DEVELOPING A BUILDING CONTRACT ADMINISTRATION FRAMEWORK FOR GRADUATE ARCHITECTS MANAGING HOUSING PROJECTS

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THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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DEVELOPING A BUILDING CONTRACT ADMINISTRATION FRAMEWORK FOR GRADUATE ARCHITECTS MANAGING HOUSING PROJECTS

ABSTRACT

The building contract administrator (usually the architect) is assigned to all the project matters from the time of signing the building contract until the work is accepted and final payment has been made. As the number of projects is increasing and the scope of the building contract administrator is huge, architects are unable to hands-on every project and they require the involvement of graduate architects to assist in their work. Ultimately, graduate architects play a vital role in supporting building contract administration (BCA) of housing projects in Malaysia. Previous research showed that architectural firms are dissatisfied with the quality of graduate architects and they have to re-train to make them fit for their jobs before starting their practice. The architectural education syllabus did not overcome the gap between institutions and the dynamic real world causing graduate architects to spend more time exploring while supporting BCA to acquire the necessary skills and experience. Hence, the purpose of this research is to enhance the performance of graduate architects while supporting BCA of housing projects in Malaysia through the development of the BCA framework by identifying the types of obstacles, root causes, and mitigation measures and understanding the relationship between these variables. A mixed methodology was implemented to achieve the purpose of the research. A quantitative method was used to determine the sub-themes and sequence arrangement of the BCA framework. One hundred and twenty-seven (127) survey data collected from graduate architects were analysed using statistical analysis, factor analysis, and relative importance index (RII). The relationship between variables was investigated using mediation analysis.

A qualitative method was used to obtain a detailed description of the phenomenon through seven (7) selected case studies that involved documentation reviews and semi-structured interviews with twenty (20) respondents. Data collected are analysed using thematic and content analysis. A focus group was undertaken with practicing architects to validate the draft framework. The research concluded that there are 5 themes of management in BCA. Findings from the quantitative method concluded that obstacles faced by graduate architects (or named *performance barriers*) while supporting BCA are deficient in BCA management. The root causes of the obstacles (or named *BCA skills*) are inadequate skills in BCA management and mitigation measures to resolve the obstacles (or named *competence development*) is to instill knowledge in BCA management. Mediation analysis results showed variables from performance barriers to be the sub-theme of the content framework. Findings from the qualitative method concluded that strategies for letter writing, authority submission, materials assessment, etc. are required in BCA management. The contribution of this research to the existing knowledge is the development of a BCA framework that serves as a reference tool for graduate architects' professional development in building contract administration. Academics can use the outcome of this research as a reference in their teaching modules which will help students to think about complex situations of building contract administration.

Keywords: graduate architects, housing projects, building contract administration framework, qualitative and quantitative methods

DEVELOPING A BUILDING CONTRACT ADMINISTRATION FRAMEWORK FOR GRADUATE ARCHITECTS MANAGING HOUSING PROJECTS

ABSTRAK

Pentadbir kontrak bangunan (biasanya arkitek) ditugaskan dengan semua urusan projek bermula dari masa menandatangi kontrak bangunan sehingga kerja diterima dan pembayaran akhir dijelaskan. Memandangkan bilangan projek yang semakin meningkat dan skop pentadbir kontrak bangunan adalah luas, arkitek tidak dapat mengendalikan semua urusan projek sendiri. Oleh itu, mereka memerlukan penglibatan arkitek siswazah untuk membantu dalam kerja mereka. Ini menyebabkan arkitek siswazah memainkan peranan penting dalam manyokong pentadbiran kontrak bangunan (BCA) bagi projek perumahan di Malaysia. Penyelidikan sebelum ini menunjukkan bahawa firma arkitek tidak berpuas hati dengan kualiti arkitek siswazah dan mereka terpaksa melatih semula arkitek siswazah bagi menyumbang dalam kerja sebelum memulakan perkhidmatan mereka. Sukatan pelajaran pendidikan senibina yang tidak dapat merapatkan jurang di antara institusi dan realiti menyebabkan arkitek siswazah terpaksa meluangkan lebih banyak masa meneroka BCA untuk memperolehi kemahiran dan pengalaman yang diperlukan. Justeru itu, tujuan penyelidikan ini adalah untuk meningkatkan prestasi arkitek siswazah dalam menyokong kerja pentadbiran kontrak projek perumahan di Malaysia menerusi pembangunan rangka kerja BCA dengan mengenal pasti jenis halangan, punca halangan, langkah mengatasi and memahami hubungan antara *variables* ini. Kaedah 'mixed methodology' telah dilaksanakan untuk mencapai tujuan penyelidikan. Kaedah *quantitative* digunakan untuk menentukan sub-tema dan susunan rangka kerja BCA. Seratus dua puluh tujuh (127) data tinjauan yang dikumpul daripada arkitek siswazah dianalisa menggunakan analisa statistik, *factor analysis,* dan *relative importance index* (RII). Hubungan antara *variables* telah dikaji menggunakan *mediation analysis*.

Kaedah *qualitative* pula digunakan untuk mendapatkan maklumat perincian tentang fenomena tersebut melalui tujuh *case study* terpilih yang melibatkan semakan dokumentasi dan *semi-structure interview* dengan dua puluh (20) responden. Data yang dikumpul dianalisasi menggunakan *thematic analisis* dan *content analisis. Focus group* telah dijalankan dengan arkitek yang aktif dalam BCA untuk mengesahkan rangka kerja draf. Penyelidikan merumuskan bahawa terdapat 5 tema pengurusan di BCA. Penemuan daripada kaedah *quantitative* merumuskan bahawa halangan yang dihadapi oleh arkitek siswazah (atau dinamakan halangan prestasi) semasa menyokong BCA adalah kelemahan dalam pengurusan BCA. Punca halangan (atau dinamakan kemahiran BCA) adalah kekurangan kemahiran dalam pengurusan BCA. Langkah-langkah penyelesaian (atau dinamakan pembangunan kemahiran) untuk arkitek siswazah yang menyokong kerja-kerja BCA adalah penerapan pengetahuan dalam pengurusan BCA. Hasil *mediation analysis* menunjukkan *variables* daripada halangan prestasi menjadi sub-tema rangka kerja kandungan. Penemuan daripada kaedah *qualitative* merumuskan bahawa strategi untuk menulis surat, penilaian bahan, dan sebagainya adalah diperlukan dalam pengurusan BCA. Sumbangan penyelidikan ini kepada pengetahuan adalah pembangunan rangka kerja BCA yang berfungsi sebagai alat rujukan untuk pembangunan professional arkitek siswazah dalam pentadbiran kontrak bangunan. Ahli akademik boleh menggunakan hasil penyelidikan ini sebagai rujukan dalam modul pengajaran mereka yang akan membantu pelajar lebih memahami situasi kerja sebenar pentadbiran kontrak bangunan.

Kata kunci: siswazah arkitek, projek perumahan, rangka pentadbiran kontrak bangunan, kaedah *quantitative* dan keadah *qualitative*

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LIST OF SYMBOLS AND ABBREVIATIONS

AIAC	:	Asian International Arbitration Centre
ABP	:	Amendment Building plan
ADO	:	Amendment Development order
AI	:	Architect's Instruction
BCA	:	Building Contract Administration
BIM	:	Building information Modelling
BP	:	Building plan
BQ	:	Bill of Quantities
BQSM	:	Board of Quantity Surveyors
C&S	:	Civil & structure
CAD	:	Computer aided design
CCC	:	Certificate of Completion and Compliance
CD	:	Contract documentation
CIDB	:	Construction Industry Development Board
CIM	:	Contract implementation & management
CMGD	:	Certificate of making good defects
CNC	:	Certificate of non-completion
CONQUAS	:	Construction quality assessment system
CPC	:	Certificate of practical completion
DBKL	:	Dewan Bandaraya Kuala Lumpur
DD	:	Design development
DLP	:	Defect liability period
DO	:	Development Order
DV	:	Dependent variable

EI	:	Engineer's instruction
EOT	:	Extension of time
EPDM	:	Ethylene propylene diene monomer
FC	:	Final completion
FIDIC	:	Federation of Consulting Engineers
GBI	:	Green building index
GDP	:	Gross domestic product
GFA	:	Gross floor area
HDA	:	Housing Development Act
IEM	:	Institution of Engineers Malaysia
IV	:	Independent variable
JKKP	:	Jabatan Keselamatan dan Kesihatan Pekerja
JKR	:	Jabatan Kerja Raya
KMO	:	Kaiser-Meyer- Olkin
KPKT	:	Kementerian Perumahan dan Kerajaan Tempatan
LAI	:	Landscape architect's instruction
LAM	:	Board of Architects Malaysia
LoA	:	Letter of Appoinment
M	:	Mean
M&E	:	Mechanical & electrical
MBAM	:	Master Building Association Malaysia
MBPJ	:	Majlis Perbandaran Petaling Jaya
MCO	:	Movement control order
MEP	:	Mechanical, electrical and plumbing
MHLG	:	Ministry of Housing and Local Government Malaysia
MV	:	Mediation variable

NCR	:	Non-compliance record
NEP	:	New Economic Policy
NGO	:	Non-government organization
NHP	:	National Housing Policy
NSC	:	Nominated sub-contractor
OSC	:	One stop center
PAJ	:	Jariah Charity Program
PAM	:	Pertubuhan Arkitek Malaysia
PBU	:	Prefabricated bathroom unit
PC sum	:	Prime cost sum
PKLM	:	Permit Kerja Lebih Masa
PMBoK	:	Project Mangement Body of Knowledge
PPRT	:	Housing Development program for the Hardcore Poor
PQP	:	Project quality plan
PR1MA	:	1 Malaysia People's housing program
PWD	:	Public Works Department
QLASSIC	:	Quality assessment system in construction
RFI	:	Request for Information
RIBA	:	Royal Institute of British Architects
RII	:	Relative Importance Index
RMR1M	:	Rumah mesra rakyat 1Malaysia program
RO	:	Research objective
RQ	:	Research question
RWDP	:	Rainwater downpipe
SD	:	Standard deviation
SD	:	Schematic design

SPA	:	Sales and purchase agreement
SRP	:	My First Home Scheme
SWCorp	:	Perbadanan pengurusan Sisa Pepejal dan Pembersihan
TNB	:	Tenaga Nasional Berhad
TQM	:	Total quality management
VO	:	Variation order
VP	:	Vacant possession

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

This chapter begins with an overview of the context and background that frames the research, followed by a problem statement and research gap, formed research questions before defined aims, and objectives. An overview of the methodology is outlined. Also included in this chapter is a discussion of the importance of this research, the scope of research, and the research's limitations. Chapter 1 then concludes with a summary of the contents of the chapters.

1.1 Background Study

Construction is one of the most complex, challenging, and stimulating industries in the country (Khan et al., 2014; Lee, 2023). It is an industry that is project-oriented and requires knowledge input from different project stakeholders (Zid et al., 2020). It generates huge employment in the economy as the industry consists of different professionals and expertise, an excessive range of materials, special plant and equipment, organizations, and a huge variety of exclusive products (Zairul & Ibrahim, 2008; Alawag et al., 2023). This industry shares 3.5% of the country's GDP (2022) and employs over 1.38 million people in Malaysia year 2022. Thereby, the construction sector plays an important role in the economy of the nation (Khan et al., 2014; Lee, 2023). Malaysian government put a lot of effort and campaign to promote this sector and today it has become one of the major sectors of the Malaysian economy (Khan et al., 2014; Lee, 2023). The construction industry is wide and covers not only constructing buildings such as offices, shops, houses, infrastructure, and industry, but also includes metal works, electrical, mechanical, architectural, and other related construction projects (Khan et al., 2014; Lee, 2023). Among all these categories, the housing sector is the most developed project in the Malaysian construction industry (Sambasivan and Soon, 2007; Hui, 2024).

1.1.1 Housing Sector

Malaysia is classified as an upper middle-income economy with a per capita income of US$12,449 in Dec 2022 (Al-Saedi and Abbas, 2023). The economic growth caused a massive rural-urban migration. Malaysia experienced tremendous population growth after its independence from 7.3 million in 1957 to 33 million in 2023 since the nation moved from an economy that was highly dependent on agriculture to a diversified economy, with the industrial sector as the engine of growth through a series of development plans (Al-Saedi and Abbas, 2023). The large increase in the number of urban residents – a six-fold increase over the period since independence was one element in changing the urban geography of Malaysia through the expansion of existing settlements (Furuoka, 2005; Hui, 2024). The creation of new towns around large metropolitan areas such as Shah Alam, Bandar Baru Bangi, and Selayang Baru in the state of Selangor, Senawang in the state of Negeri Sembilan, Senai and Skudai in Johor and Bayan Baru in Penang all contributed to the urban development strategy of promoting the satellite cities near large metropolitan areas (Agus, 2002; Hui, 2024).

The urbanization process of Peninsular Malaysia has been implemented since 1971 with the New Economic Policy (NEP) (Musarat, 2024). The demographic changes and the NEP encouraged rapid industrial and economic growth. The New Economic Policy (NEP) expanded the growth of the economy by attracting international growth since 1980 (Musarat, 2024). The migration of the rural population had a large impact on major urban centers in providing the basic infrastructure to new migrants. This migration of population to urban areas – combined with an economy that grew rapidly throughout the post-independence period created a sustained growth in the housing demand (Furuoka, 2005; Hui, 2024).

The Malaysian government active in cater the housing demand of the increasing population in the country during the Third Malaysia Plan (Saha et al., 2023). There are 2 main categories of housing in Malaysia, landed and non-landed housing. Landed housing includes bungalows, zero lot bungalows, detached, semi-detached, townhouses, terrace, link, and super link houses, and non-landed includes SoHo (Small Office Home Office), condominiums, apartments, flats, etc (Zulkifli and Ismail, 2023). The construction of this housing involved a team of expertise to plan, manage, and construct within a minimum of 24 months for landed housing and a minimum of 36 months for non-landed housing (Zulkifli and Ismail, 2023) and further elaborate in the subsequent sub-chapter.

1.1.2 Construction Project Team

The construction project team must be formed properly and the team members must be selected carefully to deliver the project on time. (Yunpeng et al., 2024). The construction project team involves multiple specialists such as architects, project managers, designers, engineers, contractors, and sub-contractors to meet the needs of the client (Kassa et al., 2023). A symbolic organization for a traditional project is shown in Figure 1.1. This organization and configuration of the project team tend to adjust throughout the project, some team members might only be involved in a particular phase, while others such as the client, project managers, and lead consultants may be involved for many years (Yunpeng et al., 2024). The key professions are architects and engineers who are involved in design, material selection, and assessment of work done in building construction (Kassa et al., 2023). Architects emphasize aesthetic and functionality aspects while engineers are responsible for the structure and performance of buildings (Daboun et al., 2023).

According to Winch (1998), these professionals assimilate ideas and functionality during the design stage, whereas the contractors are the ones who convert the design into practical during construction. This research is based on a conventional type of building contract which is a tool to formalize the cooperation between parties and administration of the building contract is a must to monitor and ensure the contractor works according to the contract (Zakaria et al., 2013; Kassa et al., 2023).

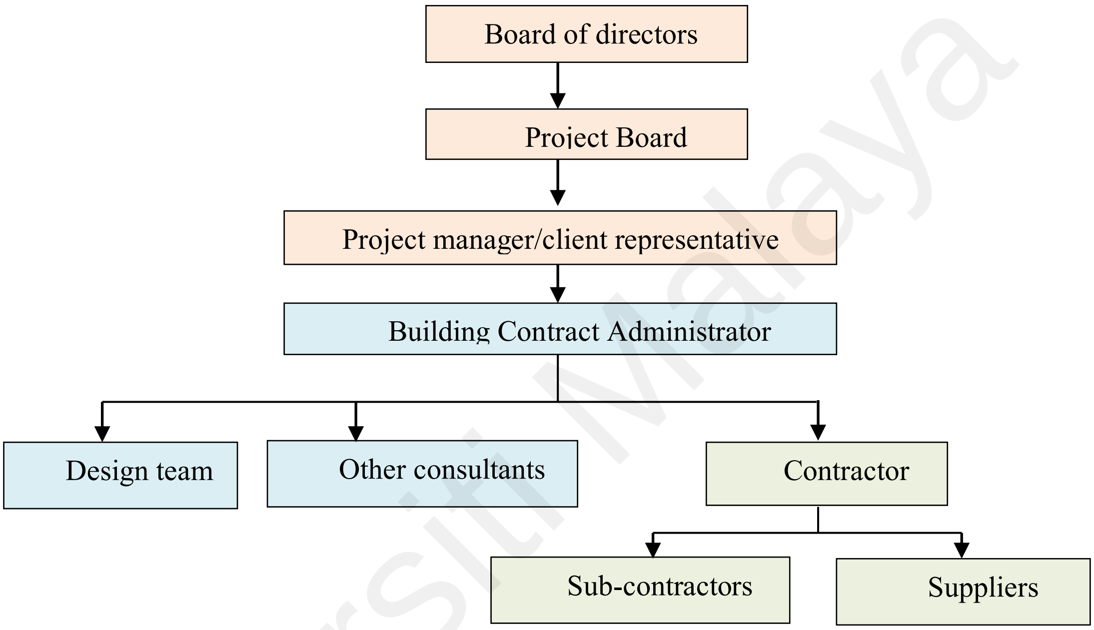


Figure 1.1: Structure of project team in the construction industry

1.1.3 Building Contract Administration (BCA)

Administration of a building contract is to ensure efficiency, conforming to articles of agreement and conditions of the contract, adhered to related laws and practices of the construction industry (Chong et al., 2011; Msawil et al., 2022). Building contract administration means all project activities are authorized by the building contract administrator from the commencement until the completion of the project (Cook, 2014).

There are a few types of standard building contracts in Malaysia, namely Pertubuhan Akitek Malaysia (PAM), the Public Works Department (PWD), the Asian International Arbitration Centre (AIAC), the International Federation of Consulting Engineers (FIDIC), and Construction Industry Development Board Malaysia (CIDB) (Zakaria et al., 2013; Berema et al., 2023). Standard forms of contract are in printed form published by reliable bodies of the industry accepted by the government and construction industry parties (Mohammad et al., 2010; Berema et al., 2023).

A building contract administrator is a person appointed to ensure the project will be delivered safely, to the specified quality standards, on time, and within the employer's budget (Cunningham, 2016; Msawil et al., 2022). The architect is the contract administrator under the PAM form, the Engineer is the contract administrator under IEM whilst the contract administrator is known as the 'superintending officer' in PWD and CIDB forms (Chong et al., 2011; Berema et al., 2023).

The building contract administrator has two specific functions an agent and a certifier (Katz, 2009; Malak and Khalife, 2017). As an agent, the administrator furnishes information to the contractor to accomplish their contractual works, giving instructions including variation or change orders, nominates sub-contractors and suppliers on behalf of the employer, supervises, chairs meetings, periodically inspects the works, assesses submission of extension of time by contractor, etc. (Cunningham, 2016; Msawil et al., 2022).

As a certifier, the administrator issues certifications on all payments outstanding under the contract certifies acceptance of completed works in adhered with contract specifications and accepted standards, and issues event certificates such as certificate of extension of time, certificate of non-completion, certificate of practical completion, etc (Weng, 2017; Patten and Saunders, 2018). The qualification of a building contract administrator can be summarized as follows (Cunningham, 2016; Msawil et al., 2022):

1) Possessed knowledge and skill to understand the relevant contractual provisions
2) Act in an independent, impartial, and fair manner when making decisions
3) Possessed in-depth knowledge of construction and the interrelation between trades and construction operations
4) Able to establish proper office procedures and record-keeping compatible with the scale and nature of the building contract and the works
5) Attentive and proficient with the different types of critical path and project programming techniques

The standard building contract that is widely used throughout the private sector in Malaysia is the Pertubuhan Akitek Malaysia (PAM) form of contract where the architect fills the role of contract administrator (Zakaria et al., 2013; Berema, et al., 2023). The architect is defined as a person with relevant qualifications and sufficient practice experience who has been registered with Lembaga Arkitek Malaysia (LAM) as an Architect (Malaysia, 2006). Architects carried out multiple tasks. He acts as an agent, advisor, and quasi-arbitrator in building contract administration (Kavanagh & Miers, 2021; Ostime, 2019a). The architect creates designs, alterations, and redevelopment and coordinates with engineers and quantity surveyors throughout the construction process from the commencement to completion (Ostime, 2022).

The scope of architecture is varied and huge, graduate architects are required to support partial of the scope (Andrews, 2022).

1.2 Problem Statement

Housing is a real physical antiquity which used as a shelter in human daily lives and is integral to the social-economic, political, and neighborhood environment (Hussin et al., 2023). Urbanization and industrialization brought along housing dilemmas due to the insufficient supply and overpriced housing (Hussin et al., 2023). Moreover, housing projects often experience delays along the course of their delivery (Kathitasapathy et al., 2023). Project delays are a common fact affecting not only the housing industry but the overall economy of countries (Hoque et al., 2023). The late delivery of housing projects has become a comprehensive problem in the Malaysian industry (Kathitasapathy et al., 2023). An abrupt delay will extend the overall duration of the project activities and lead to an increase in project costs (Hoque et al., 2023). These problems have become a nightmare for the government and the purchasers involved by bringing both socioeconomic and environmental impacts to the country (Tariq and Gardezi, 2023). Those socioeconomic impacts include unemployment, area loss, population isolation, and the nature of the environment including visual effects, landscaping, erosion, loss of biodiversity, and pollution (Ariffin et al., 2018). Its impacts were so significant that it decelerated developments in Malaysia.

Ministry of Housing and Local Government Malaysia has highlighted some common issues accomplice to delay in handing over, poor workmanship, the interest charged by the developers due to late progressive payments, reluctant to pay compensation by developers for late delivery, and payment problems related to maintenance (Amarkhil et al., 2023).

Recently, there are many studies related to housing projects have been examined as the number of problems in housing projects is experiencing delays due to various reasons (Mydin et al., 2014; Amarkhil et al., 2023; Tariq and Gardezi, 2023). According to Alaghbari (2023), he claimed that financial problems and coordination problems were the first and second factors that caused the delay. In similar research, delays, and problems occur in housing projects due to poor design and weak management and control.

Mezher et al.(1998) identify that consultant-related issues are one of the factors of delays in housing projects. Other studies also mentioned many housing projects suffered adverse outcomes linked with the attitudes of professionals from the complexity and the degree of the work, multiple prime contracting parties, ill-prepared, uncertain about roles and responsibilities, inadequate planning, financial issues, and communication problems (Ibrahim et al., 2022). The above factors wreck a project and lead to obscure litigation and arbitration, increased costs, and flawed business relationships (Ibrahim et al., 2022).

Based on previous studies, consultants contributed to the top 10 factors of delay in housing sectors due to incomplete documents, lack of experience, and delay in assessment of contractors' submission (Mydin et al., 2014; Giri, 2023). Consultants are directed by the building contract administrator (Msawil et al., 2022). The building contract administrator's task is to coordinate and persuade the project team to deliver the best possible performance both individually and as a member of the team, to achieve the target for completed project safely, meet specified quality standards, on time, and within the employer's budget (Msawil et al., 2022). However, this task is complicated when project teams are convened by members who are inexperienced working alongside each other (Koc and Gurgun, 2022).

Individuals question each other's motives and have deviated, adverse objectives that delay the project. Hence, the administrator needs to have an effective strategy to ensure the project delivers as committed to the employer. Therefore, the role of building contract administrator, ideally should be carried out by a person with expert technical knowledge of the construction process, strong leadership qualities, and highly developed interpersonal skills (Ajator, 2017).

