



***FRAMEWORK FOR IMPROVING CLASH MANAGEMENT PROCESS
FOR THE CONSTRUCTION MANAGEMENT TEAM USING
INDUSTRIALIZED BUILDING PRODUCT***

MUSTAFA FAWWAZ JARULLAH

FRSB 2020 11



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By

MUSTAFA FAWWAZ JARULLAH

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

February 2020

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DEDICATION

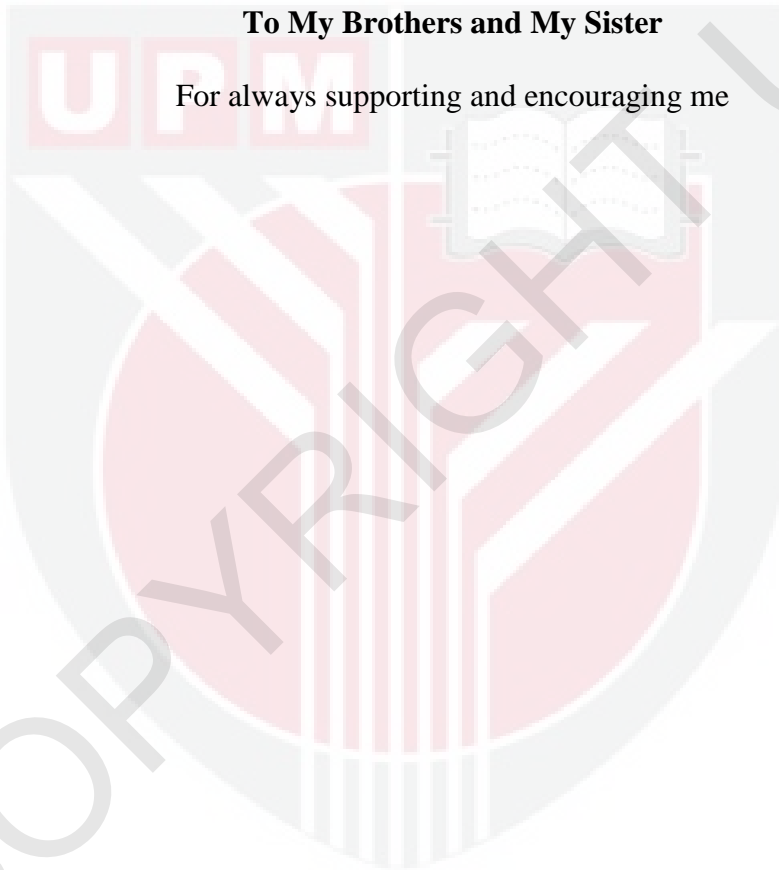
**This thesis is dedicated to My beloved parents
(Asso.Prof Fawwaz Jarallah & Mrs.Hanaa Ismail)**

For their endless love, encouragement and unconditional support in all my life and providing me with unfailing support and continuous encouragement throughout my years of study

And

To My Brothers and My Sister

For always supporting and encouraging me



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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By

MUSTAFA FAWWAZ JARULLAH

February 2020

Chairman : Professor Hajah Rahinah Ibrahim, PhD
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The construction industry continually facing problems in its projects. The clashes that occur during construction phase consider one of the major problems faced by the construction project. Furthermore, controlling the construction clashes consider a crucial need to decrease the waste of time and cost in the construction project. The costs of rework in poorly managed projects can be as much as 25%-30% of contract value and 10% of the total project costs. Despite all the efforts to avoid the construction clashes during design stage, there are no ideal construction process with zero clashes, and it is almost becoming a rare thing for a project not to have clashes. Hence, clash management become a normal occurrence in all construction projects. The management of the project consider one of the main reasons to cause clashes in design and construction. As the construction industry seeks for improvement overtime, new tools and innovation has been interduce to the industry to improve the conventional practice such as industrialized building system (IBS) and building information modeling (BIM). CIP 2016-2020 highlights the intention of Malaysian government to introduce these industrialized building products to the construction industry and increase the level of adoption. The reason to implement these new products is to enhance interactions between different team members and to reduce the clashes that occur from their lacking. Therefore, there is a need to improve the clash management process during on-going construction stage in order to support the use of industrialized building product in the AEC industry in Malaysia. The purpose of this study is to discuss how can the project management team improves the clash management process during on-going construction stage. This study uses literature review to identify the key areas that the industrialized building product can support the project team during clash management and to understand the project team factors contributing towards clashes that occur during on-going construction. This study recommends aligning the industrialized building products to the management team actions during the clash management process which can improve construction

