6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

25 - 27 SEPTEMBER 2023

E-PROCEEDING

USBET 2023

e-Proceeding

6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023
SUSTAINABLE BUILT ENVIRONMENT

02 October 2023 | Perak, Malaysia
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus

Editors-in-Chief

6th Undergraduate Seminar on Built Environment and Technology 2023

- E- Proceedings-

Organized by,

College of Built Environment (KAB) UiTM Perak Branch

MAJOR CHALLENGES IN THE IMPLEMENTATION OF BUILDING INFORMATION MODELLING TECHNOLOGY AMONG CONTRACTOR G7 IN MALAYSIAN CONSTRUCTION INDUSTRY

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ABSTRACT

Abstract. Building Information Modelling (BIM) has gained significant attention as a transformative technology and methodology in the construction industry. BIM represents a paradigm shift from traditional 2D drawings to a collaborative and information-rich 3D modelling approach. Its potential to enhance project outcomes, improve coordination, and streamline workflows has sparked considerable research interest in recent years. Although BIM technologys is very useful for the construction industry, the adoption rate in Malaysia is still slow compared with other countries due to challenges in adopting BIM. However, the objective of this study is to determine the major challenges in implementing BIM software among the contractors in Malaysia. 60 questionnaires were distributed to Grade 7 contractors located in Klang Valley, Selangor. The findings found the major challenges in BIM implementation among G7 contractors are lack of awareness, high cost, lack of BIM standards, followed by a shortage of BIM experts. However, the involvement of government construction institutions in Malaysia plays a significant role in further increasing the importance of BIM among contractors in the Malaysian construction industry.

Keywords: *Building Information Modelling, BIM, Challenges, Implementation*

INTRODUCTION

Technology nowadays plays an important role in the construction sector due to the increase in development activities. Thus, the construction industry must develop fresh approaches to improve and become more effective to fulfill the constantly growing requirements. Therefore, one of the software tools that can help manage the effectiveness of construction projects is Building Information Modelling (BIM), which is a modern technique used in construction projects to manage structure design and project data in digital form throughout a building's life cycle. BIM is currently being used as the industry's digital framework for architecture, engineering, and construction (Pan & Zhang, 2023). BIM has been embraced by countries worldwide, with many recognizing its potential to enhance project delivery, improve efficiency, and optimize resource utilization. Governments, industry organizations, and professional bodies have taken steps to promote BIM adoption and establish policies that encourage its use in construction projects. Besides, there have been worldwide initiatives to develop common standards for BIM data exchange and interoperability. According to (Panova, 2022), BuildingSMART was classified into workflow standards, which include information delivery manuals. BuildingSMART is an international organization focused on promoting open standards for BIM. Collaboration withvarious countries and regions such as Italy, Hong Kong, Poland, Norway, USA, and Austria to develop BIM policies and initiatives. The global nature of BIM implementation has facilitated collaboration and knowledge sharing among nations and organizations in terms of exchange experiences, best practices, and lessons learned through conferences, workshops, and forums. This international collaboration accelerates the development and advancement of BIM technology, pushing the boundaries of its capabilities and driving innovation in the construction industry.

In 2007, the idea to implement BIM software in Malaysia was introduced by the Director of the Public Works Department (PWD). The Malaysian government has taken proactive measures to promote the adoption of BIM. The Construction Industry Development Board (CIDB) Malaysia, functioning as the regulatory authority for the construction sector, has introduced policies and initiatives aimed at encouraging BIM implementation. These efforts include the formulation of the BIM Roadmap and the establishment of BIM Competency Standards. The BIM Roadmap outlines the strategic direction for successful BIM implementation in the country, while the BIM Competency Standards define the essential skills and expertise required for effective BIM utilization. However, although the Malaysian government has expressed support for the implementation of BIM, a lack of familiarity among professionals in the construction sector regarding the benefits, processes, and methodologies often leads to hesitancy in adopting technologies associated with BIM. This is supported by (Al-Ashmori et.al., 2020) the complications and challenges in project management will be greatly minimized with good adoption and application of BIM. It is crucial to address this issue by providing education and training initiatives to increase understanding and promote the potential benefits of BIM within the industry.