In a PAM contract, an architect is the building contract administrator since he is the designer of the project and has a better understanding of the PAM contract which enables him to converse easily with the team to carry out planning and supervision work, and to resolve problems at construction sites (Yadollahi et al., 2014; Malak and Khalife, 2017). An architect is a key player in the construction industry whose services are needed from the commencement to the completion of the project. They acquire a detailed understanding of contractual, legislative, and statutory bases, which enables them to advise the contracting parties on their contractual rights and obligations and implement the administrative procedures set out in the particular contract (Ahuja, 2023).

According to Ar. Mohd Zulhemlee An, who was the immediate past president of the Malaysian Institute of Architects, there are approximately 2000 professional architects in the country (Salleh et al., 2016). The ratio between one architect against the population is 1:15000 – which is far below the range of 1:4000 to 1:8000 recommended by UNESCO for developed nations (Fadzil & Azlan, 2017). The past president added "We need to double our numbers to achieve the UNESCO ratio, by registering 400 new architects annually over the next five years. But we're only registering 50 and 100 new professionals yearly" (Fadzil & Azlan, 2017). The number of architects unable to accommodate the number of building developments in Malaysia.

Initially, the building contract administration role has traditionally been performed by architects under PAM contract, however, due to a shortage supply of architects; graduate architects (GA) have been assigned to perform partial of the role (Salleh et al., 2016; Mari et al., 2019). The delegation part of the supervision and monitoring duty to GA is permitted under Uniform Building By law-5 "*where under these By-laws any plan, drawing or calculation in relation to any building is required to be submitted by qualified person, no erection or continued erection of that building shall take place unless that qualified person or any person duly authorized by him undertakes the supervision of the erection and the setting out, where applicable, of that building*" (UBBL, 2022). Subsequently, GA plays a valuable role in assisting and supporting BCA (Mari et al., 2019).

The performance of the graduate architect in BCA is important because the management of the project from any initial stage will affect the project's success (Yadollahi et al., 2014). Based on research carried out by Mari (2019) aimed at discovering the performance of graduate architects from the Malaysian industry's point of view stated that employers have often given negative feedback regarding the attributes of graduates in their early careers. According to data from a previous study, they had summarized a list of negligence done during BCA including negligence in supervision, poor design, insufficient design documentation, failure to comply with authority requirements, incomplete work, unclear detailed work, inconsistent information, incorrect dimensions, unworkable details, uncoordinated systems, etc (Paprzyca, 2018). Architectural firms are disappointed with the quality of the graduates and still note that they have to mentor fresh graduates to make them competent for their jobs (Khodeir & Nessim, 2020).

Previous literature also indicated that graduate architects failed to perform due to their incompetence to accommodate the working environment (Mari et al., 2019). Education focuses on the creation of a knowledge base, but not on practical terms (Alharbi et al., 2015; Ng et al., 2022). There is a gap between education at the university level and the practical knowledge required by architecture students (Khodeir, 2018; Andrews, 2022). Architectural education did not encourage any fundamental rethinking of the structure and operations in overcoming the gap between institutions and the dynamic real world (Tzonis, 2014; Burridge et al., 2022). A 'reality shock' describes a frightening experience of the transition from the safety of an academic environment to an independent practice (Mari et al., 2019). There should be a bridge to close the gap for graduate architects to perform efficiently while supporting BCA of housing projects in Malaysia.

Construction today is much more complicated than 20 or 50 years ago, project owners are more knowledgeable and their representatives are often former contractors and know as much about construction (Paprzyca, 2018). Consequently, graduate architects spent more time exploring BCA to acquire the necessary skills and experience to cover their lack of exposure and guidance while at work (Hai 2010; Açici et al., 2014; Salleh et al., 2016). Subsequently, some of the projects failed due to improper management by unqualified architects who are inadequate in contract and communication, inadequate proper planning and monitoring, and inadequate special skills to lead and handle problems at construction sites (Yadollahi et al., 2014; Yap et al., 2021).

Previous research also showed that the major cause of contract claims is due to design deficiencies during construction (Yap et al., 2021). Poor design and delays in design documents are common problem that occurs in construction projects due to inadequate time given during the design phase causing the design unable to develop adequately and eventually stir misunderstandings between construction players working on the project (Yap et al., 2021). The reliance on the contractor to finish the design either through design-build or design-assist delivery methods and the disengaged of the design team during construction had made the building contract administrator's job become more complex and challenging (Holm & Schaufelberger, 2019).

From the above issues, it can be concluded housing projects delayed caused a major impact on project stakeholders (Giri, 2023). Housing project delays could be minimized if there is effective management on either the consultant or contractor team (Giri, 2023). The role of effective management falls under the shoulder of the building contract administrator who is the architect when adopting the PAM contract (Kassa et al., 2023). The insufficient number of architects and the massive development in Malaysia had caused architects to delegate partial of BCA scope to graduate architects (Malaysia, 2006). However, due to architecture education not matching with market's demand and inadequate experience, architectural consultancy practices need to re-train them to adapt to the working environment which is time and cost-consuming (Mari et al., 2019). There is a need for effective transfer of spatial and technical information from practical to graduate architects (Gunduz and Elsherbeny, 2020). **In a nutshell, the emphasis on graduate architects' work performance in BCA was key throughout the construction phase. However, the graduate architects' skills and knowledge for supporting the BCA were in question.**

Therefore, graduate architects should acquire building contract administration knowledge that aids the smooth running of a construction contract, for example, document control techniques and systems, meetings and reporting procedures, advice on appropriate methods to resolve if a dispute arises, assisting in the preparation of certificates, evaluate change orders and assessing entitlements for extension of time (Paprzyca, 2018).

1.3 Research Gap

Four research gaps have been identified following the review of literature relevant to the research as stated in Table 1.1; namely related to building contract administrators, obstacles in BCA, gaps in architectural education, and methods to improve graduate architect's performance. These four aspects are as below:

1) Various types of research have been conducted focused on building contract administrators who are architects or engineers but yet discussed graduate architects who play a vital role in supporting the BCA.
2) There is literature about the obstacles faced when administering building contracts. However, research narrates obstacles from the perspectives of graduate architects while support for BCA in the construction phase is scarce.
3) There is research about a variety of types of obstacles in BCA. However, limited research on the root causes of the obstacles faced by graduate architects while supporting the BCA.
4) Previous research discussed more on improving graphic skills, learning through practice, and mentor-coaching approach for the design phase, less study has been done on mitigating the obstacles faced by graduate architects while supporting the BCA through self-improvement.

Table 1.1 Research gap and referenced study

Gaps	**Referenced study**
1) Building contract administration focused on professionals but not GA	(Chong et al., 2011; Cook, 2014; Malak and Khalife, 2017; Ajator, 2017; Pooworakulchai et al., 2017; Gunduz and Elsherbeny, 2020; Msawil et al., 2022)
2) Obstacles when administering the building contract from a professional point of view	(Avots, 1969; Hendrickson et al., 1989; Verma, 1998; Heerkens, 2002; White and Fortune, 2002; Gray et al., 2006; Lientz and Rea, 2007; Love et al., 2008; Guo and Zhang, 2022; Daboun et al., 2023)
3) Types of obstacles in BCA	(Carpenter, 1997; Shannon, 2012; Khodeir and Nessim, 2020; Andrews, 2022; Burridge et al., 2022; Kezer and Güzer, 2022; Kharvari and Kaiser, 2022; Rajeev and Mohammad, 2022)
4) Methods to improve graduate architects' performance	(Riskiyanto et al., 2022; Christodoulou et al., 2022; Huber et al., 2022; Lester, 2022; Malott, 2022; Nisonen, 2022; Núñez-Andrés et al., 2022; Jolliffe and Crosby, 2023)

1.4 Research Questions

The research questions are as follows: -

1) What types of obstacles that graduate architects face while supporting BCA of housing projects in Malaysia?
2) What are the root causes of these obstacles to the graduate architect while supporting BCA of housing projects in Malaysia?
3) How to mitigate the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?
4) What is the relationship between the obstacles, root causes, and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?
5) How to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?

1.5 Research Aim

This research aims to enhance the performance of graduate architects while supporting BCA of housing projects in Malaysia. This aim could be achieved by introducing a building contract administration (BCA) framework for graduate architects supporting BCA of housing projects in Malaysia which serves as a reference tool for graduate architects' professional development in building contract administration and expedites to obtain their professional qualification.

1.6 Research Objectives

The research objectives are as follows: -

1) To identify types of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia
2) To investigate the root causes of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia
3) To establish mitigation measures of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia
4) To analyze the relationship between the obstacles, root causes, and mitigation measures for graduate architects while supporting BCA of housing projects in Malaysia
5) To develop a building contract administration framework to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

1.7 Conceptual Framework

The conceptual framework of this study as shown in Figure 1.2 is about the work performance of graduate architects which is affected by deficient in certain types of management (obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia or simplified term as "*performance barriers*") due to inadequate of certain types of skills (root causes of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia or simplified term as "*BCA skills*") and could be improved by instill certain type of knowledge (mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia or simplified term as "*competence development*").

After understanding the relationship between these variables, a building contract administration framework then be developed. The mediating role of BCA skills on the relationship between performance barriers and competence development will be tested and analysed in the following chapters.

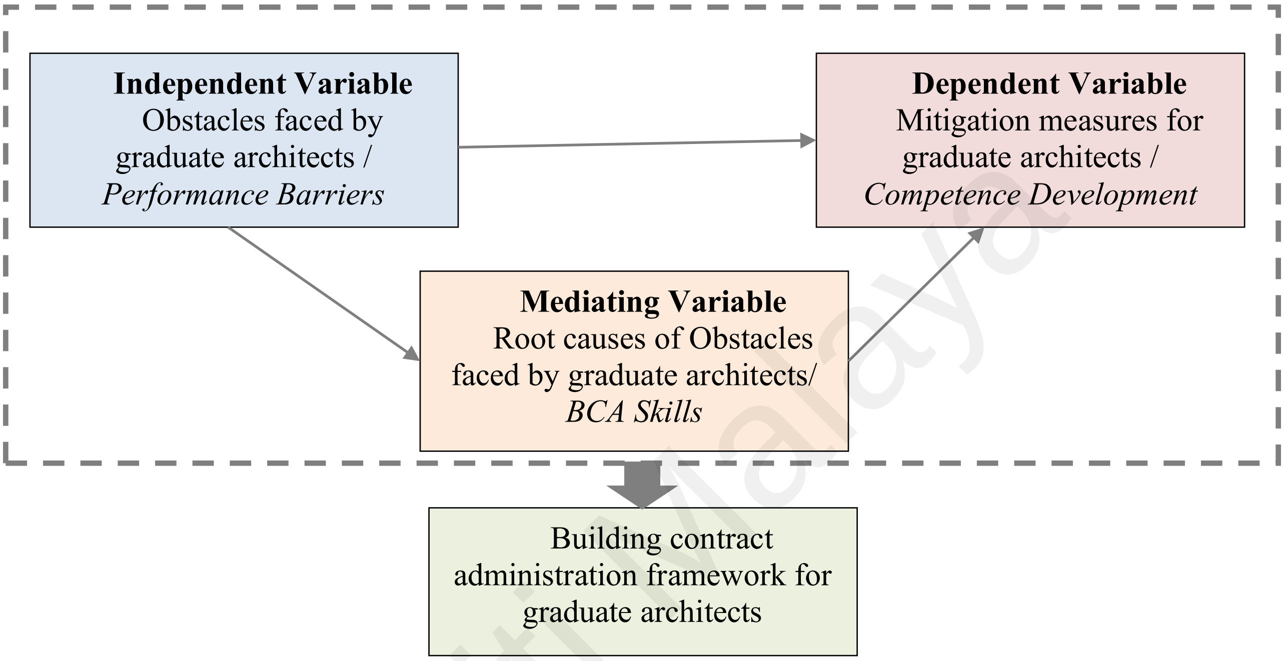


Figure 1.2: Conceptual framework of building contract administration framework for graduate architects

Table 1.2 shows a summary of research issues, objectives, and methodology for this research starting with a mixed methodology of quantitative and qualitative data collection and analysis. The quantitative method was applied to answer research objectives 1, 2, 3 & 4. The qualitative method was applied to answer research objective 5. The results generated from the quantitative method were used to determine the sequence arrangement and sub-theme of the BCA framework and qualitative methods were used to develop the content of the BCA framework. A focus group had been undertaken with practicing architects to validate the draft framework. The overall research framework is shown in Figure 1.3.

Table 1.2: Summary of Research Issues, Objectives, and Methodology

No.	Issues	Research Questions	Research Objectives	Research Methods	Data collection	Respondents
1	Graduate architects spent more time exploring BCA to acquire the necessary skills and experience to cover the lack of exposure and guidance while at work (Hai, 2010; Açici et al., 2014; Salleh et al., 2016)	What types of obstacles are faced by graduate architects while supporting BCA of housing projects in Malaysia?	To identify types of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Quantitative	Questionnaire	Graduate architects
2	Negligence in supervision, poor design, insufficient design documentation, failure to comply with authority requirements, incomplete work, unclear detailed work, inconsistent information, incorrect dimensions, unworkable details, uncoordinated systems, etc (Paprzyca, 2018)	What are the root causes of these obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?	To investigate the root causes of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Quantitative	Questionnaire	Graduate architects
3	Architectural firms are disappointed with the quality of the graduates and still note that they have to mentor fresh graduates to make them competent for their jobs (Khodeir & Nessim, 2020)	How to mitigate the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?	To establish mitigation measures of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Quantitative	Questionnaire	Graduate architects

4	Some of the projects failed due to improper management by unqualified architects who are inadequate in contract and communication, inadequate proper planning and monitoring, and inadequate special skills to lead and handle problems at construction sites (Yadollahi et al., 2014; Yap, et al., 2021)	What is the relationship between the obstacles, root causes, and mitigation measures for graduate architects while supporting BCA of housing projects in Malaysia?	To analyze the relationship between the obstacles, root causes, and mitigation measures for graduate architects while supporting BCA of housing projects in Malaysia	Quantitative	Questionnaire	Graduate architects
5	There is a need for effective transfer of spatial and technical information from practical to graduate architects (Gunduz and Elsherbeny, 2020)	How to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?	To develop a building contract administration framework to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Qualitative	Case studies: Documentation review & Semi-structured interview	Graduate architects

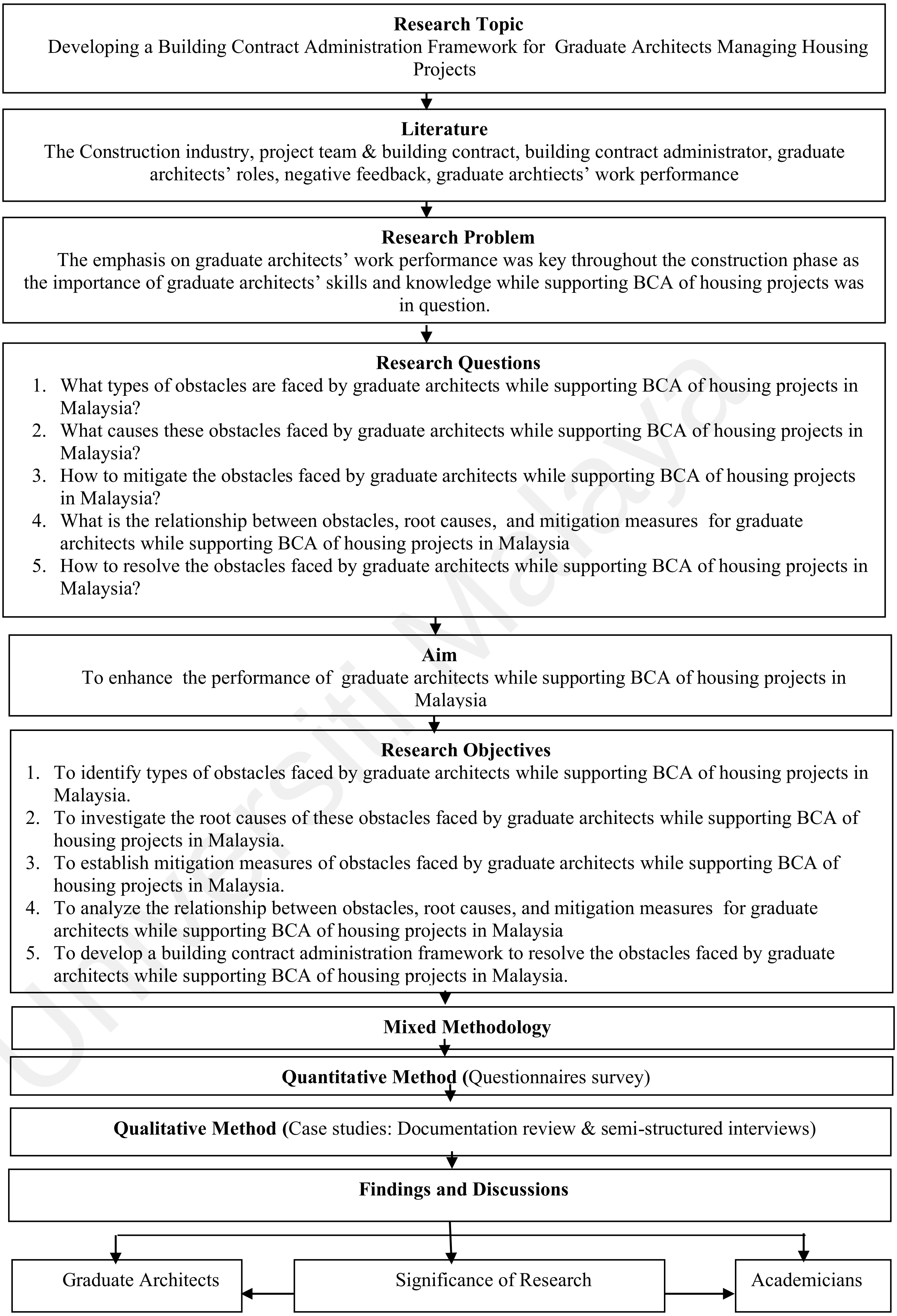


Figure 1.3: Research Framework

1.8 Significance of Study

The results obtained from the research are expected to benefit the graduate architects, project stakeholders, and academicians involved in architectural education. The benefits provided through the research are:-

1) Mitigate the housing projects delayed

Housing projects delayed caused by consultant-related factors would be minimized due to the improvement of management on consultants and contractors through BCA (Yap et al., 2021). As graduate architects play an important role in BCA, it was aimed at enhancing graduate architects' knowledge in claim and legal matters management, project management, communication and relationship management, quality and assessment management, and design management in the context of collaboration through a framework. Graduate architects would be able to reply and advise contractors/employers precisely & on time. This would ease the employer when making decisions and confirmation. Hence, the contractor would be able to proceed work without delay.

2) Improve coordination among project stakeholders

This research would assist graduate architects in acknowledging the concerns of all stakeholders and in a dialogue to appease conflicting interests. A project stakeholder is a person or group of people who have a vested interest in the success of a project (Szumlic, 2017). A negative approach from stakeholders would severely obstruct construction. Different stakeholders have different demands and requests. If the concerns of the stakeholders are improperly managed, it often leads to chaos and delays in the project.

With the development of a building contract administration framework, graduate architects would be able to understand each other's viewpoints better, and avoid preconceived ideas and assumptions (Alaloul et al., 2016).

In addition, this research eases project stakeholders during construction as it assists in decreasing unpractical, unproductive, and unrealistic solutions which saves time and cost for every party (Saram and Ahmed, 2001). Graduate architects may utilize this building contract administration framework as a guide for them when they support BCA. The number of trials and errors of design, construction methods, and materials on site would be able to reduce. Re-work is avoidable. Thereby, this research indirectly enhances the potential of graduate architects to perform efficiently and intensify the bonding between project stakeholders.

3) Indirect Knowledge contribution to architecture syllabus

The contribution of this research can be utilized for developing further models/tools in the future that would improve the work performance of graduate architects while supporting BCA of housing projects in Malaysia. The framework assists the university by moving forward to the professional practice stage (Ghonim and Eweda, 2019). The framework proposed could be incorporated into a pedagogy that focuses on methods to support BCA instead of achieving those predetermined learning outcomes set by academicians (Ghonim and Eweda, 2019). The goal of this research is to produce graduates with sound professional practice capabilities that align with their interests so that they are managed to support the BCA of this era. This study proposes a framework that centers around 5 thematic management: claims and legal matters management, design management, project management, quality and assessment management, and communication & relationship management.

The building contract administration framework is integrative and practical and fits the current market demand in which students would have the opportunity to explore the reality of architectural professional practice and facilitate their entry into the labor market (Ghonim and Eweda, 2019).

4) Develop professional competence among graduate architects

Having an in-depth understanding of the comprehensive building contract administration framework developed by integrating the types of obstacles, root causes of the obstacles, and mitigation measures of the obstacles faced by graduates while supporting BCA of housing projects in Malaysia could assist graduate architects in developing professional competence and inevitable would move a step closer to acquire their professional qualification. Supporting building contract administration is a skill that is compulsory to be mastered by the graduate architect before adopting professional qualifications and contract management never fails to appear in the architect's professional exam annually (Gafar et al., 2012). By having this building contract administration framework, a graduate architect would be able to get a glimpse of architecture professional practice in reality and better prepare them to confront problems faced during work.

1.9 Scope and Delimitation of Research

This research is specific to graduate architects in Malaysia and addresses the ineffective work performance in BCA for housing projects and the necessity to develop a building contract administration framework for their professional development. This study will only focus on strata housing projects where architect is the building contract administrator. This is in order for the scope of this study to be manageable. Criteria selection of the research scope and research target is due to the following reasons:

1) **Housing strata projects**

Housing is a basic need for humans. The increase in population and income has lead to an increase in housing demand (Lau, 2020). **Malaysia's residential sector remains the largest area by volume and value** due to the government's effort to ensure Malaysians have homes (Ezeanya, 2004). Subsequently, there is steady growth in both the volume and total value of transactions on high-rise residential, the growing population, and the increasing drive by citizens to own their homes (Shuid, 2004). The increase in housing demand and the lack of land for development in major cities in Malaysia has resulted in the rapid development of high-rise residential schemes (Shuid, 2004; Lau, 2020). High-rise living in urban centers is a logical response to increasing of land prices (Shuid, 2004; Lau, 2020). The priorities of these buildings were economy, efficiency, volume, and speed (Shuid, 2004; Lau, 2020). This research focuses on housing strata project development mainly for high-rise apartments/ condominiums where the scale of the project is bigger, and more complex, with more procedures/protocols to adhere to rather than individual housing projects (Chai and Yusof, 2013). Another reason for selecting high-rise housing strata projects for this research is because these buildings pose numerous engineering and technological problems with high uncertainty and complexity relating to foundation, ventilation, cooling, lighting, transportation (elevators, stairs, parking), communication, electrical power, plumbing, wind resistance, structural integrity, fire protection and building security issue which requires close coordination with various consultants and specialists (Chai and Yusof, 2013). Landed property is on a smaller scale and the problems faced are normally foreseeable.

2) **PAM contract**

PAM standard form of contract is commonly used in the Malaysian building industry (Rajoo, 2010; Berema et al., 2023). PAM undertook a complete revitalization of the PAM 1969 Form which was replaced by the PAM 1998 Form and then the PAM 2006 Form (Rajoo, 2010; Berema et al., 2023). In 2018, PAM launched the PAM Contract 2018 Form to replace the earlier PAM 2006. **90% of the building contracts in the private sector are based on PAM form where the risks are known to local industry** (Rajoo, 2010; Berema et al., 2023)**.** In PAM form, the Architect is the contract administrator who is an independent certifier, quasi-arbitrator, and agent to the Employer (Rajoo, 2010; Berema et al., 2023). This research focused on private development utilized PAM contracts that place significant further responsibilities on an architect undertaking the role of building contract administrator.