productivity, and thereby, reducing future reworks. Results of this study would provide a framework for the management team actions through the clash management process and recommends the required areas for improvements. This study contributes in documenting the clash management process and the current practice, and improves the clash management process for the project management team during the construction stage. Also, this study contributes in supporting the implementation of the industrialized building product towards automating the clash management process in the future. Results of this study will lead towards supporting CITP 2016-2020 plan to increase the adoption of the BIM and IBS in the construction industry in Malaysia.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**KERANGKA PENAMBAH BAIK PROSES PENGURUSAN KONFLIK
UNTUK KUMPULAN PENGURUSAN PEMBINAAN YANG
MENGUNAKAN PRODUK BINAAN BERINDUSTRI**

Oleh

MUSTAFA FAWWAZ JARULLAH

Februari 2020

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Industri pembinaan berterusan menghadapi masalah di dalam projek-projek yang terbabit. Percanggahan maklumat yang berlaku semasa fasa pembinaan adalah antara salah satu permasalahan besar yang dihadapi oleh projek pembinaan. Tambahan pula, pengawalan percanggahan maklumat dianggap kritikal untuk mengurangkan pembaziran waktu dan kos bagi sesebuah projek. Kos ulang kerja di dalam projek-projek yang lemah pengurusannya dianggarkan berjumlah 25%-30% nilai kontrak dan 10% dari kos keseluruhan projek. Walaupun pelbagai ikhtiar dibuat untuk menghindari percanggahan dalam pembinaan semasa peringkat reka bentuk, ketika ini masih tiada proses pembinaan yang terbaik yang mencapai percanggahan sifar, dan ianya semakin amat jarang berlaku di dalam sesebuah projek pembinaan. Justru, percanggahan maklumat semakin menjadi kebiasaan lumrah bagi projek-projek pembinaan. Pengurusan projek dianggap penyebab utama percanggahan berlaku dalam reka bentuk dan semasa pembinaan. Oleh itu, industri pembinaan mencari penambahbaikan dalam kerja-kerja lebih masa, alatan baharu dan inovasi dalam praktis seperti system pembinaan berindustri (IBS) dan permodelan informasi bangunan (BIM). CITA 2016-2020 menggariskan hasrat Kerajaan Malaysia memperkenalkan produk-produk bangunan berindustri kepada industri pembinaan dan ingin meningkat lagi penerimaannya. Keperluan utama penggunaan produk IBS adalah untuk meningkatkan integrasi antara ahli pasukan yang berlainan dan mengurangkan percanggahan yang berlaku disebabkan kekurangan interaksi sesama ahli pasukan. Oleh itu, terdapat keperluan untuk meningkatkan lagi proses pengurusan percanggahan di peringkat pembinaan bertujuan menyokong penggunaan produk IBS oleh industri pembinaan Malaysia. Kajian kes yang dijalankan bertujuan membincangkan bagaimana pasukan pengurusan projek dapat menambahbaik proses pengurusan percanggahan maklumat semasa pembinaan di tapak. Kajian terlebih dahulu membuat sorotan literatur untuk mengenalpasti ruang utama bagaimana produk IBS dapat menyokong pasukan projek semasa pengurusan percanggahan berlaku dan