According to (Arif et al., 2021), small and medium-sized construction companies cannot afford the substantial upfront cost associated with BIM technology implementation. This high front-end cost appears as a barrier, impeding the widespread adoption of BIM in these contexts. It can serve as a deterrent, especially for small and medium-sized enterprises (SMEs) with limited financial resources. Besides, (Ngiik and Soon, 2021), the major concern regarding the implementation of BIM software is the cost updating the latest version of the software and providing staff training. Giving staff a training session to familiarize with BIM, requires time and temporarily reduces the productivity, resulting in additional costs in the short term. The perceived high cost associated with BIM adoption may discourage organizations from committing to the necessary investments, consequently slowing down the overall adoption process.

Furthermore, a lack of reference sources is also one of the issues with using BIM software. As described by (Ngiik and Soon, 2021), users create their criteria without engaging BIM experts because there is no national BIM implementation guideline, resulting in a wide range of outcomes. The current legal and contractual frameworks within the Malaysian construction industry may not sufficiently address the unique requirements and implications associated with the implementation of BIM. As a result, uncertainties arise concerning legal liabilities, intellectual property rights, and contractual obligations related to BIM. The absence of clear guidelines and frameworks creates hesitancy among industry stakeholders, impeding their full embrace of BIM in the construction sector.

The limited awareness and understanding of BIM among industry stakeholders in Malaysia present a critical obstacle to its widespread adoption. This is supported by (Al-ashmori et al., 2020), the delayed adoption and implementation in Malaysia are due to a lack of awareness. Professionals such as architects, engineers, contractors, and government agencies in Malaysia often possess limited familiarity with BIM. Consequently, they may lack comprehensive knowledge of its capabilities, functionalities, and potential benefits. This lack of familiarity prevents them from fully understanding how BIM can enhance project collaboration, streamline workflows, and improve project outcomes. Therefore, this research intended to investigate the challenges that hinder the adoption and acceptance of BIM in the construction industry.

BUILDING INFORMATION MODELLING (BIM)

There are many different definitions of BIM throughout the lifespan of BIM. As described by Al-Ashmori et al., (2020) BIM, alternatively referred to as n-D modelling, virtual modelling, or virtual prototyping technology, is a collaborative platform that utilizes a digital information model to facilitate the processing, production, communication, and analysis of construction projects throughout their entire life cycle. According to Sinoh et al., (2020) was stated that BIM is frequently considered to be a software program, a group of applications, or just a tool. BIM is a representation of

a building's information that can be immediately processed by a computer program and contains all the data necessary to support all life cycle operations. It contains details on the structure as a whole and its parts, as well as details regarding functions, shapes, materials, and building life cycle procedures. Furthermore, a virtual process that integrates all facility, disciplines, and systems into a single, virtual model allows owners, architects, engineers, contractors, subcontractors, and suppliers to interact more precisely and effectively than with traditional methods (Azhar, 2011). Instead of being thought of as a tool used in a project workflow, in this definition, BIM is considered as the actual workflow. It depends on the software's purpose, at the planning stage, during the design, construction, and management of buildings, or in infrastructure projects.

BIM Advantages

Construction management is a complicated process that necessitates open communication between design and construction teams. Costs for the entire project can be significantly impacted by delays, mistakes, and poor communication. Project teams may communicate, exchange data, and keep track of project expenditures by using a BIM model. Project management is considerably simpler and more organized using digital tools, which also prevents the silos that are sometimes created when utilising conventional CAD methods. The following are the various advantages of implementing BIM that can improve every aspect of a project.

- Improved Communication and Collaboration

The capacity of BIM to enhance communication and cooperation among all project team members is one of its most significant advantages. This is supported by Basak & Eraslan (2018), who described that the whole project team benefits from improved communication and organization. In the traditional design and construction process, each team member works individually, often using various software programs as well as standards. This may cause misunderstandings and mistakes, especially when combined drawings or information is exchanged across team members. Therefore, BIM makes it simpler for team members to locate and share the data they want since it uses a single integrated model that everyone on the team can access. This makes collaboration considerably more effective and reduces the chance of errors.