3) **Contract Implementation and Management Phase**

This research focused on the contract implementation and management phase because **this is the practical phase where the planning converts into reality where the contractor will convert the project into actual construction.** The professional team's role will be the building contract administrator or their representative who performs quality control inspections, responds to requests for information, reviews and approves technical submittals, and ensures the project is delivered as designed (Katz, 2009; Gunduz and Elsherbeny, 2020). The success of a project depends on the building contract administrator or their representative implementing parameters such as response time, approval process, resolving issues, coordination, and documentation (Ricchini, 1979; Kassa et al., 2023). Poor administration will cause poor planning, a lack of systems, procedures, and guidance, and delays in handing over sites to homebuyers (Katz, 2009; Gunduz and Elsherbeny, 2020).

4) **Graduate architects**

This research develops a building contract administration framework particularly for graduate architects while supporting BCA of housing projects. **Concerns have been raised about graduate architects' lack of employment competencies** (Shannon, 2012; Mari et al., 2019). The exam-oriented education system and the imbalance between the university curriculum and the expectations of the industry are partly blamed (Ng et al., 2022). Higher education is unable to generate a sufficient skilled workforce for society and provide the appropriate learning opportunities for students to develop the necessary skills and competencies (Shannon, 2012; Mari et al., 2019). Moreover, the role of graduate architects is constantly evolving and becoming more multidisciplinary (Salleh et al., 2016). Graduate architects are involved in planning, designing, and modeling building construction, leading specialists, dealing and negotiating with clients and contractors, and solving problems (Salleh et al., 2016). They become the key players in the building industry. Hence, graduate architects who support the roles of building contract administrators need to be competent and have diverse qualities from technical aspects to soft skills. Their work performance is crucial as it will affect the entire project team and the project delivery. The areas of study in this research are illustrated in Figure 1.4 below.

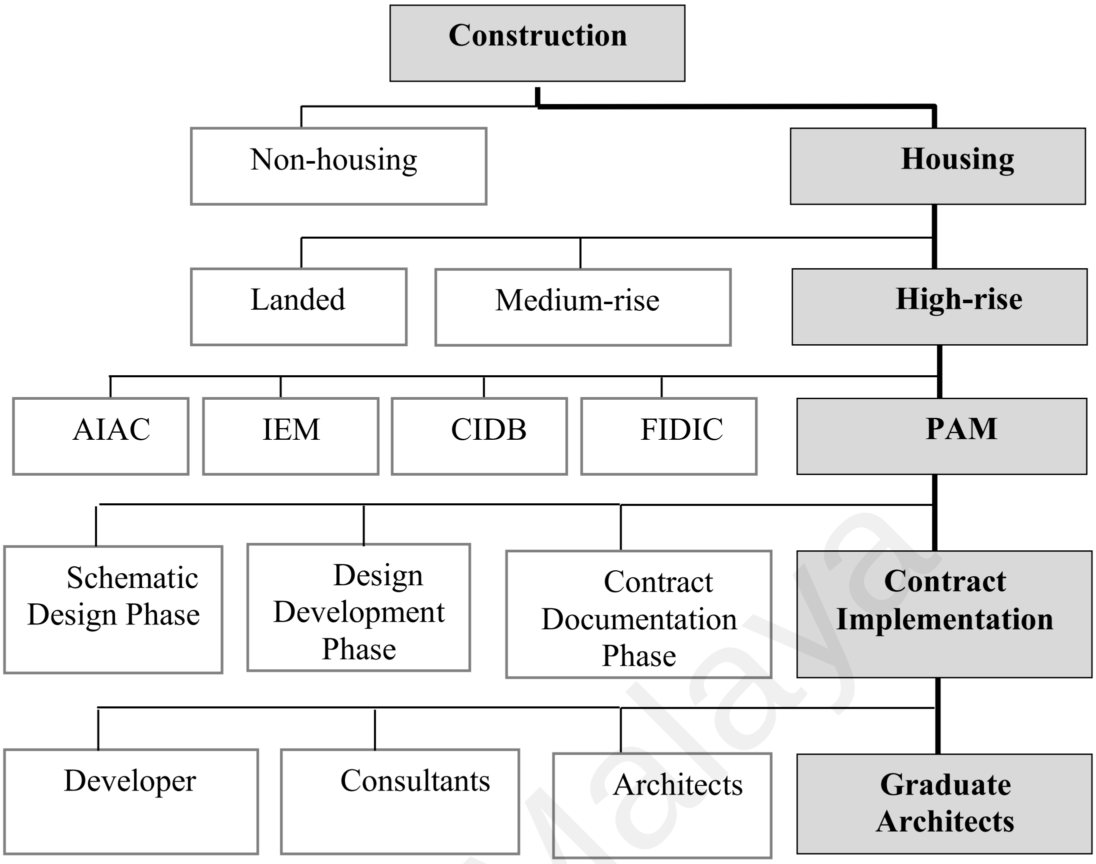


Figure 1.4: Area of Study

1.10 Outline of the Thesis

There are six chapters in this thesis on developing a building contract administration framework out of obstacles faced by the graduate architect while supporting BCA of housing projects in Malaysia as shown in Figure 1.5. This introductory chapter has presented an overview of the research, including the research problem and purpose, the methodology, and a brief description of the contextual background of the study. The following chapter (Chapter 2) will present a review of literature relevant to the research before identifying the methodology in detail that the research aims to address. Chapter 3 then discusses the methodology used in this research, including the research framework, the data collection, and the analytical methods.

Chapters 4 and 5 present the findings and discussion of this study, addressing each of the five research questions in turn. Chapter 4 reports the findings from the application of quantitative study by graduate architects, beginning with demographic data. Chapter 5 reports the findings of the case studies starting with reviewing documents followed by semi-structured interviews with selected graduate architects to describe the contents of the building contract administration framework required while supporting BCA of housing projects in Malaysia. Chapter 6 concludes the thesis with a summary of the findings and establishes a building contract administration framework focusing on housing projects for graduate architects.

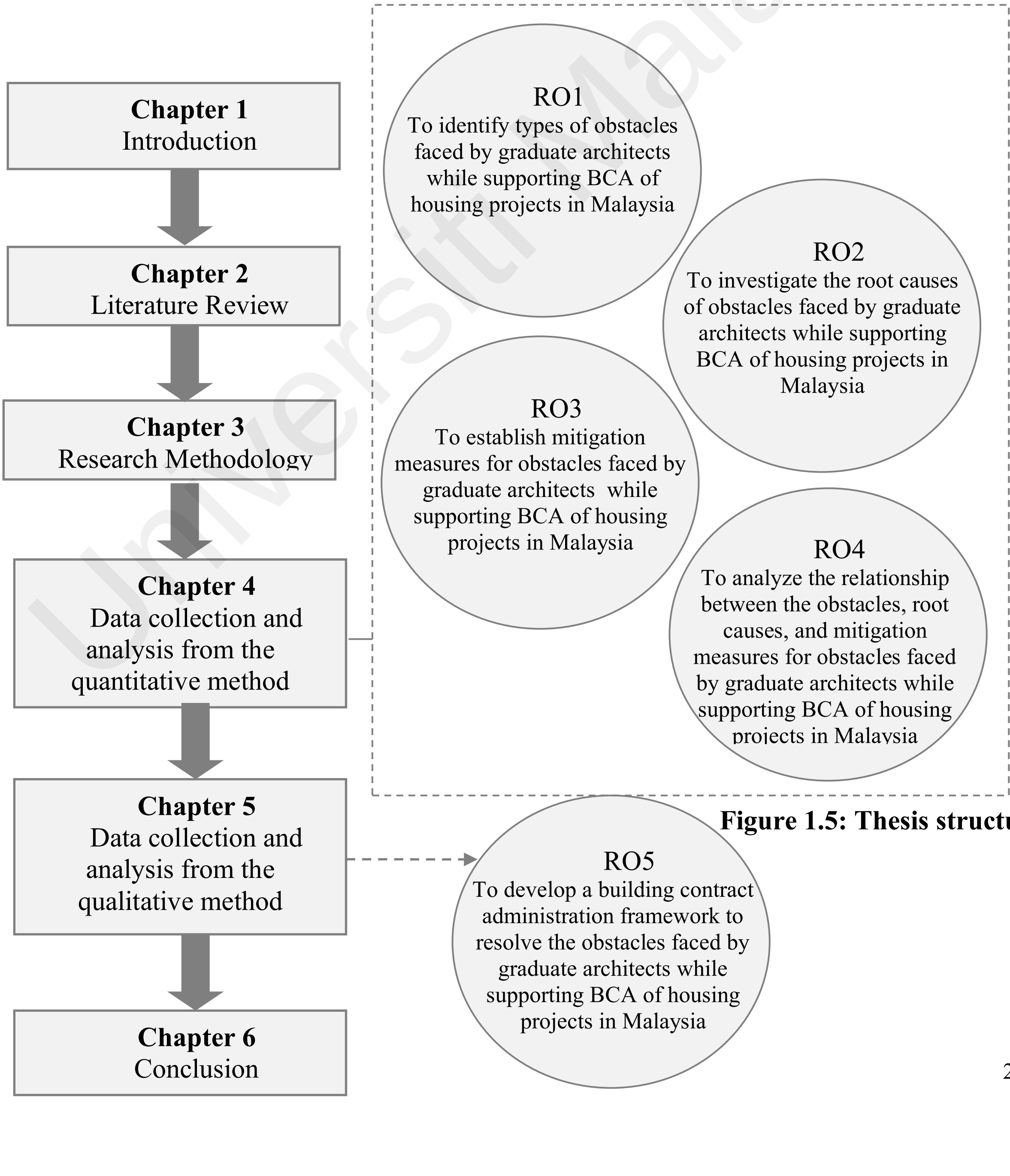


Figure 1.5: Thesis structure

1.11 Summary

This chapter has described the critical components that form the core of the study: problems of increasing housing projects and the shortage of architects in Malaysia caused the demand for graduate architects' assistance in BCA. Many studies highlighted the poor work performance of graduate architects in BCA affected construction progress. The aim of this research is to develop a framework that assists graduate architects supporting BCA in housing projects. The research problem, purpose, and research questions are essential in providing an understanding of the objectives of the study and determining the manner in which it was conducted. In addition, this chapter also describes the research approach, contribution to knowledge, and the structure of the thesis. The next chapter reviews the literature on construction, construction project teams, building contract administrators, graduate architects' roles, negative feedback from architectural firms, and graduate architects' work performance.

CHAPTER 2: LITERATURE REVIEW

Chapter 2 presents a summary of the literature review about the role of graduate architects and their performance in building contract administration (BCA) of housing projects in Malaysia. This chapter is represented in six sections. The first section starts with the construction industry in Malaysia and the housing policy implemented, the Housing Development Act (HDA) to protect house buyers, the Ministry of Housing that governs the HDA act, the types of housing that exist, and their issues in Malaysia. The second section introduces construction project teams and types of building contracts in Malaysia. The third section covers architects as building contract administrators and their roles in BCA. Forth section describes graduate architects and their roles in assisting Building Contract Administration (BCA). The fifth section highlights negative feedback received from the construction project team and the last section illustrates the poor work performance of graduate architects in BCA. The content of Chapter 2 is summarized in the diagram as shown in Figure 2.1. Chapter 2 then concludes with a summary of the information provided.

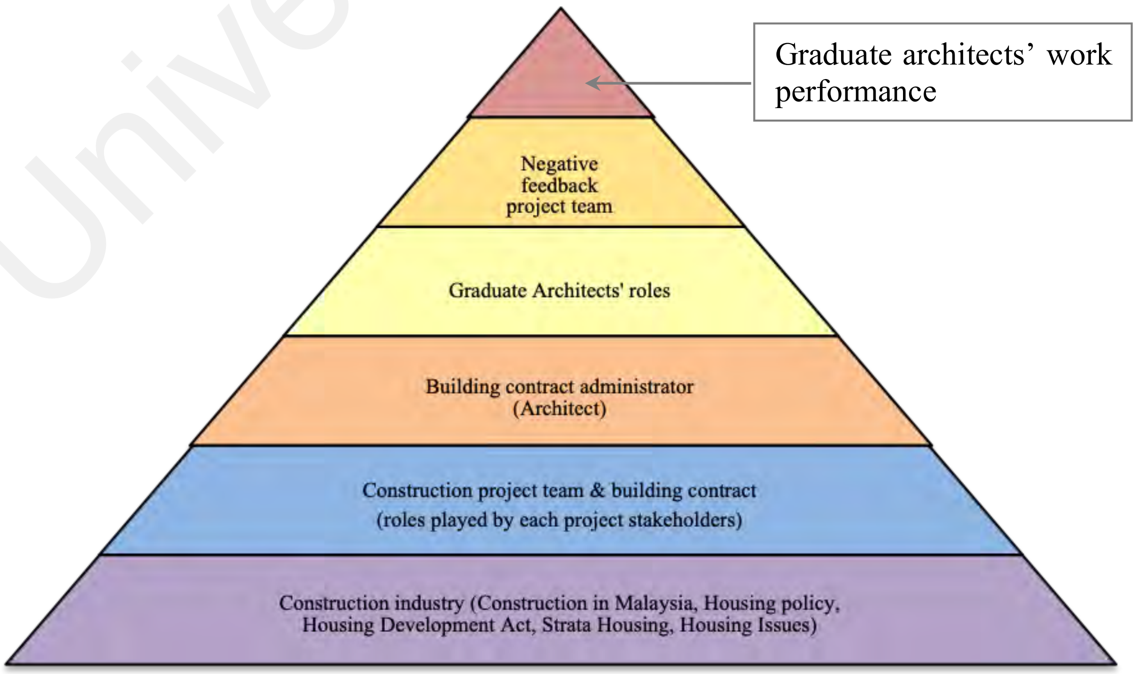


Figure 2.1: Summary content Chapter 2

2.1 Construction in Malaysia

Several studies have confirmed that approximately half of the investment in gross fixed capital formation is arranged by the construction sector in most developing countries (Kamal et al., 2012; Zid et al., 2020). In Malaysia, the construction industry is one of the vital sectors of the development process (Zid et al., 2020). This sector accounted for nearly 10.1 % of GDP in the year 2022 and employed about 1.21 million workers (8% of overall employment people in Malaysia) (Mansour et al., 2023). Thus, the construction industry is one of the main contributors to the economy as there is a strong correlation between the construction sector and economic growth in Malaysia (Khan et al., 2014; Chan and Aziz, 2020). Agencies such as the Ministry of Works, Public Works Department (PWD), Construction Industry Development Board (CIDB), Master Building Association Malaysia (MBAM), Board of Engineer (IEM), Board of Architect (LAM), and Board of Quantity Surveyors (BQSM) play a significant role in the growth and development of Malaysian construction industry (Khan et al., 2014; Chan and Aziz, 2020). They create employment opportunities and generate new income sources for both skilled and unskilled people of the society which includes thousands of contractors, workers, developers (government and private), management, engineering, architectural, and surveying consultants, etc (Kamal et al., 2012; Chan and Aziz, 2020). Besides that, the industry also creates a multiplier effect on other industries including manufacturing, financial services, and professional services (Dehdasht et al., 2022).

The construction sector plays a significant and effective role in socio-economic infrastructure for industrial growth, production, and basic amenities, such as residential and commercial space, parks, playgrounds and stadiums, health care units, roads, highways, railways, ports, airports, dams, power generating and supplying stations, communication utilities (Dehdasht et al., 2022). In this research, housing development had been selected for the study. Justification for the selection of housing development is reiterated in the following sub-chapter. To have a better understanding of the housing provision in Malaysia, the housing policy of the nation has been reviewed.

2.1.1 Housing Development and Policy

Globalization, demographic changes, and rising income levels since the 1970s have influenced the housing provision system in Malaysia (Iskandar et al., 2023). Housing continues to be an important expression of family aspiration and the single most expansive investment by households. The development of housing projects plays an eminent role in the country's economy in terms of employment, capital market, consumption, and financial wealth to stimulate the business cycle (Sufian and Rahman, 2008; Lau, 2020). The housing sector has been one of the construction industry contributors in terms of physical output and provider of basic human needs (Chai and Yusof, 2013; Hui, 2023). Malaysia faced a population increase from 21.3 million in 2000 to 33.9 million in 2022 (Mansour et al., 2023). The social and economic changes experienced by the people necessitate improvement in housing conditions (Sufian and Rahman, 2008; Lau, 2020). More people are demanding a better quality of housing in line with rising income (Sufian and Rahman, 2008; Lau, 2020). Thus, the pressure on housing demand is enormous.

The government has a responsibility to provide quality housing adequate for all citizens by enacting various policies and housing programs (Sufian and Rahman, 2008; Lau, 2020). To address the housing need for the growing middle-income group and changing people's lifestyle, another 1 million affordable housing units had been built in 5 years until 2020 mainly through the state affordable housing programs (Iskandar et al., 2023). Policies relating to housing development are outlined in the five-year Malaysia Plans which are the longer-term Outline Perspective Plans (1991-2000) and National Housing Policy (NHP) in 2011(Iskandar et al., 2023). Under the NHP, the Ministry of Housing and Local Government Malaysia (MHLG) plans to set the prices for affordable houses, particularly in projects subsidized by the Government (Iskandar et al., 2023). The objective of the National Housing Policy is to provide adequate and quality housing with comprehensive facilities and a conducive environment, especially for the low-income group (Iskandar et al., 2023). Malaysia's housing policy is divided into various stages as shown in Table 2.1 (Iskandar et al., 2023).

Table 2.1: Characteristics of housing policy in each stage

Stage	Period	Housing characteristic
Colonial period	Before 1957	1) The government is the main player in the housing provision 2) Housing for government servant 3) Resettlement to protect from communist 4) FELDA scheme 5) Housing provision for the low-income group in urban areas
The early stage of independent	1957 – 1970	1) Emphasized housing for low-income groups in urban areas 2) The public sector focused on low-cost housing 3) The private sector started to develop medium and high-cost housing 4) Enhancement of basic infrastructure
New economic policy	1970 – 1990	1) The private sector played a role in the development of low, medium, and high-cost housing 2) Housing for low-income groups becomes the national agenda 3) Implementation of the human settlement concept
National development plan	1991 – 2000	1) The government created new laws and guidelines to ensure quality housing 2) Housing law and policies that emphasize sustainable development 3) All people able to live in a decent house based on their income 4) Public and private sector responsibilities to provide housing
Vision development plan	2001 – 2010	1) The government is a key player in providing low-cost housing and the private sector for medium and high-cost housing 2) Emphasize sustainable urban development and adequate housing for all income groups 3) Housing development integrated with other type of development, such as industry and commerce
National housing policy	2018 – 2025	1) ensure good quality housing 2) Improving accessibility and affordability of housing 3) Ensuring quality and cohesive neighborhood 4) Improving housing and transportation coordination for a better quality of life

The housing provision in Malaysia since 1971 is divided into four phases namely Housing the Poor (1975 – 1985), Market Reform (1986 – 1997), Slums Clearance (1998 -2011), and State Affordable Housing (2012 – 2014) (Iskandar et al., 2023). The Malaysian government also has introduced several housing programs as follows (Iskandar et al., 2023):-

1) Low-cost and affordable public housing program – provide residential facilities to low-income groups earn less than RM 1,500
2) *Program perumahan rakyat miskin tegar* / Housing development program for the hardcore poor (PPRT) – Introduced in 1988 to eradicate poverty among the rural poor and to provide them with decent houses with basic amenities
3) Jariah charity program (PAJ) – Introduced in 2008 to repair dilapidated houses of hardcore poor nationwide
4) Integrated housing program – development of low-cost housing for rent to squatters
5) Rumah mesra rakyat 1Malaysia (RMR1M) program – to help low-income groups such as fishermen, farmers, and poor families who have no home or live in dilapidated houses
6) *Skim rumah pertamaku* / My first home scheme (SRP) – introduced in 2011 assisting young adults to own a home
7) MyHome scheme – introduced in 2013 to encourage the private sector to build more affordable homes
8) Perumahan rakyat 1Malaysia/ 1Malaysia people's housing program (PR1MA) – introduced in 2012 to plan, develop, construct, and maintain affordable housing for middle-income households in key urban centers.

In the Tenth Malaysia Plan (2011 – 2015), key points on housing targets are as follows (Iskandar et al., 2023):-

1) Build 78,000 new affordable low-cost public housing units for individuals and families with income lower than RM2,500 per month
2) Establish a housing maintenance fund for residents of low-cost housing units to conduct repairs and
3) Poverty eradication agencies such as the Ministry of Housing and Local Government will be given mandates to cover and assist the bottom 40% of households.

National Housing Policy (2018 – 2025) emphasized systematic, quality, inclusive, efficient, and affordable housing planning, development, and management of the people to generate sustainable and empowered housing (Hui, 2024). However, this policy yet takes into consideration about COVID-19 pandemic where people were mandatory to stay and work from home during that period (Hui, 2024).

A government agency has been formed to ensure the above-mentioned housing policies and programs are achieved. Details of the government agency have been reiterated in the following sub-chapter.

2.1.2 Ministry of Housing and Local Government (Kementerian Perumahan dan Kerajaan Tempatan KPKT)

The Ministry of Housing and Local Government is a ministry that is responsible for urban well-being, housing, local government, town planning, country planning, fire, and rescue authority, landscape, solid waste management, strata management, etc (Nuruddin et al., 2015; Shuid, 2016). The functions of KPKT are (Samsurijan et al., 2023):-

1) To guide and encourage local authority in planning, regulation, and implementation of programs that contribute towards socio-economic development and to boost efficient municipal services to create a healthy, prosperous, and developed society in line with national development goals
2) To ensure local authorities serve as local government units are efficient and capable in terms of administration and finance that will enable them to provide modern and high-quality services for the benefit and well-being of local communities under respective administration
3) To ensure local authority plays an active and effective role in the development of urban and rural areas through the implementation of infrastructure projects and to ensure developmental activities are carried out following the Malaysia 'people first, performance now' government policy
4) To ensure the local authority plays a role in effective government administration in terms of securing the participation of private agencies, non-government organizations (NGO), and the Congressional Budget Office relating to local affairs
5) Develop local authorities as planning authorities that are effective, competent, and efficient in carrying out their duties at the local level by exercising good planning and adopting a systematic approach to regulating development activities in urban and rural areas following existing rules
6) To establish and maintain a good working relationship between Federal and State government agencies as well as other government agencies at all levels in matters about policies and administration of Local Government.

Under the public sector, public housing programs are undertaken by the state and federal governments with supervision and monitoring from the Ministry of Housing and Local Government (Samsurijan et al., 2023). The governments are involved in the implementation of (Samsurijan et al., 2023):

1) Public housing programs
2) Housing in Land and Regional Development Authority area
3) Government and Institutional Quarters and
4) State Economic Development Corporation

Besides implementing housing programs, the Ministry of Housing and local government also administered the Housing Development Act which safeguards the interest of purchasers of primary market residential properties against developers for a specific period.

2.1.3 Housing Development Act (HDA)

The Housing Development Act was gazette in Malaysia in 1966 to provide regulation of housing development to protect Malaysian homebuyers' interests when purchasing a property from developers (Foo & Wong, 2014). HDA was formerly known as The Housing Developers (Control and Licensing) Act 1966 (Act 118). It was implemented and enacted based on 3 main objectives (Foo & Wong, 2014):

1) To regulate the activities of housing developers
2) To protect house buyers
3) To check abuses of the infant housing industry

Private housing developers supplied 97% of the overall private sector housing in the Seventh Malaysia Plan (1996-2000) (Shuid, 2016; Lau, 2020). Private housing developers are involved in high, medium, and low-cost housing.

All developments of housing sectors carried out by licensed private developers are governed by the Housing Development (Control and Licensing) Act 1966 and its regulations made thereunder (Foo & Wong, 2014). The Ministry of Housing and Local Government (KPKT) is the agency that manages and monitors housing developments in Malaysia by regulating and controlling the sales of contracts in the Housing Development Act (Foo & Wong, 2014.