untuk memahami factor-faktor penyumbang dalam percanggahan tersebut. Kajian ini mencadangkan penyelerasan produk-produk IBS kepada tindakan pasukan pengurusan semasa proses pengurusan percanggahan yang didapati mampu meningkatkan produktiviti pembinaan, justeru, mengurangkan ulang kerja pada masa hadapan. Hasil dapatan kajian telah menggariskan sebuah kerangka tindakan pasukan pengurusan semasa pengurusan percanggahan dan turut mencadangkan beberapa penambahbaikan. Kajian ini menyumbang dalam mendokumentasi proses pengurusan percanggahan dalam praktis hari ini, dan menambahbaik proses pengurusan percanggahan untuk pasukan pengurusan projek semasa pembinaan. Di samping itu, kajian ini turut menyumbang dengan menyokong implementasi produk IBS ke arah mengotomasi proses pengurusan percanggahan di masa hadapan. Hasil dapatan kajian juga menyokong CITEP 2016-2020 dalam meningkatkan adoptasi BIM dan IBS dalam industri pembinaan Malaysia.



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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

AEC	Architecture, Engineers and Construction
BIM	Building Information Modeling
CAD	Computer-Aided Design
CITP	Construction Industry Transformation Program
CM	Clash Management
FCR	Fill Change Request
IBP	Industrialized Building Products
IBS	Industrialized Building System
M/E	Mechanical, Electricity
MEP	Mechanical, Electricity and Plumbing
PHJKR	Rating Scale for Sustainable Healthcare Facilities in Malaysia
PWD	Public Work Department
QS	Quantity Survey
RFI	Request for Inspection
RFID	Radio Frequency Identification
4D	Adding Time Dimension
5D	Adding Cost Dimension

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter discusses the background of the study, the problem statement for this research, research question and objectives. Moreover, this chapter discuss the used methodology including the study proposition, linking data to proposition, and the criteria for interpreting the findings. Then discuss the validation of the study and the scope and limitation of the study. The last section discusses the organization of the thesis chapters.

1.2 Study Background

The construction industry considers on of the key economic engines for the overall economy in Malaysia. It composes a significant value of Malaysia's Gross Domestic Product, around 4.0 percent at 2013 and expected to reach 5.5 percent by 2020. The construction industry expected to grow to 10.3 percent per year, outpacing overall Malaysian economy which expected to grow at a steady rate of 5-6 percent per year (CIDB, 2015). These numbers show the importance of the construction industry on the Malaysian economic. Therefore, CIMP 2016-2020 aims to improve the construction industry and the use of new technologies and new approaches to achieve this target. In relation to the construction industry, previous studies in the Malaysian context shows the importance of the clash management on the improvement of construction industry in developing countries such as Malaysia. These studies also investigated the impact of the construction clashes and the variation orders on the construction industry, and the significant increase of the clashes in building project using the conventional methods of construction (Osman, Omran, and Foo, 2009; Mohammad, 2010; Hameed Memon, Abdul Rahman, and Faris Abul Hasan, 2014).

In addition, the construction industry continually facing problems in its projects. The clash that occur during construction phase consider one of the major problems faced by the construction project (Ibbs, Wong, & Kwak, 2001). Moreover, controlling the construction clashes consider a crucial need to decrease the waste of time and cost in the construction project. The management of the project consider one of the main reasons to cause clashes in design and construction (Hameed Memon et al., 2014). According to Palaneeswaran (2006), the costs of rework in poorly managed projects can be as much as 25% of contract value and 10% of the total project costs. Supporting this numbers, other researchers stated that design clashes discovered late or during construction contribute approximately around 30% of project's contract's value (Al Hattab and Hamzeh, 2015; Lopez and Love, 2012). They also lead to schedule delays due to rework and changes required to mitigate the errors or accelerate the resolution process. These numbers show the impact of the clashes on the total cost of the project and the need to mitigate the clashes and improve the clash management process.

Despite all the efforts to avoid the construction clashes during design stage, there are no ideal construction process with zero clashes, and it is almost becoming a rare thing for a project not to have clashes. Hence, clash management become a normal occurrence in all construction projects (Sunday, 2010). The main cause of clashes in construction can be attributed to human error, which often occurs due to poor managerial practices. This is because errors mainly take place within the actions of individual firms and the interfaces between project team members (Love & Josephson, 2004). This elaborate the importance of the project management knowledge and experience to deal and react to the construction clashes that occur during project construction.