- Reduce Risk

The construction industry is fast shifting towards a more BIM-focused approach as more experts realize the benefits of this technology. BIM makes building planning safer and less risky, which encourages tighter contractor collaboration. According to Ibrahim et al., (2019) who stated that using BIM might help to decrease the risk of losing the project information, especially the management phase. This is because, with the use of cloud-based BIM tools, collaboration and communication are made simple for all project participants. All the data they want as well as e most recent models are always available to them, wherever they are. There is also no risk of the team members using outdated information

- Reduce Cost and Wastage

BIM is not just an effective tool for design and construction, instead it also has advantages over the entire span of a building's service life. BIM software provides contractors and designers with a variety of tools to help them optimize their workflows before construction begins. Time and cost may be integrated into BIM, supporting real-time updates as well as assessing effective tracking and monitoring procedures throughout the project phases (Al-Ashmori et al., 2020). This can lead to considerable cost savings and waste reduction. BIM also facilitates the building process, reduces human mistakes that could occur, and aids in better material selection for contractors. BIM can assist contractors in reducing the number of unused building materials and avoiding waste during the planning stages.

- Maximized Efficiency

One of the main benefits of BIM is that construction projects operate more effectively and have a shorter life cycle. It becomes simpler and quicker to handle and execute each aspect of the planning and pre-construction processes. This is supported by Whitlock et al., (2021) who described that BIM increased the effectiveness of logistics planning using 3D information that is indicative of the anticipated site environment and the corresponding increase in comprehension. Other than that, BIM may be utilized for clash detection and design optimization (Al-Ashmori et al., 2020).For instance, one of the two systems needs to be changed if an air duct crosses a plumbing line. Before construction starts, BIM automatically identifies MEP conflicts and alerts the designers so they can resolve the problem. Construction costs can be reduced by thousands of dollars if site complications are found early in the planning phase.

The Challenges of BIM Implementation

BIM is a powerful digital technology that offers numerous benefits to the construction industry. However, there are also several challenges associated with its implementation and use. Based on an extensive literature review from the previous research, table 1 shows challenges in BIM implementation:

Table 1: The Major Challenges of BIM

Bil	Author	Respondents	Findings
1	(Ahmad Jamal et al., 2019)	Architects at the management and operational level	-Lack of enforcement by local authorities on BIM -Difficult learning curve for those unfamiliar with BIM -High cost of operation, hardware & software

			-Lack of support and incentive from government and professional bodies -Lack of training and awareness programs -Lack of active participation from consultants -Lack of BIM standard, guidelines and protocols
2	(Firdaus Razali et al., 2019)	Journal Publications	-Lack of expertise within the project team -Lack of expertise within the organization -Lack of demand -Investment cost -Lack of additional project finance to support BIM -Resistance at operational level -Lack of collaboration between team members -Lack of immediate benefit from projects delivered to date -Legal issues pertaining ownership, IP & PI insurance
3	(Gamil & Rahman, 2019)	construction practitioners working at managerial and technical levels	-financial restrictions -lack of BIM knowledge -improper introduction of BIM concepts -lack of awareness of BIM benefits -no governmental
4	(Hong et al., 2019)	small and medium-sized construction contractor organisations (SMOs) in Australia	- High implementation expenses - Increased costs brought by workflow change - Increased communication issues - Staff's inadequate experiences in using BIM - People's resistance to change
5	(Al-Ashmori et al., 2020)	clients/ developers, contractors, consultants, participants from Construction Industry Development Board (CIDB)	-Lack of Awareness -financial - technical challenges, - management challenges - environmental, - legal risks
6	(Mostafa et al., 2020)	Industry professional	- Business change practices to support BIM - Replacing CAD technologies with BIM

			- Investment required in software, training and hardware - Challenges with collaborating and sharing information among the project team members - Legal concerns with fabrication and multiple designs
7	(Ngiik & Ang 2021)	Contractor G5 to G7	-High cost of software and updates -High cost of implementing the process and -Policy Lack of support and incentive from government and professional bodies -Process Lack of time for experimentation and implementation in fast-paced projects -Training cost is too expensive
8	(Yusoff & Brahim, 2021)	Facility Manager, Architect and Conservator	- Lack of knowledge and expertise. -Paranoid and rigid attitude to new technology. -Documentation. -Dragging-out time -Cost
9	(Umar,T. 2022)	Top construction organizations from all over the GCC region	-Difficulty in adapting BIM Technology and Process -Lack of domestic-oriented BIM Tools -Increased workload for model development -Cost of technology -BIM training and its cost -The complexity of BIM technologies (software) -The requirement of high-specification computers -Misunderstanding of BIM -Negative Attitude towards working collaboratively -Lack of a well-established BIM-based workflow -Immature dispute resolution mechanisms for BIM implementation -Lack of BIM knowledge -Lack of awareness of BIM benefits -Lack of BIM expertise BIM experts -Fear of the outcomes -Reluctance to change to BIM -Lack of collaboration among parties -Lack of support from top management -Lack of professional Interactivity