There are two types of sales of contract (sales & purchase agreement) for the housing sector in the Housing Development Act, which is Sell then Build (STB) that consists of Schedule G (for building type) and Schedule H (for parcel type) and Build then Sell (BTS) that consists of Schedule I (for building type) and Schedule J (for parcel type) in Housing Development (Control and Licencing) Regulations 1989 respectively (Sufian and Rahman, 2008; Fawzi et al., 2012). Sell then build (STB) means the housing sector is constructed after money collection while build then sell (BTS) means money collection after the housing sector is completed (Sufian and Rahman, 2008; Fawzi et al., 2012). The concept of BTS which was launched by the Prime Minister in 2004 to overcome the problem of abandoned projects is not well accepted by the Real Estate and Housing Developers' Association (REHDA) because this concept requires developers to have a strong financial background to invest in the housing sector before sell which was rare in the market (Zairul et al., 2008; Kathitasapathy et al., 2023). Hence, STB is the norm practice in Malaysia's construction industry.

The proof of purchasing a housing unit from a developer or ownership of housing units is a title deed (Shuid, 2016; Lau, 2020). There are two types of title deeds available in HDA, one is individual titles, and the other is strata titles (Foo & Wong, 2014. This research selected strata titles for study which the selection of study have been reiterated in the following sub-chapter.

2.1.4 Strata Housing in Malaysia

Strata housing developed in major cities due to the scarcity of urban land, and demand from city population. Notably, the high demand for housing from city dwellers has spurred the growth of vertical living (Dahlan, 2006; Yadollahi et al., 2014; Amarkhil et al., 2023). In Malaysia, strata housing ranges from high-rise types such as flats, apartments, and condominiums to gated community types comprising townhouses and terrace houses (Shuid, 2016; Lau, 2020). The proof of ownership of each parcel of building or land is named Strata Title (Aziz et al., 2014; Kathitasapathy et al., 2023). Strata housing in Malaysia was governed by the Strata Titles Act 1985 which forms uniformity of legislation and regulation relating to ownership, registration of titles, transferences of parcels, lease, and charge of the parcels of building and other rights and interests related to the parcel (Zairul et al., 2008; Kathitasapathy et al., 2023).

The main difference between strata housing and non-strata housing is the existence of common property and Management Corporations (Ishak et al., 2016; Kathitasapathy et al., 2023). Property management and maintenance are necessary for common properties shared among strata owners which comprise a myriad of stakeholders namely the developer, owner, and management corporation (MC) (Ishak et al., 2016; Kathitasapathy et al., 2023). The involvement of the developer was at the early stage which is after vacant possession (VP) and before MC (Ishak et al., 2016; Kathitasapathy et al., 2023). The time for delivery of vacant possession for strata housing (schedule H) is within 36 months (Schedule H) and within 24 months (Schedule G) from the date of first Sales and Purchase Agreement (SPA) signed (Shuid, 2016; Lau, 2020). The developer is supposed to hand over the housing unit to the purchaser during the time of VP stated in SPA. However, incidents of late delivery of VP are common in Malaysia and these incidents caused huge impacts on purchasers and developers.

2.2 Housing Delayed in Malaysia

One of the most plaguing enigmas in the housing sector is the delay of projects (Dahlan, 2006; Yadollahi et al., 2014; Amarkhil et al., 2023). Delay is regarded as an unexpected extension of time beyond the date of completion in an agreement or beyond the agreed period that the parties granted to deliver a project (Kathitasapathy et al., 2023).

Accordance to the KPKT definition, a project is considered delayed when the gap in the construction period between the actual and scheduled version is 10 to 30% (Kathitasapathy et al., 2023). Meanwhile, sick projects occur when the gap is more than 30% between the actual and scheduled or when the projects fail to be completed in the construction period (Salam et al., 2020).

KPKT emphasized some common issues associated with delayed projects: delay in issuance of the certificate of completion and compliance, delay in handing over, poor workmanship, and payment problems related to maintenance (Chai and Yusof, 2013; Latiff et al., 2023). These problems in the construction industry are a global phenomenon and will cause deep impacts on the organization and the overall development of a nation (Chai and Yusof, 2013; Latiff et al., 2023).

The impact of delayed housing projects had caused sell-then-build (STB) homebuyers left with housing units still under construction and a huge debt to repay as financial institutions avoided assuming any liabilities on this matter (Razak et al., 2015; Kabine, 2023). The STB homebuyers are the ultimate victims (Razak et al., 2015; Kabine, 2023). The need to ensure efficient and effective housing delivery is inevitable. This is the reason for regulating the Housing Development Act 1967 to protect the homebuyers' rights as the housing sector becomes socially and financially important (Kathitasapathy et al., 2023).

Many studies have identified the causes of housing project delays, for example, Agyekum-Mensah (2017) investigated the causes of delay under the project-related factors, Dolol, Hemanta; Sawhney (2012) describe more on-site related delays; Hamzah, Noraini, and Khoiry (2011) analysed the cause of construction delay more on authority related and technical factors.

The causes identified are categorised into five major causes: employer-related delays, contractor-related delays, consultant-related delays, design-related delays, and third-party-related delays (Mydin et al., 2014; Giri, 2023). Employer-related delays included variations in orders, slow decision-making, and cash flow problems (Chai and Yusof, 2013; Latiff et al., 2023). Contractor-related delays identified were financial difficulties, material management problems, planning and scheduling problems, inadequate site inspection, equipment management problems, and shortage of manpower (Yap et al., 2021). Consultant-related delays recognized were delays in approving shop drawings and sample materials, delays in performing inspection and testing, delays in approving major changes in the scope of work, inflexibility, poor communication/coordination between consultant and other parties, late in reviewing and approving design documents, conflicts between consultant and design engineer, inadequate experience (Hamzah et al., 2011; Giri, 2023). Design-related delays were mistakes and discrepancies in design documents, delays in producing design documents, unclear and inadequate details in drawings, the complexity of project design, insufficient data collection and survey before design, misunderstanding of owner's requirements during design, and inadequate experience in design (Niazai and Gidado, 2012; Amarkhil et al., 2023). Third-party-related delays were natural disasters, pandemics, authority matters (delay in utility supply, changes in government regulations and laws), effects of subsurface conditions (soil, high water table, etc), market inflation, etc (Niazai and Gidado, 2012; Amarkhil et al., 2023).

Some studies indicated that the housing industry is facing many obstacles including low productivity, poor compliance, lack of adequate collaboration and information sharing, and poor payment practices (Alaghbari et al., 2007; Giri, 2023). The obstacles to housing projects may be caused by improper management, lack of technical skills, lack of innovation and technology, lack of financial resources, inadequate coordination, inadequate integration, inadequate communication, and inadequate control of project activities (Alaghbari et al., 2007; Giri, 2023). According to the World Bank, effective contract management requires systematic and efficient planning, execution, monitoring, and evaluation to ensure that both parties fulfill their contractual obligations (Ibrahim et al., 2022).

From the above, the delays in housing projects were majority caused by the mismanagement of construction project teams formed by employers (developers), consultants, contractors, and others.

2.3 Construction Project Team

The construction project team consists of the developer (client), consultants, contractors, sub-contractors, suppliers, etc (Jia et al., 2023). The team approach to project delivery has in recent times become predominant and a viable means of meeting client expectations in the construction industry (Youssef, 2023). Hence, the roles played by each project team member are considered critical for superior team performance in project delivery (Jia et al., 2023).

1) Employer's representative/project manager – Intermediary between employer and the project team and ensures employer's needs are met & project is progressing in the right direction

2) Land Surveyor – provide information such as the size, topography, location, detail survey, utility mapping on-site condition, conduct site setting out, pre-computation plan, etc for proper, adequate, effective, and accurate planning, design, and execution of building projects to be carried out.
3) Architect – agent of a client who designs a building that fulfills employers' requirements and complies with statutory conditions, leads the construction project team, and carries out building contract administration work during the construction stage (under Pertubuhan Arkitek Malaysia (PAM) contract). Details of the architect's scope of work are reiterated in the following sub-chapter.
4) Engineers – to assist in the overall design of the project within their scope of specialists such as geotechnical, structural, electrical, mechanical, civil, etc. They produce drawings, specifications, schedules, and other relevant data required for the overall design to assist quantity surveyors in preparing a bill of quantities and builders in constructing the building.
5) Quantity surveyor – expertise in construction costs and preparing cost plans from sketch drawings for elemental cost checks during design, advising an employer on the appropriate form of contract to use, preparing contract documents, conducting tender process and preparing the tender report, conducting interim valuations, variations, ascertain the amount of loss and expense incurred by the contractor, prepare final account, etc.
6) Landscape architect – enhance the value of the building by incorporating softscape and hardscape
7) Builder/contractor – construct the building and take charge of activities on a building construction site in translating the design, working drawings, schedules, and specifications into physical structure.

8) Subcontractors – carry out the specialized scope of work such as electrical, mechanical, pool service, earthing system, plumbing system, etc.
9) Suppliers – goods and services to be delivered as specified in the contract and pertaining documentation such as purchase order and agreed upon by both parties

The Construction project team as mentioned above (including builders) was formed during the commencement of the project and dissolved after the completion of a project. This team was formed with the existence of a building contract.

2.3.1 Types of Building Contracts

A building contract is between two parties which may include the Employer and main contractor or between a supplier and the contractor or supplier and subcontractor (Kavanagh & Miers, 2021). A standard form of construction contract would be useful in expressing the obligation of the parties and setting out reasonable clarity on the scope of the project (Zakaria et al., 2013; Berema et al., 2023). In Malaysia, there are five common standard forms of contract in use in the construction industry, namely Pertubuhan Akitek Malaysia (PAM) standard form of contract, the Institution of Engineers Malaysia (IEM) standard form of contract, the construction industry development board (CIDB) standard form of contract used in private works, Jabatan Kerja Raya (JKR) standard form of contract, and Asian International Arbitration Centre's (AIAC) standard form of contract (Berema et al., 2023).

1) PAM contract consists of PAM 1969/1998/ 2006/ 2018 with quantity, or without quantity and NSC contract (Zakaria et al., 2013; Haron et al., 2020). The PAM standard form of contract has been widely used by the Malaysia Building Industry over the last 40 years. PAM undertook a complete revamp of the PAM 1969 Form which was replaced by the PAM 1998 Form (Zakaria et al., 2013; Haron et al., 2020). The PAM 1998 Form was extensively employed in the building industry in Malaysia but was subjected to criticism by segments of said industry. After further review by the PAM committee, PAM Contract 2006 was culminated and implemented (Zakaria et al., 2013; Haron et al., 2020). This form had been officially launched and intended by PAM to replace the earlier PAM 1998 (Zakaria et al., 2013; Haron et al., 2020). It is estimated that 90% of building contracts in the private sector are based on PAM Form 2006 (Zakaria et al., 2013; Haron et al., 2020). Even though PAM 2018 had been developed to improve PAM 2006 version, by incorporating several amendments and one new clause added, the local industry still preferred PAM 2006 Form due to familiarity and comfort with using PAM 2006 (Haron et al., 2020).
2) Institution of Engineers Malaysia (IEM) standard form of contract essentially follows the corresponding FIDIC standard form. They are currently used in private-sector civil engineering works and mechanical and electrical works in Malaysia (Haron et al., 2020).
3) The Construction Industry Development Board (CIDB) produced two standard forms: the CIDB standard form of contract for Building Works (2000 Edition) and the CIDB standard form of contract for Nominated Subcontractor (Haron et al., 2020). It is planned by CIDB that a standard form of Design and Build Contract and Civil Engineering Contract will also be published (Kheng, 2002). The CIDB Form entered the market in the year 2000.

However, it is not as popular as the PWD and PAM standard Forms of contracts in terms of use and adoption (Haron et al., 2020).

4) Jabatan Kerja Raya (JKR) has produced standard forms PWD 203a for use in public sector works for building and civil engineering works. It is not all public sector works follow the PWD 203a especially those funded by the World Bank where preference is for the adoption of the FIDIC Form (Zakaria et al., 2013; Haron et al., 2020).
5) Asian International Arbitration Centre’s (AIAC) standard form of contract was launched in 2017 and includes a main contract with quantities, a main contract without quantities, a sub-contract, a minor works contract, a design-build contract, and a design-build sub-contract (Haron et al., 2020).

The administration of a contract is necessary to ensure the contract is performed according to the articles of agreement and conditions of the contract and within the framework of related laws and the practices of the construction industry (Zakaria et al., 2013; Haron et al., 2020).

2.4 Building Contract Administration

Building contract administrators refer to people who ensure the contract between employer and contractor is executed and adhered to the terms of the contract (Cunningham, 2016; Msawil et al., 2022). The primary objectives of an individual to be appointed to administer a building contract include delivering the project safely, to the specified quality standards, on time, and within the employer’s budgetary constraints (Deventer, 1994; Berema et al., 2023).

They undertake any necessary design changes, advise on any particular program and sequence of work implications, advise on any costing for their field of expertise, produce, and supply design documentation, inspect works to ensure design and specification met by the contractor, prepare documents to issue instructions under the building contract, coordinate and advise on the adequacy of information provided, certify the amount of interim payments to be made by the employer to the contractor, approve the quality of materials or goods or of the standard of workmanship (Cunningham, 2016; Msawil et al., 2022).

In addition, the administrator's task covers orchestrating and motivating various consultants and contractors to deliver the best possible performance both individually and as members of the team (Ostime, 2019; Ricchini, 1979). This role is carried out by a person with expert technical knowledge of the construction process, strong leadership qualities, highly developed interpersonal skills, an understanding of contractual, legislative, and statutory underpinnings, and capable of advising the contracting parties on their contractual rights and obligations and enables implementing the administrative procedures set out in the particular contract (Hughes et al., 2015; Cunningham, 2016; Msawil et al., 2022). In practice, a building contract administrator will be appointed among the engineers and architects depending on the type of contract document that is applied (Zakaria et al., 2013; Haron et al., 2020).

In the PAM contract, the building contract administrator is the architect. They undertake the decision-making, advisory, and information roles in the context of the PAM forms of contract and contribute to the achievement of the primary project objectives (Tan et al., 2010; Haron et al., 2020). Since architects play a vital role in building contract administration, it is crucial to understand their roles and responsibilities in detail.

2.4.1 Architect in the construction industry

An architect as defined by Lembaga Arkitek Malaysia (LAM) is a qualified professional who assists in translating building requirements into practical reality (Malaysia, 2006). They act as an agent/advisor/contract administrator for the building project (Ostime, 2019).

The architect's role in the process of creating a building can be distilled into 3 key steps: define, design, and refine. An architect is responsible for ***defining*** the program, and a written narrative statement of the owner's needs (Ostime, 2019b; RIBA, 2020). The main purpose is to describe the purposes of the spaces in the project and their relationship to one another (Zedong and Rongji, 2021). The second step moves on to schematic ***design*** and preliminary design in architectural agreements (RIBA, 2020). The schematic design consists of creating two to three distinct alternative means to resolve the problem (Ostime, 2019). This usually takes the form of differing floor plans and is expanded to include alternative exterior elevations. The purpose of presenting diverse schemes is to flush out owner preferences (RIBA, 2020). On larger projects, a preliminary design is a distinct phase where the most desirable schematic design scheme is expanded and explored in more detail (Ostime, 2019). Exterior elevations, preliminary sections, and primary finishes are selected and developed (RIBA, 2020). The design development (DD) phase of an architect's contract represents the period to take the design and ***refine*** the details of appearance, structure, mechanical, electrical, and plumbing systems and to select finishes (RIBA, 2020). The endpoint of DD represents approximately 40% of the construction documents (RIBA, 2020). The final phase is where work is produced to such an extent that a contractor can build from the result (RIBA, 2020). Contract documents are then prepared for the bid process (Ostime, 2019). This is the phase where the owner will rely on the architect's professional expertise.

The process of securing the person legally obligated to deliver the completed construction is referred to as the bid process/procurement process (RIBA, 2020). The term derives from the practice of sending tender documents to several potential contractors and inviting them to submit bids to build the work, with the reasonably acceptable bidder getting the job (RIBA, 2020). This is the opportunity where architects to have their documents critiqued for practicality, and economically, and an opportunity to revise them with impunity (Nicol and Pilling 2000). In this stage of work, the owner will select the bidders for his projects based on the capability of delivering the best value in terms of the low bid, schedule conformance, and construction quality (RIBA, 2020). The architect will advise the client which contractor will provide the desired benefits to the project (Oyedele and Tham, 2007; Białkiewicz, 2021). Architects should disclose any biases, preferences, or affiliations with the potential bidders and will conduct a fair bidding process on behalf of the client (Oyedele and Tham, 2007; Białkiewicz, 2021).

The tender process consists of call tender where the quantity surveyor will send an invitation to tenderers' request for the interest of participation; close tender where tenderers will submit quotation/bidding after reviewing tender documents for bidding the job; tender interview where clarification will be made between architects and tenderers; tender resubmission where tenderers will revert the pricing after tender addendum and clarification obtained from architects; tender evaluation will be done by consultants to advise the client which tenderer is recommended and tender award to the preferable tenderer by the client (Oyedele and Tham, 2007; Białkiewicz, 2021). During bidding and negotiation, numerous documents may have been created that represent a part of the construction contract (Nicol and Pilling, 2000).

Once the agreement is signed between contractor and client, the contractor has obligations to provide several documents such as performance bond, insurance policy cover, CIDB levy, etc before the commencement of work on site (Nicol and Pilling, 2000). Once these documents are submitted, the contractor will mobilize to the site and commence construction (Nicol and Pilling, 2000).

The architect will start duty as building contract administrator. The scope of the building contract administrator is explained in detail in the following sections. When the construction is completed, the client will rely on the building contract administrator to advise whether everything under the contract has been fulfilled by the contractor (Malaysia, 2006). The end goal of all construction is that the client will be provided with the project he hoped for. Overall, the services provided by the architect can be concluded as below (Malaysia, 2006):-

a. Basic services
   i. Schematic design phase (SD)
   ii. Design development phase (DD)
   iii. Contract documentation phase (CD)
   iv. Contract implementation and management phase (CIM)
   v. Final completion phase (FC)
b. Supplementary services

   Supplementary services in the Architect Act 1967 are defined as services not included in Basic Services but may be provided to supplement basic services, e.g. preparing sales and purchase drawings, interior design services, designing graphics and signages, etc.

c. Additional services

Additional services are services provided by the architect under a separate appointment with the employer, e.g. project management consultancy services, financial advisory services, exceptional negotiations, and protracted involvement services, etc (Malaysia, 2006).

2.4.1.1 Architect as Building Contract Administrator

Services provided by architects as building contract administrators commence during the contract implementation and management phase. Some existing studies have developed contract administration roles and frameworks with different objectives (Deventer, 1994; Davison and Sebastian, 2009; Chong et al., 2011; Msawil et al., 2022). Gunduz and Elsherbeny (2020) proposed a global, systematic, operational, and multidimensional building contract administration framework for ensuring the successful completion of a project.

There are 11 work categories with 93 types of activities related to building contract administration scope of work (Gunduz and Elsherbeny, 2020). The work can be categorised as project governance and start-up, contract administration team management, communication and relationship management, quality and acceptance management, document and record management, financial management, change control management, claims and disputes resolution management, control risk management, and contract closeout management (Gunduz and Elsherbeny, 2020). The scope of work of the building contract administrator is summarized in Table 2.2.

Given the scope of building contract administration (BCA) is huge and the housing development projects have increased throughout the years, the architect is unable to be hands-on with every project. Hence, the involvement of graduate architects is required to assist in BCA (Fadzil and Azlan, 2017).

Table 2.2: Building Contract Administrator Scope of Work (Source: Gunduz & Elsherbeny (2020)

Cat 1: project governance & start-up Establish a project management plan Review the contractor's quality plan Review the contractor's HSS plan Review the contractor's environmental plan Review the contractor's programs Review the contractor's key staff Review the subcontractor's qualification Project kick-off meeting Support review of contract securities Support handing the project to the contractor Support nominated subcontractors' appointment Remove violating persons from the site Review the contractor's logistic plan Review the contractor's laboratory Avoid bureaucracy & lengthy process	**Cat 6: Document & record** Establish documentation system Use information technology Maintain documentation with registers Support stakeholders with statistics **Cat 7: Financial management** Instructions to spend the provisional sum Certify due payments Notify the owner about due payments Timely assessment for loss and expand Advise in contingency plan/funds Collect quotations for price estimates
Cat 2: BCA Team Management Assignment of a competent team Early assignment of team Clear roles and responsibilities Training programs Regular performance assessment Set performance dialogue for the team	**Cat 8: Changes & changes control** Establish a change control system Timely evaluation of the contractor's proposal Suggestions of workable solutions Notify contractor about urgent works Timely process change orders
Cat 3: Communication & Relationship Establish communication system Advising the owner Measurement of owner's satisfaction Agreement with the owner for any changes Regular meetings Effective coordination with third parties Timely response to queries Timely management of operational issues Manage the interface between contractors The clear language of communication	**Cat 9: Claims & dispute resolution** Establish a claims and dispute resolution system Timely notify the contractor about the owner's claim Timely assessment extension of time claims Timely assess additional payment claims Effectively negotiate the claim with the contractor Support parties in alternative resolution dispute Represent owner in dispute resolution Legal support owner during litigation
Cat 4: Quality & Acceptance Auditing contractor's QMS Timely issuance of supplementary information Timely review of construction material Timely review of shop drawings Auditing contractors' HSE Auditing contractors' environmental plan Timely inspection of work's quality Control of non-compliance work Track corrective actions Managing design and design developments	**Cat 10: Contract risk management** Periodically assess contractual risks Assign contractual risk responsibility Support owner for design risk Monitor the contractor's financial status
Cat 5: Performance monitoring & reporting Report major issues Regular progress reports Review contractor's reports Monitor contractor relationships Monitor contractor's resources Monitor contractor's community services Notify the contractor for the mitigation program Monitor public interference arrangements Notify the contractor of the obligation's failure	**Cat 11: contract completion** Verify physical work completion Timely review of closeout documentation Timely issue CPC Timely release retentions Inspection during defect notification Post-mortem and best practices Timely processing final account Management of suspension of work Management of termination of the contract

2.4.2 Graduate Architects

Graduate architect (GA) as defined by the Board of Architects Malaysia or Lembaga Arkitek Malaysia (LAM) refers to a person who holds a qualification recognized by LAM for those who pass the Part I and Part II LAM examination before being qualified to be registered as a graduate architect with LAM (Malaysia, 2006).

They act as assistants for architects and carry out tasks such as understanding design briefs from clients, coordinating with designers, preparing and submitting drawings to authorities, arranging and preparing schematics, tender, construction, contract drawings, etc (Ostime, 2022). Besides performing as assistants in the design phase, graduate architects also support building contract administration (BCA) during the construction phase (Chappell and Dunn, 2015; Ostime, 2022).

2.4.3 Scope of work delegated to graduate architect to support BCA

Graduate architects are required to be involved in the full scope of contract administration work before obtaining professional qualifications as requested by LAM. Summary of the scope of work delegated to graduate architects shall be any or all of the following (Malaysia, 2006; Ostime, 2022): -

a) Support in performing all functions and duties in BCA is described in detail in section 2.4.3.1;
b) Coordinate with consultants and contractors through meetings is described in detail in section 2.4.3.2;
c) Support contract documentation in BCA is described in detail in section 2.4.3.3;
d) Support in assessing contractors' submissions is described in detail in section 2.4.3.4;

e) Support in the inspection and supervision of contractors' works is described in detail in section 2.4.3.5

2.4.3.1 Support in Performing all functions and duties in BCA

Graduate architects support building contract administration by being involved in work as stated in Table 2.2 such as reviewing contractor submissions, chairing meetings, carrying out contract documentation work, assisting in preparing certificates and resolving disputes, advising clients when necessary, etc (Ostime, 2022).

2.4.3.2 Coordinate with consultants, contractors, manufacturers, and sub-contractors through meetings

Building construction is a teamwork project. Various consultants are required to make the project a success (Ostime, 2022). A graduate architect supports BCA by assisting the building contract administrator to collect information on the appointment of suitable consultants to fill the position (Ostime, 2022). A graduate architect is to assist in coordinating with various parties through meetings to: obtain civil & structural input from the C&S engineer, mechanical & electrical input from the M&E engineer, pricing input from the quantity surveyor, softscape & hardscape input from the landscape architect, etc during design development and construction stage to avoid clashes of services and better design performance (Nicol and Pilling, 2000; Ostime, 2022).

Meetings are a central means of communication in construction projects as there will be issues that arise that need to be discussed and resolved by various parties (Sahlstedt, 2012; Kerzner, 2022). Accordance to Cooke and Williams (1998), they stated that 'What is the secret of success? Well, by meetings- bloody meetings'(Cooke and Williams, 1998; Kerzner, 2022).

They provide a platform for updating the current status of a project, identifying issues and corrective action to be taken at the earliest opportunity (Ricchini, 1979; Hayes, 2014; Kerzner, 2022).

Meetings are supposed to be convened, chaired, and minuted by the building contract administrator where the meeting minutes record the action points to be resolved by various contract participants (Sahlstedt, 2012; Kerzner, 2022). However, this task has been taken over by graduate architects (Paprzyca, 2018).

There are several types of meetings conducted during the construction process, namely client consultants' meetings, kick-off meetings, site meetings, technical coordination meetings, value engineering meetings, safety meetings, etc (Ostime, 2019a).

A kick-off meeting is the first site meeting conducted during site possession by the contractor (Oke et al., 2016; Ostime, 2022). The graduate architect who supports BCA will introduce each party: client, consultants' team, and contractors' team and clarify a list of agenda during the meeting. Item discussed during the first meeting includes contract details: commencement date, completion date, liquidated damages, the scope of work, insurance, progress claim interval, section completion date; site acceptance, utility mapping, statutory requirement, temporary water, power supply, submission of documents within 2 weeks upon received LoA: project quality plan, progress report format, schedule of material, method statement, shop drawing submission, site organization chart, performance bond, health and safety plan, environmental plan, dilapidation survey on the neighborhood, etc, schedule of next meeting, etc (Oke et al., 2016; Ostime, 2022).

A kick-off meeting is crucial because this meeting is to set expectations across the entire project team and prevent the project from being open to ambiguity, miscommunication, and risk (Mohammed, 2021). Subsequent meetings after the kick-off meeting with the contractor are site meetings which are generally held on a fortnightly basis to present site progress and issues (Oke et al., 2016; Ostime, 2022). The contractor's report reviews progress relative to the master program, raises matters affecting the progress of the works, and records information received and required (Demkin, 2001; Lee, 2020). These reports highlight aspects that need to be followed by the contractor and consultants (Oke et al., 2016; Ostime, 2022).

Client consultants meeting is organized without the contractor's presence for consultants to discuss items with the client. It is a platform for QS to update the current cost situation and identify matters such as unconfirmed variations, and notifications by contractors for compensation (Chappell and Dunn, 2015; Ostime, 2022).

2.4.3.3 To support contract documentation in BCA

The duty of the graduate architect in supporting BCA includes the preparation of paperwork such as a letter of nomination, letter of award, letter of acceptance, letter of instructions, issuing architect's instruction to the contractor, etc (Ostime, 2019a). Each letter contains vital information on terms and conditions prior contract being issued (Mohamad and Madon, 2006; Ostime, 2022).

The content of the letter includes the date of commencement, completion date, contract sum, the scope of work, insurance, performance bond, documents that need to be submitted upon receiving LoA, liquidated damages amount, etc (Mohamad and Madon, 2006; Ostime, 2022).

Besides that, graduate architects also support preparing architect's instruction that is limited expressly identified in the Contract (Rajoo, 2010). The clauses that allow issuance of architect's instruction as stated in the PAM Contract handbook are (Tan et al., 2010):

Clause 1.4 Discrepancy or divergence between documents

Clause 3.4 Further drawings or details

Clause 3.5 Revise the work program

Clause 4.2 Inconsistencies with statutory requirements

Clause 4.4 Fees, levies, and charges

Clause 5.1 Setting out

Clause 6.2 Provision of vouchers

Clause 6.3 Inspection and testing

Clause 6.5 Works not following the Contract

Clause 8.3 Exclusion of person employed on the works

Clause 11.2 No variations issued by the architect shall vitiate contract/instruction ordering variation

Clause 11.3 Issue variations after practical completion

Clause 11.4 AI on PC sums and provisional sum

Clause 12.2 Correction of errors or omissions

Clause 15.4 Schedule of Defects

Clause 15.5 Instruction to make good defects

Clause 16.3 Contractor to remove equipment upon partial possession by employer

Clause 21.1 Commencement and Completion

Clause 21.4 Postponement or suspension of the works

Clause 23.3 Insufficient information for EOT

Clause 24.5 Contractor duty to remove temporary buildings, plant, tools, equipment, materials, and goods upon determination of contractor's employment

Clause 25.7 Instruction to remove construction plant, tools, and equipment upon determination of contractor's employment

Clause 27.1 Nominated Subcontractor

Clause 27.4 Action following objection to the nomination of sub-contractor

Clause 27.11 Re-nomination of sub-contractor due to determination by the nominated sub-contractor

Clause 28.1 Nominated suppliers

Clause 28.4 Action following the objection of suppliers

Clause 31.1 Protective work in the event of an outbreak of hostilities

Clause 32.1 Removal or disposal of debris or damaged works following war damage or protective works

Clause 33.1 Antiquities – discovery on site

In addition, graduate architects also support preparation certificates (Mari et al., 2019). Certification requires the contract administrator to exercise judgment on various matters arising from the performance of the contract (Weng, 2017). There are two types of certificates, certificates that record the occurrence of a particular event, such as a certificate of practical completion, certificate of sectional completion, certificate of non-completion, certificate of partial possession, certificate of making good defects, certificate of extension of time, etc or certificates that have a financial implication that provides payment to the contractor, for example, interim certificate, penultimate certificates, final certificate (Ansah, 2011; Berema et al., 2023).

The certificates may be routine or may record the occurrence of a particular event. The issue of certificates has financial implications and provides payment to be made to the contractor (Cunningham, 2016; Weng, 2017). A graduate architect is to prepare the said certificates during construction for the building contract administrator to formalize an event/honor payment (Mohamad and Madon, 2006; Weng, 2017).

2.4.3.4 To support in assessing contractors' submission

A graduate architect plays an important role in supporting BCA to ensure successful project delivery to the specified quality standards. During construction, a contractor will submit material, samples, catalog, shop drawings, and method statements for the consultant to review and assess (Ostime, 2019a). Material, sample, catalog submission such as anti-termite material, sanitary ware, ironmongery, tiles, windows components, door frame, door leaf, ceiling board, metal railing, bricks, etc; shop drawings submission such as metal deck installation, aluminum, and glazing, metal railing installation, etc; method statement submissions such as floor screeding work, painting work, drywall installation, brickwork, door installation, plastering, and skim coat work, etc (Ostime, 2019a).

The role of a graduate architect in this task is to ensure the contractor's submission adheres to the contract, e.g. material submitted is in accordance or equivalence to the specification captured in contract documents (Pooworakulchai et al., 2017). Counter-proposed material should be equivalence with contract specification.

Queries have been raised by the contractor when a discrepancy is found between contract documents and drawings, a discrepancy between large-scale and detailed drawings, or unclear or missing information in drawings (Mohamad and Madon, 2006; Ostime, 2022). The graduate architect is to reply to these queries within the time frame to prevent delay in overall work progress (Fawzy and El-adaway, 2012; Salleh et al., 2016). In addition, a graduate architect is to issue further drawings and specifications to finalize the design and to issue instructions to the contractor relating to various operational matters relating to the contract (Fawzy and El-adaway 2012; Salleh et al., 2016).

Timely delivery of projects is a primary objective of most private sector clients (Mohamad and Madon, 2006; Ostime, 2022). Effective contract administration will enable the contractor to complete the works by minimizing delays arising from unforeseen circumstances such as weather events, strikes, and accidental damage (Chappell & Dunn, 2015). Hence, a work program is required to monitor site progress. A graduate architect is to comment on the work program submitted by the contractor (Paprzyca, 2018). Items that should be incorporated in the work program as stated in PAM Handbook 2006 include:

i. Any design, manufacturing, and procurement activities;
ii. On-site construction activities;
iii. Manpower requirements;
iv. Design and construction requirements;
v. Materials and samples testing and approval; and
vi. Appointment of sub-contractors and suppliers which is the responsibility of the employer

2.4.3.5 To support in inspection and supervision of contractors' work

One of the duties assigned to graduate architects is to inspect and supervise the work of the contractor with site walk (Salleh et al., 2016). The function of a site walk is to allow an authentic and accurate experience of the space designed; it assists in a better understanding of site context, construction methods, and site constraints; it trains the graduate architect to think and make decisions, communication skills, etc (Weinberger, 2005; Paprzyca, 2018). The inspection involves looking and noting, possibly even carrying out tests (Deventer, 1994; Ostime, 2022).

There will be circumstances where field tests be carried out during the site walk. These field tests are to ensure the quality of work, e.g. water leakage test on aluminum glazing / sliding door, tiles pull-out test, waterproofing ponding test, etc based on contract requirements (Green, 2023; Ostime, 2022).

A graduate architect is then expected to witness or assign site representatives to monitor the testing result and ensure quality complies with the expected standard (Mari et al., 2019). This is different from supervision. Supervision not only covers inspection but also the issuing of detailed directions regarding the execution of the works (Green, 2023; Ostime, 2022). Graduate architects, in this case, should visit the site periodically to ensure work done on-site complies with local and national regulations and contract documents (Mari et al., 2019). In addition, material & method construction, and quality of workmanship follow contract specifications e.g. QLASSIC, CONQUAS, or employer's standards (Apandi, 2010; Khodeir, 2018).

These are the basic roles of Graduate architects in supporting BCA of housing projects in Malaysia where graduate architects are expected to perform during works. Overall, graduate architects are involved in various types of management when supporting BCA work which could be summarized into 5 themes as described in the following sub-chapter.

2.4.4 Claims and legal matters management

Claims and legal matters management including certification and authority submission in BCA (Zakaria, 2013; Mohammed, 2021). There are two types of certificates issued by contract administrators, one is certificates issued to contractors for interim payment, and the other is issued to developers for claim payment from house buyers (Kasi, 1998; Gunduz and Elsherbeny, 2020).

GA must understand the types of certification to be issued during the construction process to record events that have occurred and to issue certificates accordingly (Abidin, 2012; Mohammed, 2021).

There are various stages of authority submission to be done before construction/ completion, i.e. conversion of land use application, planning permission, building plan approval, strata application, and submission of certificate of completion and compliance (CCC) (Rahim, 2004). It is important to understand the types of authority submission because it will enhance planning for submission to avoid the issue of delays in obtaining approvals from local authorities that affect the development costs including cost holding of land, manpower, resources, machinery, office rentals, and bank interests (Zakaria, 2013; Mohammed, 2021).

2.4.5 Project management

Project management includes the following aspects of management: integration, scope, time, cost, quality, human resources, risk, communication, and procurement (Gallo et al., 2002). Project management as pursued in this research is related majority to document management (Pinto, 2002; Lock, 2017). It is important to understand contract documentation to prevent inefficiencies that result in increased project cost, time, risk, and dispute.

2.4.6 Communication and relationship management

Communication and relationship management in the construction workplace can be either on a large scale between construction parties such as consultants, clients, and contractors or a small scale between individuals in the same firm which is internal communication breakdown (Gamil and Rahman, 2017). It is important to have superb communication abilities for effective BCA (Wahyuni et al., 2018).

2.4.7 Quality assessment and management

Quality and assessment management is to ensure that the works as carried out conform to detailed drawings (Salleh, 2016). It is important to understand quality assessment and management to enable graduate architects to furnish advice and design solutions from time to time during the contract.

2.4.8 Design management

Design management involves understanding, coordinating, and synthesizing a wide range of inputs while working alongside a diverse cross-section of multidisciplinary colleagues and concerned with interfaces (people, places, processes, and products) (Cooper and Press, 1995). it is important to understand design management to ensure the workability of the design and reduce rework (Mari et al., 2019).

2.5 Work performance of Graduate architect and its impacts

Graduate architects play a vital part in contract administration work (Paprzyca, 2018). The employer relies on them to make proper decisions and control the construction activities on site (Mari et al., 2019). However, they are among the graduate architects who have poor planning, poor communication, and coordination, lack of system, misunderstand the process, lack of skills, unclear roles, lack of training, and lack of performance measurement which caused inefficient construction processes, delays, reworks, un-necessary variations, poor communication among team players, conflicts and disputes for both employer and contractors (Mari et al., 2019). As a result, construction in the housing industry suffered delays when the graduate architects were unable to perform (Mari et al., 2019).

To assist the graduate architects in elevating their work performance, the types of obstacles faced by the graduate architects need to be identified, the root causes of the obstacles to be investigated, the mitigation measures for the obstacles to be established, and the relationship between the obstacles (or performance barriers) and mitigation measures for obstacles (or competence development) through root causes (or BCA skills) need to be analysed to develop a building contract administration framework on better practices, to act responsively with a sufficient level of competency, and to efficiently monitor the contract and to make efficient decisions. A systematic literature review has been conducted before the survey to achieve the objectives illustrated above.

2.6 Types of Obstacles faced by graduate architects while Supporting BCA of Housing Projects In Malaysia

Graduate architects are supposed to be able to timely response queries, timely issuance of supplementary information, timely management of operational issues, etc (Paprzyca, 2018). Starting in practice, graduate architects are confronted with many stressful and dissatisfying situations (Shannon, 2012; Salleh et al., 2016). When they are assigned with BCA scope of work, their responsibilities are greater than what their actual level of competence can cope with which we defined as 'obstacles' (Corseuil et al., 2019). Understanding the types of obstacles faced by graduate architects is important before establishing measures to increase operational efficiency and effectiveness through compliance, awareness, visibility, and control over contracts (Mari et al., 2019). There are a total of 40 types of obstacles found in 20 literature reviews stated in Table 2.3. Each type of obstacle was divided into 5 themes according to the BCA work scope determined by literature reviews which are deficient in claims and legal matters management, deficient in project management, deficient in communication & relationship management, deficient in quality and assessment management, and deficient in design management.

Table 2.3: 40 Types of Obstacles in BCA Found from Literature Reviews

Obstacles summarized by various authors	Niazai & Gidado, 2012	Kasi, 1998	Love & Edwards, 2004	Rounce, 1998	Love, Irani, & Edwards, 2004	Tilley, et al, 2002	Gallo, et al, 2002	Asadi, Wilkinson & Rotini, 2023	Hoezen et al, 2021	Enshassi, Sundermeier, Zeiter, 2017	Nielsen, 2010	Lopez et al, 2010	Aiyetan, 2013	Abotaleb & El-Adaway, 2017	Weng & Ahmad, 2015	Abidin, 2012	Senaratne & Mayuran, 2015	Ajator, 2017	Agbaxode, Dlamini, & Saghatforoush, 2021	Ayodeji, Bhekisia, & Aigbavboa, 2016
Miscommunication									*											
Slow decision			*	*	*							*	*							
Lack coordination									*											
Delay reply queries			*							*	*									
Poor contract management knowledge	*	*													*	*				
Lack Information									*											
Inexperienced			*			*	*	*						*			*	*	*	*
Construction complexities			*	*	*							*	*							
Design degrade									*											
Discrepancy contract form	*	*													*	*				
Searching for Alternative building material			*							*	*									
Inadequate site inspection			*							*	*									
Confirming alternative materials			*							*	*									
Alternative design proposal			*							*	*									
Unaware legal policy	*	*													*	*				
Unclear building contract	*	*													*	*				
Inappropriate performance measurement			*							*	*									
Poor specification			*	*	*							*	*							
Non-integrated project delivery			*							*	*									
Keep track of inspection			*							*	*									
Lack of guidance and proper documentation			*			*	*	*						*			*	*	*	*

Obstacles summarized by various authors	Niazai & Gidado, 2012	Kasi, 1998	Love & Edwards, 2004	Rounce, 1998	Love, Irani, & Edwards, 2004	Tilley, et al, 2002	Gallo, et al, 2002	Asadi, Wilkinson & Rotini, 2021	Hoezen et al, 2021	Enshassi, Sunderneier, Zeiter, 2017	Nielsen, 2010	Lopez et al, 2010	Aiyetan, 2013	Abotaleb & El-Adaway, 2017	Weng & Ahmad, 2015	Abidin, 2012	Senaratne & Mayuran, 2015	Ajator, 2017	Agbaxode, Dlamini, & Saghatforoush, 2021	Ayodeji, Bhekisia, & Aigbavboa, 2016
Insufficient design details			*	*	*							*	*							
Design & detail error			*	*	*							*	*							
Lack of info on drawings									*											
Conventional management protocol			*			*	*	*						*			*	*	*	*
Impractical design			*	*	*							*	*							
Incomplete design info									*											
Ineffective management			*			*	*	*						*			*	*	*	*
Poor design management			*	*	*							*	*							
Error during design			*	*	*							*	*							
Complex details			*	*	*							*	*							
Non-compliance to specification			*							*	*									
Lack of understanding of clients' requirement									*											
Design changes			*	*	*							*	*							
Poor info use									*											
Incomplete documentation during the award			*			*	*							*			*	*	*	*
Poor site supervision & inspection			*							*	*									
Uncertainty advising other stakeholders									*											
Attending to client-driven design changes			*	*	*							*	*							
Low priority to quality performance measure			*							*	*									

2.6.1 Obstacle 1: Deficient in claims & legal matters management

This theme comprises 4 types of variables such as ‘poor contract management knowledge’; ‘discrepancy of contract forms’; ‘unaware legal policy’; and ‘unclear building contract’.

Deficient in claims and legal matters management including certification and authority submission in BCA (Zakaria et al., 2013; Msawil et al., 2022). There are two types of certificates issued by contract administrators, one is certificates issued to contractors for interim payment, and the other is issued to developers for claim payment from house buyers. (Kasi, 1998; Gunduz and Elsherbeny, 2020). In a building contract, the certificate is to record events from the performance of the contract which includes assessment of delay events and quality of work, and the determination of payments to be made to the contractor (Abotaleb & El-Adaway, 2017).

Certification is normally prepared by graduate architects who monitor and supervise work to ensure the quality of work matches the standard specified in the contract (Weng & Ahmad, 2015). Error information when work is not done according to the standard stipulated but accepted by a graduate architect or inadequate examination on-site by a graduate architect will subsequently contribute to wrongful certification by the building contract administrator (Mari et al., 2019).

2.6.1.1 Wrongful certification due to misleading information given by graduate architects

Incidents of wrongful certificates occur when a graduate architect is not fully aware of the responsibilities of an architect legal responsibilities and the scope of duties (Mari et al., 2019). The unawareness may be due to insufficient and incomplete guidelines for certification (Weng, 2017). Fraudulent certification happened in the following scenarios (Weng & Ahmad, 2015):-

a. Contract administrator signed certificate which is not prepared by him / or not supervised by him

b. Over-certified payment for incomplete housing project

c. Premature certified VP which is unfit for occupation / without support documents for Form G

Certification of works not according to the relevant laws and agreements showed the highest propensity and it affected vacant possession stage certificate and certificate of completion and compliance the most (Weng & Ahmad, 2015). The same scenario occurred with payment certificates issued to the contractor.

The certificates are regarded as Doctrine of Substantial Performance (Abidin, 2012; Msawil et al., 2022). The purpose of the certification procedure is to express formal approval of work and trigger an obligation to pay money (Abidin, 2012; Msawil et al., 2022). Building contract administrator to certify acceptance of completed works in conformity with contract specifications and standards (Katz, 2009; Ostime, 2022). They must act with independence, impartiality, and fairness between contractor and Employer in assessing work done (Katz, 2009; Ostime, 2022).

However, there are cases where building contract administrators blindly follow recommendations from consultants and graduate architects without justifying the completion of work by themself, and the decision has been challenged by the employer (Salleh et al., 2016). Below are some of the examples to show wrongful certification in BCA: -

Case of Sutcliffe v Thackrah

The building contract administrator over-certified a series of certificates and the employer duly paid the contractor who failed to complete the work and was removed from the site (Patten and Saunders, 2018). The new builder completed the remaining work at a higher cost and the employer was unable to claim the damages from the previous contractor as they went into liquidation (Patten and Saunders, 2018). The building contract administrator is liable for damages as failed to exercise reasonable skill and care when carrying out his duty (Patten and Saunders, 2018).

The building contract administrator was assisted by graduate architects and a quantity surveyor. In this case, both of them failed to notice non-completion work and over-recommend payment interim certificate (Shannon, 2012; Mari et al., 2019). Failure to communicate properly or being unaware of the consequences of over- certified caused the building contract administrator to be liable to the employer (Anumba and Evbuomwan, 1997; Weng, 2017).

Case of Lojan Properties v Tropicon Contractors

In this case, the building contract administrator under certified twelve interim payment certificates to the contractor which resulted in the contractor suffering financial losses (Weng, 2017; Lalive, 2023). Hence, the contractor brought court proceedings against an employer (Weng, 2017; Lalive, 2023).

The building contract administrator was assisted by graduate architects. In this case, the graduate architect failed to prepare and remind the building contract administor to sign those relevant certificates on time to honor payment after work completion.

Case of Royal Brompton Hospital NSC Trush v Hammond and others

In the case of Royal Brompton Hospital NSC Trush v Hammond and others (Taylor Woodrow Construction (Holdings) Ltd Pt 20 defendant, the building contract administrator was negligent in granting extensions (Weng, 2017; Lalive, 2023). This caused the Employer unable to recover their damages due to delay and subsequently sued the building contract administrator for failure in work performance (Weng, 2017; Lalive, 2023).

Building contract administrator needs the assistance of a graduate architect to assess the completion of work and non-completion of work before a certificate of practical completion or certificate of non-completion can be issued, or compensable delay before the extension of time can be considered (Salleh et al., 2016). This is a case where the graduate architect failed to report site progress, prepare their recommendation for the event certificate, and assess of extension of time (EOT) submitted by the contractor (Salleh et al., 2016). Graduate architects inexperienced in legal matters complicated the certification process when they were unable to assist building contract administrators in assessing and preparing certificates accordingly (Salleh et al., 2016). A summary of the 3 cases is stated in Table 2.4.

Table 2.4: Summary of legal cases related to building contract administration

Case	**Negligence**	**Remarks**
Sutcliffe v Thackrah	Failed to notice non-completion work and issue certificate of practical completion	The reason due to poor contract management knowledge
Lojan Properties v Tropicon Contractors	Failed to issue payment certificates	The reason due to unclear building contract
Royal Brompton Hospital NSC Trush v Hammond and others	Failed to report site progress, failed to issue payment certificates, and failed to assess extension of time	The reason due to unclear building contracts and poor contract management knowledge

Case of Stage Billing Certification in Sales and Purchase Agreement

In the STB housing delivery system, the STB house buyers are required to pay progressive bills according to stages of construction by relying fully on the building contract administrators' professional integrity in performing certification and completing their houses in a good manner (Weng, 2017).

Concerning the responsibility given, the building contract administrator should recognize their duty by delivering services that have a standard of professionalism, integrity, and skills (Weng, 2017). Building contract administrator is expected to perform at their peak for their client and to distinguish between what is desirable and necessary.

Building contract administrator with good management of knowledge and skills would increase client satisfaction that correlates with the product outcome (Weng, 2017). In Sim & Associates v Tan Alfred, *"The normal measures of an architect's skill are that of the ordinary skilled architect. An error of judgment may or may not amount to negligence. If the majority of architects would, under the circumstances, have done the same thing this normally provides a good defense"*

By law, a building contract administrator is accountable for conformance to the standards of care as practiced by others under the same name (UBBL, 2022). LAM has received a complaint about incorrect or fraudulent certification when the building contract administrator provided undated signed certificates to the developer, issued certificates even though the work was still incomplete, and delegated his duty to other parties in satisfying himself that the work was completed according to the sales and purchase agreement (Weng & Ahmad, 2015).

The majority of complaints relating to the certification problems are related to the building contract administrator's failure to provide meaningful reasons underlying his decision in certification and failure to certify the works have been reasonably completed and complied with the terms of the agreement (Weng & Ahmad, 2015).

They relied heavily on graduate architects who supported their duty in building contract administration work (Salleh et al., 2016). If the graduate architect is incapable, the building contract administrator would have to be liable for the consequences (Weng & Ahmad, 2015). There are incidents regarding graduate architects who had been routinely exploited by developers to prepare certificates for vacant possession even though work incomplete to avoid liquidated damages imposed on the developers (Weng, 2017). This incident should not be entirely blamed on graduate architects as according to Ho (2012), there is a lack of clear and specific certification guidelines in the act and regulation, nor does it endeavor to encourage inexperienced graduate architects to acquire sufficient knowledge and experience to deal with the procedural vagaries of a housing project.

Previous studies have shown that negligence cases during certification caused damages to the project stakeholders (Patten and Saunders, 2018; Tariq and Gardezi, 2023). Although there are many studies, the research on the roles of graduate architects in supporting claims & legal matters management remains limited. Most studies have concentrated on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects (Weng, 2017; Patten and Saunders 2018; Mari, 2019; Lalive, 2023). The question now is how graduate architects can perform and become reliable assistants in BCA during claims & legal matters management in the local context. A new approach is therefore needed to understand types of the obstacles in claims & legal matters management faced by graduate architects in Malaysia.

2.6.2 Obstacles 2: Deficient in project management

This theme comprises 5 variables such as ‘inexperienced’; ‘lack of guidance proper documentation’; ‘conventional management protocol’; ‘ineffective management’; and ‘incomplete documentation during award’.

Project management as pursued in this research is related majority on document management (Pinto, 2002; Lock, 2017). Supporting in administering building contracts involves tons of documentation work (Madon, 2005; Lock, 2017, Cuff, 1992).

Project documentation management is an unavoidable and necessary part of the building contract administrator’s job (Ajator, 2017). Proper project documentation could have altered the outcome of a dispute, reduced rework, and maintained the smooth flow of the construction process (Senaratne & Mayuran, 2015).

Incidents occur when insufficient time is given to prepare the documentation (Love and Edwards, 2004; Kerzner, 2022). Subsequently, the quality of documentation is being compromised. Poor document management is detrimental to the success or failure of a project as it can lead to delay, over budget, and rework (Madon, 2005; Lock, 2017). The situation becomes worse when the use of inexperienced graduate architects lack technical knowledge which could lead to errors and omissions in contract documentation (Mari et al., 2019). The most frequent causes of severe deviations especially during design were attributable to deficient planning or resource allocation, deficient or missing input, and changes (Madon, 2005; Lock, 2017).

Previous literature highlighted that a large number of rework requests were generated due to a lack of version control on drawings and plans (Senaratne & Mayuran, 2015, Cuff, 1992). This occurred when workers assembled structure from an obsolete set of plans that didn’t reflect the latest change orders (Asadi et al., 2021).

One mistake in a single document from architectural plans to a request for inspection (RFI) can lead to costly mistakes in execution (Asadi et al., 2021). Besides that, poor documentation also includes the following (Love and Edwards, 2004; Kerzner, 2022):-

1) Inaccurate bill of quantities,
2) Fail to record proper meeting minutes and
3) Lack of coordination
4) Jobs not have projected drawing lists to quantify the design workload
5) Jobs not having design programs based on project drawing lists and therefore specific design deliverables unable to be identified
6) Difficulty in estimating the physical progress of the design
7) Uncertainty in advising other stakeholders when information is likely to be available
8) Lack of specific procedures generally to control the design process in program terms

Ajator (2017) has identified declining quality of documentation and disregard of due processes and inefficiencies have resulted in increased project cost, time, risk, and disputes. Tilley, et al (2002), Gallo, et. al (2002), and Ajator (2012) identified issues associated with documentation failings and their manifestations, which are consequential on others and involve more than one stakeholder.

2.6.2.1 Client-Related causes of documentation failure

The client provided an unclear, vague, and uncoordinated brief to the consultant which caused no clear direction on design (Ajator, 2017; Cuff, 1992). Graduate architects while supported in BCA unable to advise clients accordingly and determine the confirmation design from the client (Mari et al., 2019).

The client has inadequate knowledge of construction and has impractical expectations of the project with a limited budget (Ajator, 2017). For example, the client requested the consultant to compromise the design to suit budget constraints by using inappropriate material which is not durable and cause major defects in the future (Asadi et al., 2021). This is due to graduate architects failing to advise the client accordingly regarding the impacts of using inferior materials to replace the original specification (Salleh et al., 2016).

Client-initiated Variation evaluation (VE) exercise for cost saving and compromise the initial design intent (Ajator, 2017). This is where the original design had been modified until a stage that defeat the initial purpose (Asadi et al., 2021). This often occurs when a graduate architect supporting BCA is unclear about the initial design intention and allows the client to modify the designs according to their preference which causes severe consequences (Pinto, 2002; Lock, 2017). Lack of proper documentation/sign-off on the documents after the Variation Evaluation exercise caused the building contract administrator to bear unnecessary responsibility (Pinto, 2002; Lock, 2017).

Client-engaged building contract administrators with the lowest price mentality jeopardize professional practice (Ajator, 2017). Within such a critical economic environment especially during by pandemic, the professionals are forced into fierce competition with each other (Mohammed, 2021). They often promise the employer more than they actually can offer in an attempt to gain remuneration (Cooper and Press, 1995). They fail to perform by their original promises and reputation when the employer presses for a reduction in fees which the building contract administrator must often accept to receive the remuneration (Cooper and Press, 1995; Gunduz et al., 2022).

The current level of fees is not sufficient to assure the performance of the building contract administrator and the graduate architects, and consequently, the reduction in fees jeopardizes the quality of the service (Cooper and Press, 1995; Gunduz et al., 2022). This is where the building contract administrator is unable to engage experienced staff to work on the project (Katz 2009; Msawil et al., 2022). Trial and error by junior graduate architects when producing drawings implied unworkable design detail during construction (Mari et al., 2019). Moreover when graduate architects are unable to advise practical/workable solutions to contractors while supporting BCA (Mari et al., 2019).

Client unwilling to pay for additional works (variation orders) done due to lack of proper documentation of work done on-site – confirmation of VO is not properly recorded and caused denial from the client side after work is done (Ajator, 2017). This is because graduate architects are unclear about the client's brief during the design phase and are unable to provide affordable solutions that match the client's preference while supporting BCA (Mari et al., 2019). This had substituted contractors to install a substandard material replacement to cover their losses which ended up suffering damages to purchasers (Ibrahim et al., 2022).

2.6.2.2 Designer-related causes of documentation failure

This incident occurred when the graduate architect was unable to advise the ambitious designer, lacked experience in construction detail, unfamiliar with local building requirements due to studying abroad, or engaged foreign designers in their practice (Mari et al., 2019). Designers lack design experience and produce unworkable detail designs/designs that do not conform to authority requirements (Ajator, 2017) or designer-produced designs which has inadequate client briefs or attending to client-driven design changes (Asadi et al., 2021).

Graduate architects failed to fix the design during construction which caused variation order (Mari et al., 2019). Immature design due to quick fix rushed design, cut and paste syndrome (Ajator, 2017). This occurs when the designer designs without considering the site context, and without studying thoroughly due to time constraints imposed by the client (Mari et al., 2019). Construction error often takes place as standard detail yet modified to suit the site context.

Graduate architects failed to coordinate with other consultants while supporting BCA. The discrepancy in drawings caused the contractor to re-work (Hai et al., 2012; Krishna, 2023). Design failure due to inadequate checking of details/ lack of coordination between consultants/design by crisis approach/ optimum project solution not provided by experienced staff (Ajator, 2017). This happened when each consultant worked in isolation to produce a building where the design failed to meet coherence (Hai et al., 2012; Krishna, 2023).

Graduate architects found difficulty in understanding the bill of quantities (Mari et al., 2019). Factors that inhibit inaccurate bill of quantities (BQ) due to lack of understanding of contract documents which are too thick and contain lots of legal phrases, lack of training, or fully delegating the preparation of BQ work to subordinates, unclear about general requirements, language usage inappropriate, stringent and impractical specifications, unfamiliar with contract forms used and seldom read document (Agbaxode et al., 2021).

Besides BQ, the record of meeting minutes is also an important document control (Madon, 2005; Lock, 2017). Graduate architects found difficulties when chairing meetings due to the majority of the meetings having no outcomes, the absence of a decision-maker, or failure to bring the discussion to a conclusion (Mari et al., 2019).

Meeting minutes intend to record ideas, decisions, solutions, interpretations of the contract documents, and follow-up actions during each meeting (Ayodeji et al., 2016). There should be a proper record of meeting minutes for ease of reference and action by each party (Sahlstedt, 2012; Lock, 2017).

Meetings conducted during the construction stage include site meetings, client consultant meetings, technical coordination meetings, nominated sub-contractor coordination meetings, safety committee meetings, ad-hoc meetings with suppliers/manufacturers on impromptu matters, etc (Hai et al., 2012; Krishna, 2023).

The importance of recording minutes of construction meetings becomes obvious when the direction or decision that was made in the meeting is inappropriately recorded and impacts the work, construction schedule, or costs (Hai et al., 2012; Krishna, 2023). Contents of each meeting minutes should be thoroughly reviewed and promptly reported if there are any errors, omissions, or incorrect statements (Sahlstedt, 2012; Lock, 2017).

Most meetings fail due to a lack of a meeting agenda, no action plan, no involvement of each participant, no follow-up action, or the inexperience of the chairperson (Romano and Nunamaker, 2001; Krishna, 2023). This is where meeting of mind becomes chatting or gossip which is a waste of time and money (Stanton, 1990; Krishna, 2023).

In addition, failure to document properly previous meetings will cause failure of the following meetings as follow-up action by respective parties cannot be taken on time (Ayodeji et al., 2016). Either the discussion brings to a conclusion or a proper document of minutes requires technical knowledge (Hai et al., 2012; Krishna, 2023).

The graduate architect who lacks this type of knowledge will face difficulty while chairing meetings as unable to use appropriate words to describe the scenario when they support BCA (Mari et al., 2019).

Previous studies have shown that weakness in project management delayed project delivery (Tilley and Barton, 1997; Jafari, 2021). Although there are many studies, the research on the roles of graduate architects while supporting BCA in project management remains limited. Ineffective integration of project management with enterprise operational processes prevents synergistic effects and causes resource waste and reduced operational efficiency (Agbaxode et al., 2021). Most studies have concentrated on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects (Tilley and Barton, 1997; Jafari, 2021; Mari, 2019). The question now is how graduate architects can perform and become reliable assistants in BCA during project management in the local context. A new approach is therefore needed to understand types of the obstacles in project management faced by graduate architects in Malaysia.

2.6.3 Obstacles 3: Deficient in communication and relationship management

This theme comprises 9 variables such as 'miscommunication'; 'lack of information'; 'lack of coordination'; 'design degrade'; 'lack of information on drawings'; 'incomplete design information'; 'lack of understanding of client requirement'; 'poor information use'; 'uncertainty advise other stakeholders'.

Deficiencies in communication and relationship management in the construction workplace can be either on a large scale between construction parties such as consultants, clients, and contractors or a small scale between individuals in the same firm which is internal communication breakdown (Gamil & Rahman, 2017).

Deficiencies in communication and relationship management are described as ineffective, unsuccessful, deficient, and lacking communication process of project information which should be prevented in the construction industry (Zerjav and Ceric, 2009; Krishna, 2023). The consequences of a deficiency in communication and relationship management are cost overruns, time overdue, disputes, and finally project failure (Hoezen et al., 2006; Krishna, 2023).

There are chances where an employer seeks a consultant's advice to make a decision (Anumba et al., 1997; Mari et al., 2019). Graduate architects while supporting BCA are to advise the employer of their statutory and contractual obligations and to advise the employer regularly whether the project is on schedule and within budget (Kavanagh & Miers, 2021).

The inability to communicate and advise the employer appropriately will indirectly lead to wrong decisions being made throughout the construction period (Hoezen et al., 2006; Krishna, 2023). This will subsequently cause the employer to lack interest in project involvement, lack of strategy, absence of executive direction, delay in decision-making, and interference by the owner (Hoezen et al., 2006; Krishna, 2023).

Graduate architects support BCA by supervising a workforce of craftsmen and their assistants who are committed to producing quality craftwork (Salleh et al., 2016; Gunduz and Elsherbeny, 2020). However, the current workforce is substantially formed by semi-skilled laborers with no particular concern for the nature of craftsmanship (Ibrahim et al., 2022).

The responsibility for the quality of work falls upon the general contractor whose interest is in management and reaching the minimum of the designer's specification/expectation (Gunduz & Elsherbeny, 2020).

The graduate architect has no direct communication with the workforce since the craftsman does not share the ambition of producing quality work whereas the general contractor becomes preoccupied with contractual responsibilities and the adoption of predominantly legalistic attitudes (Mari et al., 2019). This is another form of deficiency in communication and relationship management which leads to poor site productivity and decreased project performance.

There are scenarios where graduate architects commence design management and begin documenting the project before the engineering consultants are appointed (Mari et al., 2019). Mechanical, electrical, and hydraulic service requirements were not given due consideration when designing (Hai et al., 2012; Krishna, 2023). Poor coordination of drawings during the design process resulted in service clashes occurring (Hai et al., 2012; Krishna, 2023). These clashes arose due to inadequate time combined with the use of inexperienced personnel contributed to errors in documentation (Love and Edwards, 2004; Krishna, 2023).

In addition, the late inclusion of engineering consultants in the project resulted in those services having to be designed afterthought to suit architectural design (Love and Edwards, 2004; Krishna, 2023). An architect stated that junior graduates were used to producing documentation to maximize profitability (Mari et al., 2019). Hence, the design was found without checking, verifications, or reviews undertaken before documenting and leaving the consultants' offices (Mari et al., 2019).

There are various factors that cause deficient in communication and relationship management which include lack of regular communication among construction parties, no proper channel adopted to manage and control the communication process, slow information flow, wrong design, wrong interpretation, lack of effective communication system and platform, poor communication skills, language barrier, possessing a different level of education among construction teams, lack of support for advanced communication technologies, diversity of culture and ethics among construction teams, personal barriers, technology malfunction, different skill levels among construction teams, lack of communication plan, lack of communication medium, inaccessibility of information, poor planning and coordination, poor communication management, lack of clear objectives, lack of mutual respect and trust among construction teams, weak organizational structure, inaccurate delivery of project information, unavailability of information in the time of need, contractual barrier, lack of adequate representation for project stakeholders, lack of understanding among parties, poorly detailed drawings, incorrect instructions or technical information and gender differences, etc (Gamil & Rahman, 2017).

According to the literature, the most recurring causes were lack of effective communication among construction parties followed by poor communication skills (Zerjav and Ceric, 2009; Krishna, 2023). Graduate architects while supporting BCA in the project team should eliminate these causes to result in zero negative effects to the project.

Most construction professionals are aware that communication and relationship management in construction projects are reasonably deficient in comparison to other industries (Zerjav and Ceric, 2009; Krishna, 2023). This is proven via the poor structure and ineffective communication among project teams that caused people to work together poorly and fail to communicate (Hai et al., 2012; Krishna, 2023).

We are evaluated through writing, graphical, and conversation dexterity (Hai et al., 2012; Krishna, 2023). Communication breakdown occurs when one party fails to convey his or her intentions to another, leading to misunderstanding and the associated problems that such a state may bring about (Zerjav and Ceric, 2009; Krishna, 2023).

Deficiencies in communication and relationship management can wreak havoc on a project as team members struggle to effectively communicate and work with one another (Zerjav and Ceric, 2009; Krishna, 2023). Moreover, deficiencies in communication and relationship management have caused time wasted (Hoezen et al., 2006; Gamil and Rahman, 2023). This occurs when errors from early stages have to be solved later and making adjustments at that time usually costs extra money (Hoezen et al., 2006; Gamil and Rahman, 2023). As a result, the project suffered and was delayed.

The main problem of communication lies in the lack of ability from graduate architects to empathize with other parties involved where they fail to think along with the employer; or convince an employer to accept their input and design ideas that do not match the wishes and needs of employer (Salleh et al., 2015). Most construction disputes are due to breaches or inadequate communication among the team members and poor communication of design information leads to design problems and will lead to delays and poor quality (Hoezen et al., 2006; Gamil and Rahman, 2023).

Therefore, the efficiency and effectiveness of the construction process depend on the quality of communication and relationship management. The improvement of communication and relationship management is crucial due to the following reasons (Hoezen et al., 2006; Gamil and Rahman, 2023):-

1) It could reduce the failure of the project,
2) Lead to innovations and better technical solutions
3) Quality influenced as perceived by all stakeholders involved
4) This leads to better decision-making

Previous studies have shown that communication breakdown among project teams retard construction (Hoezen et al., 2006; Gamil and Rahman, 2023). Although there are many studies, the research on the roles of graduate architects in supporting communication and relationship management remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects (Hoezen et al., 2006; Gamil and Rahman, 2023; Mari, 2019). The question now is how graduate architects can perform and become reliable assistants in BCA during communication and relationship management in the local context. A new approach is therefore needed to understand the types of obstacles in communication and relationship management faced by graduate architects in Malaysia.

2.6.4 Obstacles 4: Deficient in quality and assessment management

This theme comprises 11 variables such as ‘delay reply queries’; ‘delay confirm alternative material’; ‘unsure alternative material proposal’; ‘inappropriate performance measurement’; ‘none integrated project delivery’; ‘keep track of inspection’; ‘poor site supervision and inspection’ and ‘low priority to quality performance’; ‘searching alternative building material’ and ‘non-compliance to specification’; ‘inadequate site inspection’.

One of the main tasks for graduate architects while supporting BCA is to provide efficient supervision to ensure that the works as carried out conform to detailed drawings (Salleh et al., 2016). Site visits to inspect and monitor the works are critical elements in this process, allowing the detection and rectification of defects and noncompliance work in an early stage (Pressman, 2006; Alawag et al., 2023). Visits may be at regular intervals, programmed to coincide with particular events on-site, or unannounced spot checks (Ashokkumar, 2014; Alawag et al., 2023).

Incidents of graduate architects seldom carrying out site visits, and unknown what item to inspect during inspection had caused design details overlooked and ended in variation orders with additional costs (Ashokkumar, 2014; Alawag et al., 2023). Some graduate architects simply wander onto the site with no clear idea of what they expect to find or indeed what they should be looking for (Mari et al., 2019).

Moreover, problems arise when there are unclear technical requirements of the materials, and construction techniques during quality control (Pooworakulchai et al., 2017). The unfamiliarity with design detail by a graduate architect will cause the contractor to make their own decision to use the easiest method and shortest time to resolve a design problem in which the majority will sacrifice aesthetics and functionality becomes questionable (Mari et al., 2019).

There are conditions of insufficient design detail provided by the graduate architect which caused abruption to the construction process (Mari et al., 2019). The graduate architects will be called upon to issue further drawings and specifications to finalize the design and to issue instructions to the contractor relating to various operational matters in the contract (Salleh et al., 2016). He/She is required to furnish the necessary documentation to enable the contractor to complete the work (Jafari, 2021).

The documentation comprises copies of the contract documents which consist of the letter of award, articles of agreement, the conditions of the contract, the contract drawings, and the contract bills and are supplemented by the additional construction drawings, setting out information, specifications, and Bills of quantities (Tilley, 2005b; Jafari, 2021). Further drawings and details may be issued from time to time during the contract (Tilley, 2005b; Jafari, 2021).

The modification of the design, quality, or quantity of the works, the correction of discrepancies between the contract documents, the removal of materials from the site, the opening up of covering work, the condemnation, replacement, and remediation of defective work, the postponing of work, the dismissal of incompetent or misconducting personnel and any other matters relating to the contract shall be formalized with an instruction (Agbaxode et al., 2021).

There are occasions when indecisiveness from either party delays the issuance of instruction and affects the overall work progress (Enshassi et al., 2017). The reason for indecisiveness because graduate architects are unable to furnish advice or design solutions on time had causes employers to consume more time to figure out the next course of action (Salleh et al., 2016).

The lack of proper guidelines on workmanship quality is another factor contributing to deficiency in quality and assessment management(Love and Edwards, 2004; Agbaxode et al., 2021). For example, the CIDB Qlassic standard in Malaysia furnished general guidelines without detailed descriptions for each trade and construction component. Graduate architects faced difficulties when inspecting the quality of workmanship due to a lack of detailed guidelines for reference (Alawag et al., 2023).

Previous studies have shown that unsure what to inspect, unsure about design details and lack of guidelines on workmanship standards affected the construction (Tilley, 2005a; Jafari, 2021). Although there are many studies, the research on the roles of the graduate architect in supporting quality and assessment management under BCA remains limited (Burati Jr et al., 1991; Ashokkumar, 2014; Alawag et al., 2023). Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects.

The question now is how graduate architects can perform and become reliable assistants in BCA during quality and assessment management in the local context. A new approach is therefore needed to understand the types of obstacles in quality and assessment management faced by graduate architects in Malaysia.

2.6.5 Obstacles 5: Deficient in design management

This theme consists of 11 variables such as ‘slow decision’; ‘poor specification’; ‘insufficient design detail’; ‘poor design management’; ‘unworkable detail’; ‘constant design changes’; ‘attending to client drive design changes’; ‘design and detail error’; ‘construction complexities’; ‘impractical design’; ‘error design drawing’.

Graduate architects while supporting BCA should be able to step in and advise accordingly when there is defective design and cause variation (Salleh et al., 2016). There are circumstances where the contractor highlighted unworkable design and failed to obtain further input on the next course of action from the graduate architect (Mari et al., 2019). This case occurs when there is poor design or incomplete design by the designer of the project, poor management expertise, various technological and social issues, site-related problems, and the application of improper tools and techniques (Gunduz & Elsherbeny, 2020).

The scarcity of professional construction knowledge or relevant professional foundations made the graduate architect who supports the administration work not suitable as middle persons and make inappropriate resolutions (Pooworakulchai et al., 2017). This had caused lots of trial and error at the site which delayed the entire work progress.

Previous studies noted that the use of inexperienced and underqualified staff lacking technical knowledge could lead to errors and omissions in contract documentation (Best, 2006; Simpeh, 2012; Agbaxode et al., 2021). Lopez et al. (2010) argued that insufficient knowledge masks a more complicated problem inherent in design firms. Design firms engage inexperienced staff to maximize their fees and instigate them to undertake tasks within fixed unreasonable durations, irrespective of how complete/incomplete the design documentation or tasks (Love et al., 2004; Gunduz et al., 2022).

Moreover, there was an incident where the graduate architect did not adequately document the intentions of the client when the common means of communicating the clients' brief and the project objectives to the design team was verbal and caused misinterpretation (Mari et al., 2019). Palaneeswaran (2006) identified seven ways design-related factors that caused inefficient design management:-

1) Failed to incorporate quality management in design
2) Unfamiliar with information technologies for improving design
3) Lack of manpower to complete the required tasks
4) Insufficient time to prepare specification and design
5) Incomplete design during tender
6) High turnover rate among design team members

Trigunarsyah (2004) pointed out that problems attributable to design management include:-

1) Designers provided inaccurate detail
2) Error in specifications or inappropriate materials specified
3) Design which not comply with by-law due to inadequate knowledge of legislation or guidelines

4) Inadequate coordination between client/designer, designers/contractors
5) Inadequate coordination with consultants
6) Lack of design empathy for construction

Rounce (1998) suggests consequences of poor design management practices include:

1) Redesign due to an inadequate client brief
2) Changes arising from unchecked drawing and caused variation orders
3) Attending to clients' constantly driven design changes and causing differences with the original design intent

Deficiency in design management is related to the gap between theory and practice for graduate architects (Cooper and Press, 1995; Gunduz et al., 2022). Complaints about deficiencies in design management and declining quality of buildings have been common among graduate architects (Tzonis, 2014; Khodeir and Nessim, 2020).

As coined by several researchers, design education does not meet the actual needs of the industry and there is a gap between design education at the university level and the actual skills of architecture students (Khodeir, 2018; Khodeir and Nessim, 2020). The gap between theory and practice is widely documented and referred to in the literature about design education and practice (Kezer and Guzer, 2022).

Newly graduated architects experienced a transition shock and encountered a gap between knowledge acquired in initial design education and knowledge demands in occupational practice (Paprzyca, 2018). They described their first year as practicing graduate architects as not only a tough experience but also one of growth and development (Paprzyca, 2018).

It is important to explore how students' perception of coherence between theoretical and practical parts of their initial education is affected by different kinds of learning outcomes acquired during education (Paprzyca, 2018). Perceiving coherence between theoretical and practical components of initial design education is a vital step in bridging the gap between theory and practice (Paprzyca, 2018). A certain amount of acquired theoretical knowledge and several practical skills will be prerequisites for the development of design management skills (Mari et al., 2019).

Previous studies have shown that unsure about design details and the workability of design caused significant rework on-site (Paprzyca, 2018; Mari et al., 2019). Although there are many studies, the research on the roles of graduate architects in supporting design management remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is how graduate architects can perform and become reliable assistants in BCA during design management in the local context. A new approach is therefore needed to understand the types of obstacles in design management faced by graduate architects. From these studies, there is lack of graduate architects caused them left unknown and incapable of assisting the building contract administrator. It is difficult to describe obstacles precisely. A summary of the types of obstacles faced by graduate architects while supporting BCA work is captured in Appendix A.

After identifying the types of obstacles faced by graduate architects, there is a need to understand the root causes of these obstacles to overcome the problem. Hence, the root causes of obstacles faced by graduate architects have been investigated through a literature review and described in the following sub-chapter.

2.7 Root Causes Of The Obstacles Faced By Graduate Architects While Supporting BCA Of Housing Projects In Malaysia

Understanding the underlying obstacles faced by graduate architects while supporting BCA is critical for the sustainability of the construction industry (Andrews, 2022). The root causes of the obstacles will assist graduate architects understand better their role while supporting BCA and establishing better mitigation measures to deal with the associated problems (Andrews, 2022). Various reasons caused graduate architects to face obstacles while supporting BCA of housing projects in Malaysia. Those reasons could be generated from project-related criteria, design team/co-worker-related criteria, and organizational-related criteria (Oyedele, 2013; Ng et al., 2022).

Project-related criteria include the temporary nature of the project, deadlines, the uncertainty of future assignments, changing priorities, and the nature of future work colleagues among others (Oyedele, 2013; Ng et al., 2022). Donovan (2001) highlighted that construction projects induce stress and include a greater degree of thought and working process, bureaucracy, personal identification with project goals, excessive workload, and tight deadlines set by stakeholders. This excessive work pressure becomes a double-edged sword that affects creativity and performance on the negative side. For example, graduate architects have difficulty trying to understand and develop a comprehensive brief that meets uninformed and occasional client needs (Khodeir and Nessim, 2020). Some of these clients' ideas are idiosyncratic and tacit and hard to accurately develop and comprehensibly implement (Ye et al., 2015). Apart from their needs, clients are notable for constant design changes which lead to the dilution of strong design concepts (Cooper and Press, 1995; Gunduz et al., 2022). Their accustomed to making unrealistic demands, particularly regarding cost, time, and project requirements can lead to obstacles for graduate architects (Ye et al., 2015; Mari et al., 2019).

Design team/ co-worker-related criteria consist of coordination, communication, commitment, competence, compatibility, and cooperation among other things for the success of the design team as a whole (Oyedele, 2013; Ng et al., 2022). Construction involves diverse expertise from individual members of project design teams ranging from design to production of working drawings and specifications (Hai et al., 2012; Asadi et al., 2021). Each individual is responsible for the design of subsystems or elements within the overall design project (Hai et al., 2012; Asadi et al., 2021). Clear and regular communication between all team participants is an important factor for project success (Zerjav and Ceric, 2009; Gamil and Rahman, 2023). Coordination is a fundamental aspect of design management with other consultants and designers from other firms (Gamil & Rahman, 2017). Obstacles associated with co-workers include distrust, lack of liveliness among co-workers, and perception of lack of respect among co-workers that applies to counterproductive behaviors among graduate architects (Salleh et al., 2016).

Organizational-related criteria such as organizational culture and ethics, leadership, decision-making, and organizational process among others (Oyedele, 2013; Ng et al., 2022). Poor feedback and inappropriate evaluation systems an obstacles to graduate architects while supporting BCA (Salleh et al., 2016).

Similarly, a working environment that only highlights the negative aspects of employee's work and ignores the positive aspects or offers constructive criticism will affect graduate architects' performance (Oyedele, 2013; Ng et al., 2022). Other relevant criteria include inadequate leadership support, lack of open interaction between superior and subordinates, display of no interest in subordinate's work and non-recognition of effort, lack of synergy between organizational goals and leadership behaviors, and changing project priorities by supervisors, etc (Oyedele, 2013; Ng et al., 2022).

Above mentioned factors are related to obstacles caused by clients, co-workers, and working environment conditions. This research focused more on graduate architects who play a vital role in BCA.

2.7.1 Competency of Graduate Architects

Graduate architects in today's construction industry are faced with situations whereby the fundamentals and functions of their work performance are gradually declining in focus (Mari et al., 2019). Graduate architects are accountable not just for the technical content of the project, construction accuracy, reliability, and facility, cost performance but also confronted with issues such as undertaking additional roles that have not been part of their responsibility (Salleh et al., 2016). Hence, the graduate architect must supplement their traditional functions with other skills and knowledge to meet current professional demands (Salleh et al., 2016). Professional competence is defined as the ability to use a set of knowledge and skills to successfully perform jobs, roles, or responsibilities (Kwofie et al., 2016).

Professional competency is attained by the combination of knowledge acquired during training and skills developed through experience and the application of the acquired knowledge (Fotwe and McCaffer, 2000; Ghorbani, 2023). The root causes of graduate architects facing obstacles while supporting BCA is based on the inadequate of certain skills in graduate architects that become relevant to building contract administration work (Mari et al., 2019). This is because there are essential skills for graduate architects to achieve best practices in supporting the building contract administration work (Mari et al., 2019). Understanding the type of skill that is essential but lacking among graduate architects is crucial for academicians to design curriculum structures tailored to their needs to increase the performance standard amongst the profession and the whole industry (Andrews, 2022).

Moreover, it will enhance the base knowledge of professional development for graduate architects and can be used for future references (Andrews, 2022).

2.7.2 Graduate Architects Essential Skills

Katz (1974) suggested that there are three basic developed skills namely technical, human, and conceptual skills for effective administration skills. Technical skill is defined as specialized knowledge, and analytical ability within that specialty (Katz, 2009; Ghorbani, 2023). Human skill is the ability to work effectively as a group member and to build team spirit and conceptual skill is the ability to see the important contribution of each member to the success of the project (Katz, 2009; Ghorbani, 2023).

Technical skill proficiency in the use of tools and techniques; project knowledge; understanding methods, processes, and procedures; technology required; and skills in the use of computers are required to ensure project quality performance (Odusami, 2002; Ghorbani, 2023). Quality assessment and management skills, and claims & legal matters management skills are part of the technical skill (Odusami, 2002; Ghorbani, 2023). Technical problems are common in construction projects and they need to be resolved quickly to avoid delays in schedule (Odusami, 2002; Ghorbani, 2023).

Graduate architects should understand manners and procedures for implementing building contracts, i.e. payments, change orders, claims, requests for information, close-out documents, etc according to good practices and regulations within the industry (Ng et al., 2022). The system for keeping records and reports of everyday activities should be managed carefully. Graduate architects are found to lack technical skills because to architectural profession has failed to create the range of skills required to meet the demands of the present construction industry (Katz, 2009; Ghorbani, 2023).

In addition, the lack of exposure to real-life projects, issues, and clients during education reduces the chances for graduate architects to experiment with their theoretical and technical knowledge (Ng et al., 2022).

Human skill is the ability to work with other people (Katz, 2009; Ghorbani, 2023). Communication and relationship management skill is part of human skill (Jena and Satpathy, 2017). Three human skills components, i.e., interpersonal skills, understanding client aspirations, and ability to chair meetings (Jena & Satpathy, 2017). Interpersonal skills are about building relationships and getting along with others and the comfort of communication between graduate architects and clients, contractors, consultants, colleagues, and others (Than et al., 2009; Gamil and Rahman, 2023). There is a lack of interpersonal skills among graduate architects when problems below occur (Mari et al., 2019):-

1) Graduate architects found it difficult to motivate project stakeholders due to a lack of formal authority and influence
2) Conflicts arise between graduate architects and project stakeholders due to different expectations
3) Ineffective communication among the team when there is insufficient flow of information within the project team, misunderstanding, excessive amount of information, unavailability of necessary information, and late arrival of information
4) Lack of teamwork and cooperation when each individual develops personal career goals and has competitive thinking.

Understanding client aspirations is interrelated with making decisions (Kharvari and Kaiser, 2022). 'Make a decision' is the ability to choose effective solutions from alternatives (Cooper and Press, 1995; Ng et al., 2022).

A decision is a position, opinion, or judgment reached after consideration (Cooper and Press, 1995; Ng et al., 2022). It is a cognitive phenomenon and the outcome of a complex process of deliberation, which includes the assessment of potential consequences and uncertainties (Best, 2006; Ruge and McCormack, 2017). The basic elements of a decision process include information seeking, interpretation, applying decision criteria, and subsequent implementation action (Love et al., 2008; Asadi et al., 2021).

Graduate architects are found to lack 'make decision' skills due to inadequate briefing by clients (Mari et al., 2019). A study done by Barton (1996) noted that the problem of cost, quality, and concept design is attributable to inadequate briefs. Time pressure affects decision making and information suffers degradation when the information is not delivered on time (Tilley and Barton, 1997; Gunduz et al., 2022). The ability to chair meetings is aligning people through the communication of the vision through words and deeds to all whose cooperation is needed to achieve the vision, and exchange of information (Sahlstedt, 2012; Gunduz et al., 2022).

Conceptual skill is to view the project from a bigger picture perspective, to understand the relationship between each field, and to imagine how the project fits into its broader environment (Pressman, 1998; Ghorbani, 2023). Design management and project management skills are part of the conceptual skill (Katz, 2009; Ghorbani, 2023).

The lack of conceptual skill has led to a complete failure of the project as work experience has an important role in conceptual skill development (Jena & Satpathy, 2017). Such experience enables graduate architects to learn the process of managing various project components and stakeholders (Katz, 2009; Ghorbani, 2023). The most effective way to develop the conceptual skill of supporting the building contract administration work is through learning by doing (Aprianto & Zaini, 2019).

Pressman (1998) stated that the consequence of poor project management is the number one cause of project failure, and correcting the situation requires training in advance to get the job done. However, graduate architects are found to lack this skill which can be reflected in the rate of project success (Mari et al., 2019).

The focus of this study is to investigate the root causes of obstacles faced by graduate architects while supporting BCA of housing projects. There are a total of 13 types of root causes found in 20 literature reviews in Table 2.5. Each type of root cause was divided into 5 themes according to the BCA skills determined by literature reviews, which are inadequate claims and legal matters management skills, inadequate project management skills, inadequate communication and relationship management skills, inadequate quality assessment and management skills, and inadequate design management skills.

Table 2.5: Types of root causes of obstacles in BCA identified from 20 literature reviews

Types of root causes	(Edum-Fotwe & McCaffer, 2000) [1]	(Hendrickson, Hendrickson, & Au, 1989) [2]	(Walker, 2015) [3]	(Jena & Satpathy, 2017) [4]	(Than et al., 2009) [5]	(Ting, Marzuki, Chuah, Misieng, & Jerome, 2017) [6]	(Wahyuni, Masih, & Rejeki, 2018) [7]	(Allen & Iano, 2019) [8]	(Sunindijo & Zou, 2011) [9]	(Best, 2006) [10]	(Cooper & Press, 1995) [11]	(Cooper, Junginger, & Lockwood, 2009) [12]	(Emmitt, 2006) [13]	(Byrne, 2007) [14]	(Fenn, Lowe, & Speck, 1997) [15]	(Shamir, 2016) [16]	(Avots, 1969) [17]	(Gido & Clements, 2014) [18]	(Lock, 2017) [19]	(Zuo et al., (2018)) [20]
Poor Project management	*	*	*					*									*	*	*	
Inadequate technical skill								*	*				*							
Inadequate Interpersonal skill				*	*	*	*													*
Difficult to Understand clients' aspirations				*	*	*	*													*
Unable to Adapt changes										*	*	*								
Inadequate Quality management								*	*				*							
Inadequate Technical coordination				*	*	*	*													*
Unable to Resolve technical problems								*	*				*							
Inadequate Conflict management skill										*	*			*	*	*				
Poor Writing skill	*	*	*					*									*	*	*	*
Poor Oral skill				*	*	*	*													*
Inability to chair the meeting				*	*	*	*													
Unable to Make a decision										*	*	*								

2.7.3 Root cause 1 related to technical skill: Inadequate Claims & legal matters management skill

This theme consists of 1 variable which is 'inadequate conflict management skill'. Claims and legal matters management skill is defined as a skill that resolves disputes in a non-confrontational way, i.e. conflict management (Fenn et al., 1997; Koc and Gurgun, 2022). This skill is required in the process of negotiation and mediation in containing, managing, and resolving potential sources of conflict in a win-win solution (Fenn et al., 1997; Koc and Gurgun, 2022).

Studies and research on the problem of the construction industry have pointed to some fundamental causes of project failure are the proliferation of disputes in the industry, i.e. inadequate conflict management skills (Verma, 1998; Byrne, 2007; Tariq and Gardezi, 2023). Disputes are inevitable with the surge of increasingly complex and fast-track construction projects (Koc and Gurgun, 2022). These disputes tend to escalate and cause project delays, leading to claims, and litigation proceedings if disputes are not resolved promptly (Fenn et al., 1997; Koc and Gurgun, 2022). Construction projects are delayed when disputes between contracting parties prolong without resolution (Verma, 1998; Byrne, 2007; Tariq and Gardezi, 2023).

In addition, disputes occur when there is a misunderstanding and misinterpretation of the building contract by contracting parties (Koc and Gurgun, 2022). Graduate architects supporting BCA are having difficulty understanding the contents of contract documents lead to different interpretations resulting in unnecessary contractual problems such as disputes, unnecessary claims, reworks, shoddy works, and litigation (Salleh et al., 2016).

Contractual language and judicial interpretation play a key role as they may lead to misunderstanding and misinterpretation of the facts in contract obligations when one party intends to take advantage of another party (Tariq and Gardezi, 2023).

According to Ibrahim (2006), factors that inhibit the understanding of contract documents are competencies, negative attitude toward effort to understand, lack of good education background, and complexity of contract documents. The legal jargon and irrelevant materials associated with contract documents caused difficulty in understanding graduate architects (Mari et al., 2019). The complexity of documents includes difficult languages, unclear and illogical specifications used, unfamiliarity with the types and forms of contract used, documents too thick with legal phrases, clients unaware of their requirements, insufficient training, full delegating to subordinates, unclear and general requirements, application of grandiose language, time-consuming to understand contract, stringent and impractical specifications, not familiar with contract forms used, seldom read documents and inexperienced (Koc and Gurgun, 2022).

It is crucial to have a proper understanding of the contents of the contract documents which leads to the enhancement of the contractual relation and assurance of the intended deliverance of the product (Fenn et al., 1997; Koc and Gurgun, 2022). A good contract document includes well-drafted drawings and specifications that illustrate what the contractor needs to do to earn the points and provide a method of determining whether the objective has been reached (Fenn et al., 1997; Koc and Gurgun, 2022).

To understand the contract requirements is to understand the contents of the documents and the spirit of the contractual relationships when both parties agree amicably to discharge their obligations to satisfy each other needs and requirements based on a fair basis (Mohamad and Madon, 2006; Koc and Gurgun, 2022).

Contract documents should fulfill the intended roles of being the references and guidelines for the relationships between the contracting parties throughout the project (Mohamad and Madon, 2006; Koc and Gurgun, 2022).

The clarity of contract documents with ease of understanding is important to improve the understanding of contract documents (Mohamad and Madon, 2006; Koc and Gurgun, 2022). Clarity is also related to the use of simple language and other factors such as clarity and completeness of drawings, clear understanding of client requirements, objective and practicality of drawings, clear explanation of regulatory requirements and general conditions, minimum use of complicated legal phrases, use of relevant documents that suit the contract (Mohamad and Madon, 2006; Koc and Gurgun, 2022). The chances of dispute could be reduced for a graduate architect who acquires claims & legal matters management skills.

The majority of prior research has applied that the lack of understanding of contracts hinders worker performance (Verma, 1998; Byrne, 2007; Tariq and Gardezi, 2023). Although there are many studies, the research on root causes of obstacles in claims & legal matters management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what root causes obstacles in claims & legal matters management affected graduate architects in the local context. A new approach is therefore needed to investigate the root causes of obstacles in claims & legal matters management faced by graduate architects in Malaysia.

2.7.4 Root cause 2 related to conceptual skill: Inadequate Project Management Skill

This theme consists of 2 variables which are ‘poor writing skill’ and ‘poor project management’. A perceived decline in project management skills, i.e. poor writing skills among graduate architects over the past years has caused project delays which increased cost and damages to all parties involved in construction (Gido and Clements, 2014; Mari et al., 2019). Abolnour (1994) stated that the absence of a system that organizes and unifies projects leads to a higher probability of error, time consumed, and a lower rate of experience acquisition (Darwish, 2005; Kezer and Guzer, 2022). This is one of the skills graduate architects are lacking during work.

Project management skill is defined as the ability to initiate, plan, execute, monitor, control, and close the work of a team to deliver the owner’s physical development within the constraint of cost, schedule, quality, and safety requirements (Fotwe and McCaffer, 2000; Kerzner, 2022). Project management skills include the ability to write and manage a project (Walker, 2015; Kerzner, 2022). It is an important skill that is well recognized as the application of techniques, software, knowledge, and skills to initiate, plan, execute, monitor, and control the construction project effectively and efficiently (Alaloul et al., 2016). This allows project plans to become thorough with a specific intent to increase quality, lower delivery costs, and shorter time to deliver project results (Gido and Clements, 2014; Mari et al., 2019).

Graduate architects who support BCA are responsible for the overall success of delivering the owner’s physical development within the constraints of cost, schedule, quality, and safety requirements (Gido and Clements, 2014; Mari et al., 2019). A graduate architect needs to acquire this skill to manage the project professionally and successfully.

Project documentation is part of project management skills. Construction project development depends on effective documentation because it requires complex interactions with multiple stakeholders and participants (Pressman, 2006; Heagney, 2016). Effective documentation of projects requires synthesis and integration of contributions from all parties involved in ownership, use, design, estimation, construction, operation, and management, who must work together in a structured, organized, and collaborative manner in the project documentation chain to ensure success (Ajator, 2017). The quality of design and documentation depends on the method of transferring concepts and ideas into graphic and written representations that allow for construction (Levitt, 2011; Kerzner, 2022).

It is important to control all project documentation such as subcontract agreements, vendor purchase orders, contractor payment records, correspondence, meeting minutes, construction drawings, technical specifications, progress reports, schedules, progress photos, site diary and reports, permits, and other authority documents (Oberlender and Oberlender, 1993; Lock, 2017). Progress reports and schedules should precisely record the progress of the project (Oberlender and Oberlender, 1993; Lock, 2017). Site diary should include all the essential elements of information and be included in the filing system (Oberlender and Oberlender, 1993; Lock, 2017). Proper project document control, including systematic document filing and retrieval, is important to the success of the construction project (Heagney, 2016).

Adequate documentation of meeting content and outcomes is critical for assuring that the client’s preference is appropriately addressed and aligning the building design (Gido and Clements, 2014; Mari et al., 2019). Construction meetings are an important aspect of the client-consultant-contractor team and represent a valuable opportunity for clear communication between builders, engineers, and developers (Hai et al., 2012; Gamil and Rahman, 2023). Documentation of construction meetings serves to support ongoing performance measurement and quality improvement (Akdemir & Eyerci, 2016; Williams & Saunders, 2006).

Writing is a second language that plays a key role in individual professional lives (Fenn et al., 1997; Koc and Gurgun, 2022). It is an endeavor, a way of communicating with others, informing them, or instructing the contractor (Fenn et al., 1997; Koc and Gurgun, 2022). It is a form of translating your thoughts into correct and acceptable Malay / English (Akdemir & Eyerci, 2016). Lack of writing skills will affect construction (Fenn et al., 1997; Koc and Gurgun, 2022). Using writing templates in writing is an effective way of improving writing skills as the templates can be defined as models (Lock, 2017). Understanding the rules and the types of letters issued during contract administration is important to convey a message effectively from one party to another (Lock, 2017). The types of letter writing required for building contract administration and, the type of documents to record construction progress have been studied and illustrated in Chapter 5.

The majority of prior research has shown that the root causes are a lack of documentation skills and writing skills, which hinder work performance (Hendrickson et al., 1989; Heerkens, 2002; Jafari, 2021). Although there are many studies, the research on the root causes of obstacles in project management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what root causes of obstacles in project management affected graduate architects in the local context. A new approach is therefore needed to investigate the root causes of obstacles in project management faced by graduate architects in Malaysia.

2.7.5 Root cause 3 related to human skill: Inadequate communication & relationship management skill

This theme consists of 5 variables which are 'difficult to understand client's aspiration', 'inadequate technical coordination', 'poor oral skill', 'inability to chair meetings', and 'inadequate interpersonal skill'. Inadequate communication and relationship management skills occur when one party fails to convey his or her intentions to another, leading to misunderstanding and the associated problems (Anumba et al., 1997; Gamil and Rahman, 2023). Consequently, it will lead to a direct influence on the quality of service provision, and quality of the finished building and invoke conflict during a project's life cycle (Anumba et al., 1997; Gamil and Rahman, 2023).

Communication and relationship management skills are defined as non-technical and not reliant on abstract reasoning, involving interpersonal and intrapersonal abilities to facilitate mastered performance in particular contexts (Jena & Satpathy, 2017). An increase in project complexity, multicultural issues, and the growth of work by virtual teams has led to a new era in which construction contract administrators' communication and relationship management skills are more crucial to achieving project success (Zuo et al., 2018). Communication and relationship management skills include understanding the client's aspiration, technical coordination, oral skills, ability to chair a meeting, and interpersonal skills (Jena & Satpathy, 2017). These skills are concerned primarily with working with people, remaining sensitive to the needs and motivations of others in the project, and communication skills (Hoezen et al., 2006).

Graduate architects supporting BCA are more likely to cope successfully with their tasks if they win the respect of their team members by displaying politeness and reasonable (Jena & Satpathy, 2017).

Effective building contract administration is people-oriented with strong leadership and superb communication (Hoezen et al., 2006; Gamil and Rahman, 2023). Developers transmit their thoughts and aspirations to the building contract administrator; the building contract administrator to graduate architects and graduate architects to contractors (Anumba et al., 1997; Gamil and Rahman, 2023). It is to the advantage of everyone involved in construction to be able to communicate clearly and efficiently as the greater the empathy between individuals the better the communication and the greater developer satisfaction with the end product (Anumba et al., 1997; Gamil and Rahman, 2023).

Coordination was introduced in 1916 which plays a significant role in managerial activity by providing the best cooperation among team members, improving communication, integration, and teamwork (Hai et al., 2012; Krishna, 2023). In project management, coordination can be expressed as different actors working on a common project, agreeing to a common definition of what they are building, sharing information, and harmonizing their activity (Hai et al., 2012; Krishna, 2023). Close coordination is critical in ensuring project performance, especially finish-to-start linking (Hai et al., 2012; Krishna, 2023).

Coordination plays a crucial role in information sharing in ensuring the participants are in one direction to prevent conflicts of information (Hai et al., 2012; Krishna, 2023). It aims at effective harmonization of the planned efforts for accomplishing goals. In this context, a tool that makes the design, construction, and operation of buildings much more streamlined and efficient is essential (Hai et al., 2012; Krishna, 2023).

The concept of implementing coordination in construction projects is still in the infancy stage where other industries have been successfully taking advantage of coordination technologies (Alaloul et al., 2016).

All parties involved in the construction team should put more effort into the coordination process (Anumba et al., 1997; Gamil and Rahman, 2023). It can start with a checklist that explains what needs to be clarified to avoid a ‘clash’, it offers discussions on consultants/contractors’ participation and information gathering and emphasizes well-planned implementation (Hassanain et al., 2019). Further input will be discussed in data collection as there are ambiguities in the number of tasks, people, and organization units involved in coordination (Anumba et al., 1997; Gamil and Rahman, 2023).

The majority of prior research has applied that the root causes are lack of communication and coordination skills that hinder work performance. Although there are many studies, the research on the root causes of obstacles in communication and relationship management from the graduate architects’ point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what root causes of obstacles in communication and relationship management affected graduate architects in the local context. A new approach is therefore needed to investigate the root causes of obstacles in communication and relationship management faced by graduate architects in Malaysia.

2.7.6 Root cause 4 related to technical skill: Inadequate Quality and assessment Management Skills

This theme consists of 3 variables which are inadequate quality management’, ‘unable to resolve technical problems’, and ‘inadequate technical skill’ (Allen & Iano, 2019). Quality and assessment management skills are familiar with building materials and the construction process to assess contractor’s submission (Allen & Iano, 2019).

The unfamiliarity with construction details by the graduate architects will cause the contractor to make their own decision to use the easiest method and shortest time to resolve a design problem in which the majority will sacrifice aesthetics and functionality becomes questionable (Mari et al., 2019). Graduate architects must acquire this skill for quality assessment, to protect the owner's interest against substandard materials, and bad workmanship (Mari et al., 2019).

Inadequate quality management skills and unable to resolve technical problems affected construction (Burati Jr et al., 1991; Alawag et al., 2023). Severe issues arise when contractors encounter complex, uncertain, and ambiguous designs in construction drawings (Wong et al., 2007; Alawag et al., 2023). Detail design is impractical and unworkable forcing construction to suffer large waste, poor productivity, cost and time overruns, and enduring conflicts and disputes (Hai et al., 2012; Gunduz et al., 2022). The reason exists these unworkable detail designs is due to graduate architects are inadequate in quality and assessment management skills (Mari et al., 2019).

Emmitt (2006) emphasized technical skills are specific to a particular job and contribute to the overall performance and employability of graduate architects. The study pointed out that technical skills are often attained through training and experience within a field (Celadyn, 2020). Graduate architects need to have advanced technical skills as they are holding managerial positions. Katz and Thamhain (1983) described technical skill as the capacity to manage the technological innovation and integration of solutions for the success of the project. It consists of planning and scheduling, construction management activities, basic technical knowledge in own field, productivity, and cost control, forecasting techniques, quality control, estimating and tendering, reading and understanding drawings, design activities, and background (Celadyn, 2020).

Graduate architects can align their skills better with job requirements for entry-level positions if a theory is more focused on technical skills (Katz, 2009; Ghorbani, 2023). Buildability is manifested in the ease of construction, efficiency, and economy of construction (Wong et al., 2007; Borg et al., 2020). Constructability is through the integration of construction knowledge at various project stages (Osuizugbo et al., 2022). There are three common approaches to improving quality and assessment skills (Lam et al., 2006; Alawag et al., 2023):-

a. Quantified assessment of designs through finished design
b. Constructability review on design documents at an early stage by checking on discrepancies or errors and ensuring coordination between drawings and specifications to ensure smooth project delivery
c. Implement constructability programs at different project stages

The majority of prior research has applied that the root causes are lack of quality management and technical skills that hinder work performance. Although there are many studies, the research on the root causes of obstacles in quality and assessment management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects (Burati Jr et al., 1991; Ashokkumar, 2014; Agbaxode et al., 2021). The question now is what root causes of obstacles in quality and assessment management affected graduate architects in the local contex. A new approach is therefore needed to investigate the root causes of obstacles in quality and assessment management faced by graduate architects in Malaysia.

2.7.7 Root cause 5 related to conceptual skill: Inadequate Design Management Skill

This theme consists of 2 variables which are ‘unable to adapt to changes’, and ‘unable to make a decision’ (Best, 2010; Gunduz et al., 2022). Design management skill is the management of the relationships between different disciplines (design, management, marketing, finance) and different roles (clients, designers, project teams, and stakeholders) (Best, 2010; Gunduz et al., 2022).

Coles (1990) found that the most significant causes of design problems are poor briefing and communication, inadequacies in the technical knowledge of designers, and a lack of confidence in preplanning for design work. Sverlinger (1996) found that the most frequent causes for severe deviations during design were deficient planning and resource allocation, deficient or missing input information, and changes. The reason for the poor level of design management is the lack of a solid conceptual foundation in architectural knowledge (Best, 2010; Gunduz et al., 2022).

The lack of synchronization between architectural design and construction courses has resulted in unworkable design products (Latif Rauf & S Shareef, 2019). This is due to the lack of design management skills by the graduate architects supporting BCA (Mari et al., 2019). Graduate architects step further away from building production notion where Tilley (1997) justifies his speech by mentioning 3 points:

1) First disconnection: Carpenters and masons always build, not graduate architects
2) Second disconnection: The industry addresses methods of construction, not graduate architects
3) Third disconnection: Construction drawings are not prepared by designers, graduate architects do it instead

Another reason for inadequate design management skills is making a decision (Cooper and Press, 1995; Gunduz et al., 2022). A decision is a position, opinion, or judgment reached after consideration (Cooper and Press, 1995; Gunduz et al., 2022). It is a cognitive phenomenon and the outcome of a complex process of deliberation, which includes the assessment of potential consequences and uncertainties (Mari et al., 2019). The basic elements of a decision process include information seeking, interpretation, applying decision criteria, and subsequent implementation action (Tilley, 2005; Gunduz et al., 2022).

'Make a decision' is the ability to choose effective solutions from among alternatives. Graduate architects often experience decision-making as confusing and non-rational (Mari et al., 2019). They are unsure of the process of decision-making from the moment of problem definition, negotiated and controlled by powerful actors, through communication, and argument between members to nodal judgments and resolution which forms the decision (Yap & Skitmore, 2018). Furnishing knowledge to graduate architects on time and encouraging them to research will promote a certain amount of creativity in decision-making (Cooper and Press, 1995; Gunduz et al., 2022).

The less experienced graduate architects claimed that there was very little evidence of managerial skills in the practices they worked in (Mari et al., 2019). They had received little or no training in design management on the job (Mari et al., 2019). This issue occurred due to lack of a clear guidance on the role of the architectural manager, the insufficient effort being made by educational institutions to include architectural design management within the curriculum and inadequate promotion of architectural management done by professional bodies to members of the profession (Tilley, 2005; Gunduz et al., 2022).

The scarcity of professional construction knowledge or relevant professional foundations made the graduate architect who runs the building contract not suitable for a middle person and making inappropriate resolutions (Pooworakulchai et al., 2017). This had caused lots of trial and error at the site which subsequently delayed the entire work progress. Moreover, there was an incident where the architect did not adequately document the intentions of the client when the common means of communicating the clients' brief and the project objectives to the design team was verbal and caused misinterpretation (Aiyetan, 2013; Gamil and Rahman, 2023). Graduate architects must improve this skill to support BCA by making appropriate resolutions on site and to minimize construction delays caused by trial and error (Salleh et al., 2016). Table 2.6 shows a summary of the description of the root causes of obstacles faced by graduate architects while supporting BCA.

The majority of prior research has applied that the root causes are unfamiliar with design, difficulty understanding the client's aspiration, unable to adapt to changes, and failure to make decisions that hinder work performance (Cooper et al., 2009; Gunduz et al., 2022). Although there are many studies, the research on the root causes of obstacles in design management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scene is the graduate architects. The question now is what root causes of obstacles in design management affected graduate architects in the local context. A new approach is therefore needed to investigate the root causes of obstacles in design management faced by graduate architects in Malaysia. After investigating the root causes of obstacles faced by graduate architects, there is a need to understand mitigation measures for these obstacles. Hence, mitigation measures for obstacles faced by graduate architects have been established through a literature review and described in the following sub-chapter.

Table 2.6: Summary of root causes of obstacles in BCA housing projects

Theme	Variable	Description
Claims and legal matters management skill *Skill that resolve disputes in a non-confrontational way* *(Shamir, 2016)*	Inadequate Conflict Management Skill	Skill required in the process of negotiation and mediation in containing, managing, and resolving potential sources of conflict in a win-win solution (Fenn et al., 1997; Koc and Gurgun, 2022) For example, alternative dispute resolution: mediation, adjudication, arbitration
Project management skill *Ability to initiate, plan, execute, monitor, control, and close the work of a team to deliver the owner's physical development within the constraint of cost, schedule, quality, and safety requirements (Fotwe & McCaffer, 2000)*	Poor Writing skill	Ability to write effectively to convey a point of view to others in a way that the person can understand (Hendrickson et al., 1989; Jafari, 2021). For example, minutes writing, report writing
	Poor Project Management	Responsible for the planning, procurement, execution, and completion of a project within time, quality, and cost constraints (Gido and Clements, 2014; Agbaxode et al., 2021)
Communication & relationship management skills *Non-technical and not reliant on abstract reasoning, involving interpersonal and intrapersonal abilities to facilitate mastered performance in particular contexts (Jena & Satpathy, 2017)*	Difficult to Understand Client's Aspiration	Focus on clients' requirements with elicitation and communicate with clients by in-depth interviews, review of relevant documents, further discussion to clarify difficulties, report writing, comments (Kamara et al., 1999; Krishna, 2023)
	Inadequate Technical Coordination	Superimposed drawings and resolved clashes between M&E services with building structure to make the building operate (Than et al., 2009; Lock, 2017)
	Poor Oral skill	Transmit messages and correct interpretation of information verbal to others without manipulating the initial meaning of the message (Wahyuni et al., 2018)
	Inability To Chair Meetings	Attentive during the meeting, possess time management, able to take minutes of the meeting, impartial in listening to everyone's views, and prepared for the meeting (Ting et al., 2017)
	Inadequate Interpersonal skill	Ability to communicate and form relationships with others (Wahyuni et al., 2018)
Quality and assessment management skill *Familiarize with building materials and construction process to assess contractor's submission/work (Allen & Iano, 2019)*	Inadequate Quality Management	Carrying out a project through concept, development, execution, and finish with minimum deviations from the project specifications (Sunindijo & Zou, 2011)
	Unable to resolve Technical Problems	Design-related defects, and faulty or deficient specifications caused unable to proceed with construction (Emmitt, 2006; Gunduz et al., 2022)
	Inadequate Technical skill	A type of specialty in construction (Emmitt, 2006; Gunduz et al., 2022)
Design management skill *The management of the relationships between different disciplines (design, management, marketing, finance) and different roles (clients, designers, project team and stakeholders) (Best, 2010)*	Unable to Adapt to Changes	Capable of handling changes (Cooper and Press, 1995; Gunduz et al., 2022)
	Unable to Make Decisions	Selection of an option after assessing the alternative resolutions (Cooper and Press, 1995; Gunduz et al., 2022)

2.8 Mitigation Measures For Obstacles Faced By Graduate Architects While Supporting BCA of Housing Projects In Malaysia

After investigating the root causes of the obstacles faced by graduate architects while supporting BCA, mitigation measures for the obstacles established from the literature review were analysed in Table 2.7 which outlines the generic areas of knowledge that graduate architects are expected to acquire from the literature review.

From the literature, the root causes of the obstacles are found due to inadequate of certain skills in management or termed as 'incompetence'. Professional competency is attained by the combination of knowledge acquired during training (Derrington, 1981; Ghorbani, 2023). **Acquiring the knowledge inputs for a particular type of project enables the development of certain skills** (Katz, 2009; Ghorbani, 2023). Understanding the types of knowledge required to support BCA will encourage graduate architects to acquire that particular knowledge to enhance their work performance (Salleh et al., 2016).

Previous studies identified that there are 20 types of knowledge categorised into 5 themes according to the BCA knowledge determined by literature reviews required by graduate architects to be competent to support BCA as summarized in Table 2.7. Mistakes and pitfalls can be avoided by engaging a graduate architect who is knowledgeable and appropriate for the job (Salleh et al., 2016).

Academic programs in architecture cover a significant proportion of the outlined knowledge areas (Ng et al., 2022). However, the knowledge areas required by graduate architects while supporting BCA are wider than the subject boundaries by the certification requirements of Accreditation Bodies (Ng et al., 2022). In summary, the certification requirements do not equate with architectural programs (Ng et al., 2022).

Modern construction contract administration demands a wide variety of knowledge, coupled with skills that extend beyond the technical aspects of traditional architectural practice (Mari et al., 2019). The scope of knowledge areas required to support the building contract administrator will also be influenced by the context of the industry in which the graduate architect works, as well as the requirements of the Board of Architects in Malaysia (LAM). The architecture professional practice knowledge requirements are reflected in the Part III professional exam. Therefore, the type of knowledge requested by LAM has been categorized into 5 themes according to the BCA knowledge determined by literature reviews, which are claims and legal matters management knowledge, project management knowledge, communication and relationship management knowledge, quality assessment and management knowledge, and design management knowledge. The frequency of themes/topics being examined in the examination paper of Professional Architect Part III year 1990 – 2020 was analyzed and summarized in Table 2.8.

Mitigation measures established from literatures are to instill certain types of knowledge to resolve the inadequate skills faced by graduate architects. The following sub-chapters described about the type of knowledge that require to be instilled by graduate architects, such as to instill claims and legal matters management knowledge, to instill project management knowledge, to instill communication and relationship management knowledge, to instill quality assessment and management knowledge, and to instill design management knowledge.

Table 2.7: Types of Knowledge required by graduate architects from 20 literature reviews

No. /Types of knowledge	(Edum-Fotwe & McCaffer, 2000) [1]	(Hendrickson et al., 1989) [2]	(Walker, 2015) [3]	(Jena & Satpathy, 2017) [4]	(Than et al., 2009) [5]	(Ting et al., 2017) [6]	(Wahyuni et al., 2018) [7]	(Allen & Iano, 2019) [8]	(Sunindijo & Zou, 2011) [9]	(Best, 2006) [10]	(Cooper & Press, 1995) [11]	(Cooper et al., 2009) [12]	(Emmitt, 2006) [13]	(Byrne, 2007) [14]	(Fenn et al., 1997) [15]	(Shamir, 2016) [16]	(Avots, 1969) [17]	(Gido & Clements, 2014) [18]	(Lock, 2017) [19]	(Wahyuni et al., 2018) [20]
1-Project management	*	*	*						*								*	*	*	
2-Architecture				*	*	*	*													*
3-Town Planning										*	*	*								
4-Civil engineering				*	*	*	*													*
5-Mechanical engineering				*	*	*	*													*
6-Electrical engineering				*	*	*	*													*
7-Structural engineering				*	*	*	*													*
8-Geotechnical engineering				*	*	*	*													*
9-Quantity surveying				*	*	*	*													*
10-Construction contract law														*	*	*				
11-Construction methods								*												
12-Building materials								*					*							
13-Landscape				*	*	*	*													*
14-Interior design				*	*	*	*													*
15-Financial planning	*	*	*														*	*	*	
16-Valuation studies	*	*	*														*	*	*	
17-Environmental studies	*	*	*														*	*	*	
18-Authority approving process														*	*	*				
19-Feasibility study										*	*	*								
20-IT for construction				*	*	*	*													*

Table 2.8: Types of knowledge requested by Board of Architects Malaysia (LAM) (Source: LAM part III Exam paper year 1990-2020)

Year	Claims & knowledge		Legal matters management				Quality & assessment management knowledge	Design Management knowledge	Project management knowledge	Communication & relationship management knowledge
	NLC	TCPA	SDBA	SMA	AA	HDA	UBBL	Strata	PAM	LAM
2010	*	*		*	*	*	*	*	*	
2011	*	*	*		*	*	*		*	*
2012	*	*		*	*	*	*		*	
2013	*	*	*		*	*	*	*	*	*
2014	*	*	*	*	*	*	*		*	*
2015	*	*	*			*	*		*	*
2016 Mar	*	*			*	*	*	*	*	
2016 Sept	*	*	*	*	*	*	*	*	*	*
2017 Mar	*	*				*	*		*	*
2017 Sept	*	*	*		*	*	*	*	*	*
2018 Mar	*	*	*		*	*	*	*	*	*
2018 Sept	*	*	*	*	*	*	*		*	*
2019 Mar	*	*	*		*	*	*	*	*	*
2019 Sept		*	*		*	*	*		*	*
2020	*	*	*	*	*	*	*	*	*	*

Legends:

NLC – National Land Code
TCPA – Town and Country Planning Act
SDBA – Street, Drainage and Building Act
SMA – Strata Management Act
AA – Architect Act

UBBL – Uniform By-Law
Strata – Strata Title
PAM – PAM Contract
LAM – LAM circular
HDA – Housing Development Act

2.8.1 To instill Claims and legal Matters Management Knowledge

This theme consists of 2 variables which are ‘construction contract law’ and ‘authority approving process’.

Levin (1998) stated that a claim is a written demand or written assertion by one of the contracting parties seeking the payment of money in a certain sum, the adjustment or interpretation of contract terms, or other relief arising under or related to a given contract. The parties mentioned include owners, designers, main contractors, sub-contractors, or any other party of the contract or their representatives (Malak and Khalife, 2017).

Studies and research showed that the fundamental cause of project failure is the proliferation of disputes in the industry (Verma, 1998; Koc and Gurgun, 2022). Disputes should be resolved promptly to prevent escalation and cause project delays, lead to claims, require litigation proceedings for resolution, and ultimately destroy business relationships (Verma, 1998; Koc and Gurgun, 2022).

Kumaraswamy (1997) has summarized 20 common causes of construction disputes, including speed of construction, cost and quality control, technological advances, stringent building regulations, and economic difficulties. The conflict problems encountered have led to prolonged delays in implementation, interruptions, and suspension of projects (Verma, 1998; Koc and Gurgun, 2022).

Acharya and Lee (2006) concluded that most of the conflicts are minor in the initial stage, and if not handled well result in claims, counterclaims, troubles, and bad relationships between project stakeholders. Thus, it is not surprising the number of construction disputes has increased dramatically.

Hence, claims and legal matters management knowledge should be part of the tool kit for graduate architects that deserve serious attention. It is preferable to avoid construction claims from the beginning of a project and resolve claims quickly and efficiently once they arise (Verma, 1998; Koc and Gurgun, 2022).

Early identification of potential claims is necessary to successfully prevail on claim disputes arising during construction (Verma, 1998; Koc and Gurgun, 2022). Typical sources of disputes and claims are worth noting. Graduate architects in this scenario while supporting BCA need to have a basic understanding of the terms and conditions of the contract documents as they may act as 'mediators' to advise the party in a dispute to take necessary actions accordingly as there is a time limit for response (Mari et al., 2019).

In addition, a graduate architect familiar with relevant technical and general terms is essential to notify both parties of their contract rights and duties (Mari et al., 2019). Communication ideas and problems are essential for efficient and effective claim management (Verma, 1998; Koc and Gurgun, 2022). Most standard-form contracts provide some mechanism and contain clauses explaining the process of giving notices and the likely consequences that will arise for failure to deliver as specific in the contract (Verma, 1998; Koc and Gurgun, 2022). For example, most construction contracts require written notice for changes, differing site conditions, extra work, or other events that affect the contractor's time and cost performance (Tariq and Gardezi, 2023). Prompt notification is important to avoid the possibility of breaching contract policy conditions (Tariq and Gardezi, 2023). Graduate architects if familiar with claims & legal matters knowledge would be able to advise the contractor/employer to fulfill the conditions of the notice clause by responding promptly to prevent unnecessary further disputes (Mari et al., 2019).

Graduate architects should understand the requirement of supportive documents for claim management (Mari et al., 2019). A complete and strong claim document is important in presenting a claim and resolving any disputes (Tariq and Gardezi, 2023). To have solid documentation, the information should be contemporaneous, documenting and closing out the work as it is performed. Information should be consistent and clear (Verma, 1998; Koc and Gurgun, 2022).

The claim must be supported with all the required documents in dispute with a simple, complete, and comprehensive approach (Verma, 1998; Koc and Gurgun, 2022). Documents such as charts, graphs, drawings, photographs, and videos of completed work, testing conducted, quality control activities, detailed pricing of the claim, specifications, special condition, specific instruction, contractor's calculation, and project diary with a record of the weather, manpower, visitors, and contractors on-site, key deliveries and notable event, etc (Mohamad and Madon, 2006; Koc and Gurgun, 2022). The problem resolution will be able to respond more effectively if all the above considerations are addressed properly.

The Government of Malaysia has enforced a law in parliament known as the Construction Industry Payment and Adjudication Act, 2012 (CIPAA) to provide speedy and cost-effective dispute resolution for payment issues in the construction industry (Kamil et al., 2023). Another type of construction contract law is arbitration which pertains to the process of dispute resolution implemented under the law of arbitration without court involvement. The arbitration process is less favored due to the appearance of other resolution methods such as mediation that are cheaper and less time-consuming. Graduate architects should be familiar with this act to advise the disputing party accordingly when they seek alternate solutions to resolve the problem (Mari et al., 2019).

There are circumstances where graduate architects were requested to be arbitrators for an internal dispute. Disputes will be able to resolve if they are exposed to this type of knowledge (Verma, 1998; Koc and Gurgun, 2022):

a. Active listening to the other person – listening will enable them to hear important information, and learn a great deal about the other party.
b. Talk clearly and precisely – this is to make sure that whatever the graduate architect has to say is understood in the way they are meant to be.
c. Re-framing positions as interest – to restate and capture the essence of what the other party said
d. Understanding and perception – reframe what was said to ensure it was understood and indeed what was meant
e. Posed open questions – provide important information that helps the resolution process
f. Separate the people from the problem – to understand the other party's point of interest and concerns

Approval from the authority is compulsory for all property development proposals in Malaysia. This approval involved several stages of submission to the local council before construction (Zahimi et al., 2024). However, this submission becomes a lengthy process when there is a lack of coordination between local council/technical agencies and worse still if the graduate architect is unsure about the process of submission. The developer is unable to predict the time frame for their building development. Subsequently, many development projects have been abandoned. This type of knowledge could be instilled through attending the latest authority submission road show and seminars organized to understand the latest authority's requirements (Zahimi et al., 2024).

The majority of prior research has applied that claims management knowledge will improve work performance. