transfer method. The number of online meetings as well as communication efforts decreased significantly since the team could watch the knowledge transfer video in advance. However, the bridge system engineer had to allocate additional time to create the interactive video.

- *H3. The effectiveness of using interactive videos in knowledge transfer may vary across knowledge types in the detailed design.*

The findings in the verification experiment revealed the differences in interpreting two types of knowledge regarding the detailed design. There was no significant distinction in the interpretation of the structural descriptions between the interactive and non-interactive video teams. On the other hand, the team utilizing interactive videos exhibited a superior understanding of behavioral description compared to the other team. Validation in the demo project also demonstrated the same results that interactive videos triggered fewer bugs related to behavioral descriptions than the non-interactive video team. Notably, no significant bug was related to the misunderstanding of behavioral descriptions in the real-world project. Additionally, the interview results indicated that the effectiveness of interactive videos was particularly apparent in the knowledge acquisition of behavioral descriptions rather than structural descriptions.

7.1.2 Additional insights

The statistical data obtained from the verification experiment indicates that the ability of knowledge comprehension demonstrated no noteworthy correlation with the participants' age, gender, and backgrounds. However, the difference in junior and senior engineer's backgrounds appeared to have relationships with the knowledge acquisition ability to somewhat extent. Additionally, besides certain advantages of interactive videos, the video creation and operation management system may give rise to the additional cost-related constraints. Therefore, it is recommended that interactive videos are more suitable to use as reusable resources in multiple related projects to mitigate the costs.

7.2 Limitation and future research

There were limitations regarding the profile of participants since they were not fully representative of all age groups and backgrounds. Additionally, the sample sizes for the experiments were relatively small, which could have an impact on the statistical results. Furthermore, the effectiveness and applicability of the interactiveness may vary among the project domains and contents. However, the scope of the project context was relatively restricted to an automation testing project and a file management project.

Future investigation into the effectiveness of interactive videos within a wide range of project domains and participant demographics in the software outsourcing context would provide valuable insights. Moreover, conducting a cost-benefit analysis would be necessary for organizations to determine whether the benefits outweigh the costs. Last but not least, the applications in other countries and other industries such as architecture, manufacturing, entertainment, etc. should be potential research targets in the future.

Chapter 8: Summary and conclusion

The research was dedicated to the investigation of knowledge transfer problems between Vietnam and Japan, at the same time, provided potential solutions and experiment analysis. The significance of the worldwide software outsourcing sector and the value of Vietnam and Japan's market in particular were highlighted in the research. The strategic relationships between the two countries in software development and the advantages of Vietnamese offshore facilitate the high demand for software outsourcing from Japan. Along with the economic growth, the research could play an important part in indirectly mitigating the issue of labor shortages in Japan's IT industry and directly improving the quality of knowledge transfer in software outsourcing projects. In the context of Vietnam and Japan software outsourcing, the knowledge transfer of detailed design requirements from the bridge system engineer to the offshore team significantly contributes to the success of the projects. However, the complexity of the detailed design, as well as knowledge and cultural gaps, particularly the differences of uncertainty avoidance between these two countries cause negative impacts on the requirement understandings.

The utilization of interactive videos and their model were proposed as an additional knowledge transfer method to enhance the comprehension of Japanese client's requirements regarding the detailed design specifications. At the same time, the correlation between the advantages of interactive videos and the knowledge acquisition ability was proved in the research. The research's novelty lies in the investigation of using interactive videos to solve Vietnam and Japan's knowledge transfer problems regarding the detailed design in the context of software outsourcing projects. Additionally, it is proved that the effectiveness of interactive video varies depending on the knowledge types of the detailed design. To be more specific, the research experiments revealed that the effectiveness of utilizing interactive videos as an additional tool in knowledge transfer may outweigh traditional methods. The interactive team demonstrated a superior requirement understanding of behavioral descriptions in the detailed design compared to the traditional team. On the other hand, the comprehension level of structural descriptions showed no significant distinction between the two teams. Furthermore, there was a positive correlation between the capability for interpretation and the advantages of the interactive video such as the ability to explain the complex detailed design, the ease of data tracking effort, the enhancement of concentration level and memorization.

It is important to note that the research does not deny the effectiveness of other traditional knowledge transfer tools. However, the integration of interactive videos with those existing methods could have a potential impact on the project's success.

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Acknowledgement

First and foremost, I would like to express my utmost gratitude to my supervisor, Prof. Toma throughout my research journey. Without his invaluable guidance and kind support at weekly meetings, this paper would never have been completed. I am also grateful to Prof. Taniguchi for giving me comprehensive insights and feedback as my secondary advisor.

I truly appreciate the assistance of my lab tutor, Ms. Kijima for giving me continuous support at every stage of my research. Additionally, constructive criticism and comments from Toma Lab's members as well as the lessons learned from SDM professors also profoundly contributed to the improvement of my research.

I would like to acknowledge the companies and experiment participants for their cooperation and involvement in the interview and experiments. Their willingness to contribute their time, expertise, and resources has significantly enhanced the overall research quality.

Furthermore, I would like to express my sincere appreciation to the Ministry of Education, Culture, Sports, Science and Technology (MEXT) for sponsoring me with a full scholarship during my master's program.

Last but not least, I am indebted to all of my friends and family for their encouragement and support throughout my academic pursuits.