			-Lack of research on BIM implementation GCC -Improper introduction of BIM concepts -Lack of protection for intellectual property rights -Lack of BIM standards -Lack of a standard form of contract for BIM implementation -Lack of insurance applicable to BIM implementation -No-governmental enforcement -Lack of national agenda
10	(Celoza et al., 2023)	Contractors, Consultants, Designer/ engineers	-Model access -Inconsistent level of development -Hard to track changes in live model -Challenge with a live model -Assigning liability for modelled elements -BIM is not considered a contract document -Conflicting drawings and model -Traditional 2D project delivery -Lack of BIM standard practices -Different BIM expectations from clients -Lack of BIM specifications -Lack of widely implemented standard BIM contract -Permitting in 2D only -Stamping and sealing 2D drawings only

Based on table 1 above, there are various challenges in implementing BIM which has resulted in a reduction in the use of this software in the Malaysian construction industry. According to the list, there are a few major challenges that have been recognised which contribute to the challenges.

Table 2: The Major Challenges of BIM

The Major Challenges	Authors
High Cost	(Ahmad Jamal et al., 2019), Firdaus Razali et al., 2019), (Gamil & Rahman, 2019), (Hong et al., 2019), (Al-Ashmori et al., 2020), (Mostafa et al., 2020), (Ngiik & Ang,2021), (Yusoff & Brahim, 2021), (Umar,T. 2022), (Celoza et al., 2023)
Lack of BIM Standard Guideline	
Lack of Awareness	
Lack of Expertise	

- High Cost

According to Ahmad Jamal et al., (2019), when BIM is first implemented, a significant amount of money must be spent initially not just to purchase the technology but also on training and development. Initial investment costs include a variety of expenses, including staff training and upgrading of new hardware and software. Adopting BIM involves the procurement of specialized BIM software licenses, which is expensive. The price may also increase because of updating computer hardware and making infrastructure investments that can support BIM software needs.

- Lack of BIM Guideline

There is no national guideline on the implementation of BIM software. Every organization or firm comes up with its manual which results in confusion among the users (Ngiik and Soon, 2021). To allocate duties and carry out design reviews and validation, mutual procedures, and common guidelines are needed. This was supported by Hanafi et al., (2016) there are still no standard BIM guidelines for businesses in Malaysia, despite BIM being on the market for some years. Therefore, to effectively utilise the benefits of BIM, it is crucial to have a clear implementation strategy and support for the company. High Cost

- Lack of Awareness

Awareness of the benefits of implementing BIM is critical to increasing company productivity. There are parties in the construction industry who are still unfamiliar with BIM and are not interested in using it. According to Al-Ashmori et al., (2020) Malaysian acceptance and implementation of BIM have been delayed, and this is because of a lack of knowledge. Awareness has raised a lot of barriers to BIM adoption and implementation including trusting a new technology, building BIM skills, proper BIM-based tools selection, understanding the BIM project scope, and managing contracts Migilinskas et al., (2013)

- Lack of Expertise

Efficient utilization of BIM tools and techniques requires skilled employees. To fulfill this requirement, allocating a budget for the building sector becomes necessary to hire additional staff with expertise and understandingin BIM (Ngiik & Soon, 2021). It might be difficult to train current employees and find people with BIM experience. The availability of skilled BIM professionals, both within the organization and in the market, can influence the successful implementation of BIM.