As the construction industry seeks for improvement overtime, new tools and innovation has been interduce to the industry to improve the conventional practice such as industrialized building system (IBS) and building information modeling (BIM). CITP 2016-2020 highlights the intention of Malaysian government to introduce these industrialized building products to the construction industry and increase the level of adoption (CIDB, 2015). BIM technology produced many advantages to construction industry, yet, according to Fountain and Langar (2018) the most use of BIM as an outsourcing service is to detect clashes. Despite BIM adoption, AEC industry still relies very much on traditional drawings and practices (Azhar, 2011; Bockstael and Issa, 2016). With BIM rather the nature of design error changed and evolved in parallel with new technologies applied that are still being managed by 'traditional management' processes and procedures (Pärn, Edwards, & Sing, 2018). Moreover, as the adoption of IBS require specific knowledge and skills for the project management, yet, the IBS did not change the management procedure to deliver the construction process (Jabar, Ismail, Aziz, & Janipha, 2013).

These studies show that the current management practice still relies on the traditional way of management procedure to deliver the project. Meanwhile, in the traditional way clashes can be identified manually by overlaid drawing on a light table, resulting in heavy reliance on the consultant to carry out the clash detection and management (Eastman, Liston, Sacks, & Liston, 2008). Hence, the process of detecting and managing the clashes still requires more improvement for the project team to overcome and expedite the clash management process with the use of new technologies such as BIM and IBS.

1.3 Problem Statement

The study background review shows the impact of the clash management on the construction process. Moreover, the study background elaborates the important role of the construction management team on the clash management process and urgent need to support the team during the construction process. In addition, the review discussed the importance of the use of the industrialized building products such as BIM and IBS, which the Malaysian government targeting to improve and increase the adoption level to support the professionals in the AEC industry. Thereby, this study highlights this gap to focus on to try to find solution for. Therefore, the problem

statement of this study is: There is a need to improve the clash management process for the construction management team in order to support the use of industrialized building product in the AEC industry.

1.4 Research Questions

Based on the problem statement of this research, the main research question is; *How can the construction management team improve the clash management process using the industrialized building product?* To answer this question there are three sub-research question (Sub-RQ) that addressed in this study:

1. What are the project team factors contributing towards clashes that occur during on-going construction?
2. What are the key areas which the industrialized building product can support the project team during construction?
3. How can the construction management team improve the clash management process using the industrialized building product?

1.5 Research Objectives

Based on the study questions, this research aim to achieve the following objectives:

1. To identify the project team factors contributing towards clashes that occur during on-going construction.
2. To identify the key areas which the industrialized building product can support the project team during construction.
3. To develop a framework supporting the construction management team to improve clash management process.

1.6 Case Study Research Methodology

This research is based on qualitative approach in order to gain in-depth details information from the respondents and to answer the research questions, qualitative research provide a deep holistic understanding of a particular phenomenon. Qualitative approach is recommended when the data based on experts' knowledge (Denzin & Lincoln, 2005). Case study considered a convenient strategy to describe topics (a) when it is not possible to manipulate the behavior of the people involved in the study, (b) when research question starts with HOW and WHY, (c) when many more variables than data points may exist (Yin, 2003). Moreover, Yin (2003) composed five components for case study research methodology: (1) Study questions, (2) Theoretical Proposition, (3) Study unit of analysis, (4) The logic linking data to proposition, (5) Criteria for interpreting the Findings. The five components will be explained in more details in the following section.

1.6.1 Study Question

The study main question is: *How can the construction management team improve the clash management process using the industrialized building product?*

According to Yin (2003) the case study considered a convenient strategy to describe topics when the study question starts with “How and Why”. As the main research question for this study starts with “how”, this confirm the research selection for the research method approach.

1.6.2 Study Proposition

Yin (2003) believes that there are two general analytic strategies consisting of: (1) relying on theoretical proposition, (2) developing case description. This research relied on a theoretical proposition developed through literature review. This theoretical proposition proposed that “Aligning industrialized building products to the management team’s actions during clash management can improve construction productivity”. The developed proposition will be elaborated at Chapter 2.

1.6.3 Study Unit of Analysis

The unit of analysis for this study is a construction management team dealing with single case study to address the process of the clash management. The rationale for choosing a single-case approach was to be able to highlight the different motivational facets of the relationship between people culture and innovation, as supported by previous study by (Hartmann, 2006). A single case is suitable to test the proposition’s relevance (Yin, 2003). The selected unit of analysis followed the management structure established by (Seng & Yusof, 2006). More details of the study unit of analysis, including the criteria for selecting the project, the criteria for selecting the management team, and the sampling procedure, will be discussed in Chapter 3.

1.6.4 Linking Data to Proposition

The fourth component of the case study method is the logic linking data to proposition and this component including the data collection method (interview), the protocol for data collection, and the data analysis will be elaborated and explained in details in Chapter 3.

1.6.5 Criteria for Interpreting the Findings

Yin (2003) mentioned that there is no precise way for interpreting in finding for such a study, as this component consider to be the least well-developed component as it

depends on the study proposition and the confirmation of respondents. This study anticipates that 75% of the respondents will confirm the study proposition.

1.7 Expected Results

This study expected to address the following results:

- Identification of the factor that contribute toward clashes.
- Identification of the key areas of BIM, IBS impact and the possible areas of improvement.
- The use of the industrialized building product such as BIM and IBS in Malaysia.
- Process flow of the clash management and the construction team actions during clash lifecycle.
- Framework to support the construction management team to improve the clash management process.

The expected results will be linked to research design framework in Chapter 6.

1.8 Validation

The validation for this study will follow four tactics developed by Yin (2009) are; (a) construct validity: establishing correct operational measures for the concepts being studied, (b) internal validity: establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, (c) external validity: establishing the domain to which a study's findings can be generalized, (d) reliability: demonstrating that the operations of a study, such as the data collection procedures can be repeated with the same result. All the four tactics will be discussed in detail in Chapter 3.

1.9 Limitation of Study

This study documented the clash management process within the design-build approach, and further studies can target other approaches such as conventional method and IPD (integrated project delivery). Furthermore, the study documented within the use of IBS delivery method, yet, further focus can target the clash management process within the use of BIM approach. Moreover, the study focused on the governmental project with PWD (public work department) involved in the construction process as client representative company, and further studies can target the private sector. Moreover, this study is targeting the Malaysian industry and the data had been collected from Malaysian company, while further studies can target other developing countries.

1.10 Organization of the Thesis

This study is generally divided into six chapters, each chapter contain the following:

Chapter One: Introduction

The chapter deliver an introduction regarding the study, including the background of the study, problem statement, research question and objective, research methodology, research flow, and validation.

Chapter Two: Literature Review

The literature survey includes three parts discussing: construction management, Clash management and the review of industrialized building product including building information modeling (BIM) and industrialized building system (IBS). The review of BIM divided into three sections; process, organization, and product. Also, summarizing the review with discussion and theoretical proposition through diagram.

Chapter Three: Research Methodology

This chapter discuss the reason to choose the methodology and elaboration of the case study research methodology including its five components with elaboration of sampling procedure and the interview question structure and protocol. Moreover, the chapter discuss the data collection and analysis procedure and the validation of the data. Presenting the link between data and literature and the procedure to collect and analyze the data.

Chapter Four: Results and Analyses

Chapter four presents the results and the findings from the case study and present the findings under four section and themes, including factors influencing the project team managing the project, and discusses the clash management process in the Malaysian context, the controlling construction productivity, and the use of industrialized building product. All the results presented in a narrative approach with evidences form the respondents.

Chapter Five: Discussion

This chapter discusses the results and findings and relate them with previous studies to address the research objectives. Then discusses the process of developing the framework supporting the project management to improve the clash management process.

Chapter Six: Conclusion and Recommendations

This chapter summarizes the discussion and the answers to the research questions, impact of this study, knowledge contribution, and recommendation for future studies based on the limitation of the study and the areas that can be improved.

1.11 Research Design Structure

The research design structure will be elaborate the steps of this study starting from the problem statement until the validation and publication as shown in (Figure 1.1).



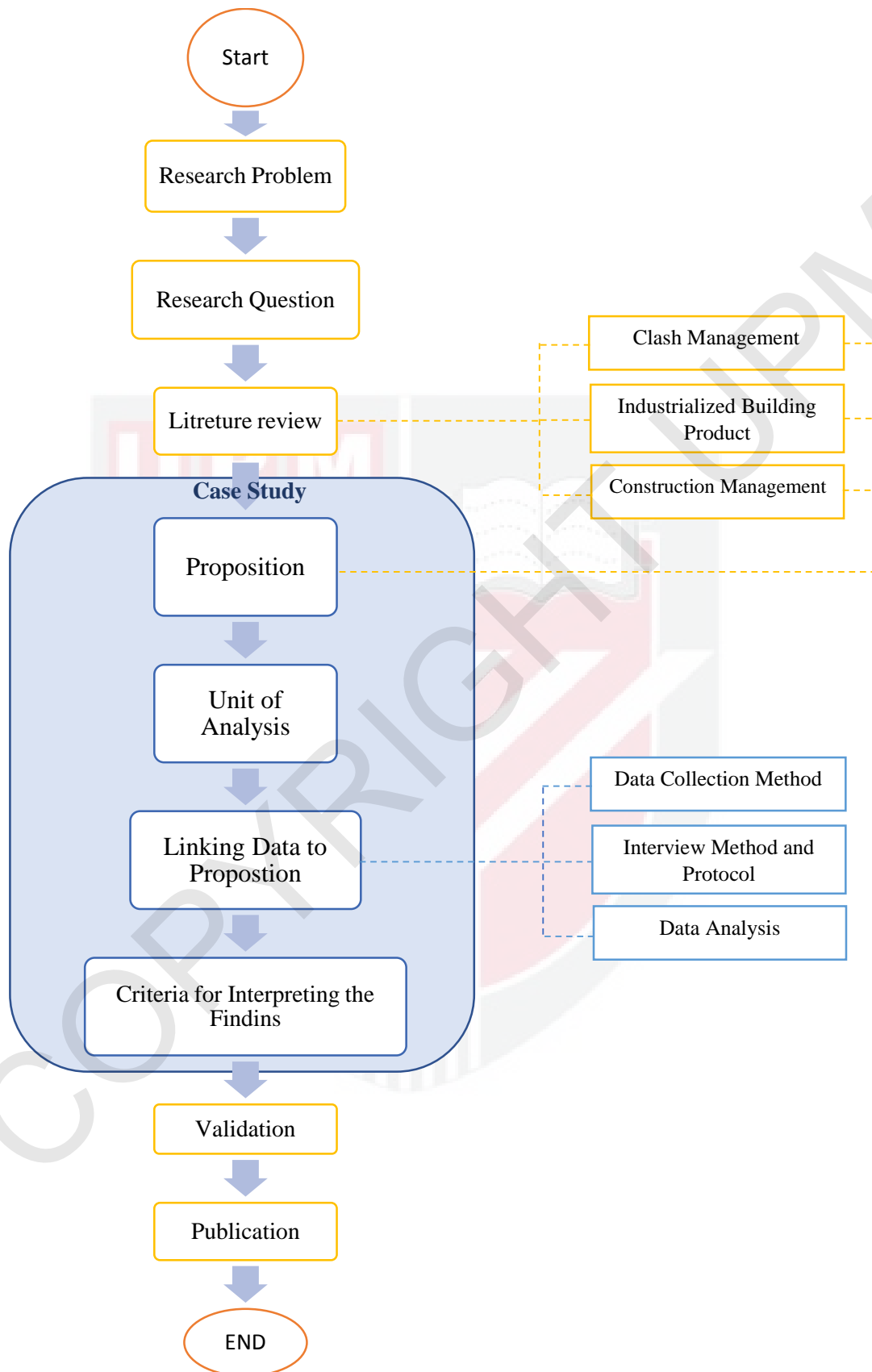


Figure 1.1 : Research Design Structure

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