RESEARCH METHODOLOGY

In this research, the contractors G7 in Klang Valley are focused as respondents to get the data. The focus is on G7 contractors because most of the G7 contractor companies have a stable financial position and are qualified to implement projects worth RM10 million and above. Therefore, the adoption of BIM technology is more relevant to the G7 contractor. There are 60 sets of questionnaires were collected from contractors (G7). Companies that have registered under the Construction Industry Development Board CIDB. They also have the following certificates: Perakuan Pendaftaran Kontraktor (PKK), Sijil Perolehan Kerja Kerajaan (SPKK), and Sijil Taraf Bumiputra (STB). The Krejcie and Morgan (1970) table is used to calculate the sample size for the survey. The data was gathered from the respondents and analysed to arrive at conclusions. The data obtained is analysed by using Statistical Package for the Social Science (SPSS) version 29. Although this research has been completed and has reached its objectives, there are still some weaknesses. This weakness can increase ambiguity and reduce the accuracy of the results of the research that was conducted. This problem happened to the sample of this study, which contractor company G7 must conduct. But some data are not filled in by the G7 contactor, and most of the contractors who received the research survey have given their employees the task of filling in the data. This has led to the data being obtained genuinely, not from the experience of the G7 contractor himself but from the workers who work there, which could be a quantity surveyor, supervisor, project executive, or clerk.

FINDINGS AND DISCUSSION

Background of the respondents

- Working Experience

Table 3: How long have you been in the construction industry?

	Frequency	Percentage
Less than 2 Years	17	28.3%
2 Years - 5 Years	14	23.3%
5 Years - 10 Years	20	33.3%
More than 10 Years	9	15.0%
Total	**60**	**100%**

Based on table 3, shows the data of the respondents based on their working experience. It was categorised into four categories: less than 2 years, 2 years to 5 years, 5 years to 10 years, and more than 10 years. Based on the data collected, the total data of respondents recorded is 60 respondents. From the results, working experience ranged from 5 years to 10 years, with 20 respondents (33.3%) taking the lead. It was followed by the respondents who have less than 2 years of experience, with 17 respondents (28.3%). Then, working experience from 2 years to 5 years represents 14 of the respondents (23.3%). Lastly, the least amount of working experience among the respondents was more than 10 years, with 9 respondents (15.0%). This shows that most respondents who answered this study are those who have been involved in the construction industry for 5 to 10 years.

- Involvement in BIM

Table 4: Have you ever been involved in BIM?

	Frequency	Percentage
Yes	57	95.0%
No	3	5.0%
Total	**60**	**100%**

Table 4 shows whether respondents have ever been involved in a Building Information Modelling (BIM) project. Most of the respondents, which is 57 (95.0%) out of 60 people in this research, stated that they had been involved in a BIM project. Meanwhile, 3 respondents (5.0%) stated that they had never been involved in BIM. This demonstrates that the respondents who contributed the data for this study are experts and users of BIM.

- .BIM Experience

Table 5: How long have you been involved with BIM?

	Frequency	Percentage
Not have	3	5.0%
Less than 2 Years	28	46.7%
2 Years - 5 Years	12	20.0%
5 Years - 10 Years	14	23.3%
More than 10 Years	3	5.0%
Total	**60**	**100%**

Based on table 5, shows the data regarding the respondent's experience using BIM. Only 3 respondents (5.0%) had more than 10 years of experience with BIM, compared to a total of 28 respondents (46.7%) who have used it for less than 2 years. However, there are 12 respondents (20.0%) with experience ranging from 2 years to 5 years, while there are a total of 14 respondents (23.3%) with experience ranging from 5 years to 10 years. Additionally, there are 3 respondents (5.0%) who have zero experience utilising BIM. This shows that most respondents who answered this study are those who have been involved with and used BIM software for less than 2 years.

Major Challenges in BIM Implementations

- Lack of Awareness

Table 6: Lack of Awareness

Variable	Frequency of Likert-scale					Mean score	Rank
	1	2	3	4	5		
I agree that lack of awareness among Contractors is one of the biggest challenges in BIM implementation	0	1	4	6	49	4.72	1
Percentage		1.7%	6.7%	10.0%	81.7%		

The first major challenges in implementing BIM among contractors are lack of awareness. Based on Table 6, most of the respondents which are 49 (81.7%) was selected strongly agree with this statement while only 1 respondent (1.7%) select disagree with this statement. Then, about respondents (10.0%) were selected agree regarding to these challenges while 4 respondents (6.7%) were selected neutral. This shows most respondents agree withthe following statement which explains that lack of awareness is one of the biggest challenges in BIM implementation especially among contractor G7. This is concurrent by Gamil & Rahman (2019) shortage of awareness of BIM benefits is the issue in BIM usage.

- High Cost

Table 7: High Cost

Variable	Frequency of Likert-scale					Mean score	Rank
	1	2	3	4	5		
I am agreeing that BIM Software required high cost in initial, operation and for update the software	0	1	6	4	49	4.68	2
Percentage		1.7%	10.0%	6.7%	81.7%		

The second major challenge is BIM required high cost specially to update and upgrade the software. According to Table 7, 49 respondents selected strongly agree which represented (81.7%) and 4 number of 60 respondents selected agree which represented (7.6%) regarding this statement. However, there are 6 respondents which represented (10.0%) who choose neutral while only 1 respondent (1.7%) was select disagree with this statement. It shows that this statement, which is BIM software required high cost in initial, operation and for update the software is one of the factors that influence BIM implementations. This was supported by Yusoff & Brahim (2021) who described that cost is one of the major issues in implementing BIM in Heritage Buildings.

- Lack of BIM Guideline

Table 8: Lack of BIM Guideline

Variable	Frequency of Likert-scale					Mean score	Rank
	1	2	3	4	5		
I agree that the lack of BIM standard guidelines and protocols by the government has led to a reduction in the use of BIM	0	0	6	8	46	4.67	3
Percentage			10.0%	13.3%	76.7%		

The next major challenge is the government's absence of BIM standard guidelines and procedures has resulted in a decrease in BIM usage. The result in Table 8 shows that most of the respondents 46 people (76.7%) was select strongly agree regarding this statement while about 8 respondents chose to agree (13.3%). However, there are 6 respondents which represent (10.0%) who were select neutral. This indicates that the lack of BIM standard guidelines and protocols by the government influenced BIM usage among contractors. Thiswas supported by Celoza et al., (2023) described that the issue in implementingBIM is the lack of widely implemented standard BIM contracts and specifications.

- Shortage of BIM Experts

Table 9: Shortage of BIM Expert

Variable	Frequency of Likert-scale					Mean score	Rank
	1	2	3	4	5		
I believe that the shortage of BIM experts is the reason for the reduction in BIM applications among contractors	0	2	3	8	47	4.67	4
Percentage		3.3%	5.0%	13.3%	78.3%		

According to Table 9, the result is regarding the next challenges, where a shortage of BIM experts is the reason for the reduction in BIM applications among contractors. Most of the respondents which are 47 (78.3%) strongly agree with this statement while 2 respondents which represented (3.3%) disagree. However, there is 8 respondent (13.3%) was selected to agree while 3 number of 60 respondents (5.0%) was choose neutral. It can be concluded that the shortage of BIM experts is the reason for the reduction in BIM applications amongcontractors. This was concurrent by Firdaus Razali et al., (2019) was indicating that the issue in using BIM is a lack of expertise among the project team.

CONCLUSION

This research is to determine the major challenges in BIM implementation. There are 4 major challenges in adopting BIM that are faced by contractors of G7 companies whichare lack of awareness, high cost, lack of BIM standard guidelines, and shortage of BIM experts among the project team. The result of the data from this research was contradicted by the result from the previous research. The highest ranking of the major challenges in the literature review was high cost, while in the analysis of the data, most respondents agree with lack of awareness, which represents a mean score of 4.72. This is because there are still contractors who are not aware of the advantages of using BIM, which can save time and avoid delays in a project. In addition, they also prefer to rely on old traditional methods to perform their project.

The contractors with their teams and the government are the important parties to encourage more people in the construction industry to use BIM in the future. Improvements can be made to overcome the issues regarding BIM usage in the Malaysian construction industry. Contractors should have a strong understanding of the utilization of BIM in the construction industry. While BIM may require a relatively higher initial investment cost, it also generates substantial returns on investment. Therefore, it is advantageous to invest more during the early stages as it can be leveraged throughout the entire project.

ACKNOWLEDGEMENT

Firstly, I would like to express my deep and sincere gratitude to my supervisor for providing invaluable guidance throughout this paper. She has taught me how to research and present it as clearly as possible. Her advice and commitment are extremely valuable. Besides, I am extremely grateful to my parents for their love, prayers, caring, and making sacrifices to educate and prepare me for my future. They also gave me support and encouragement, making me feel more motivated. Finally, my thanks go to all the people who have supported me in completing the dissertation, directly or indirectly.

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Sekian, terima kasih.

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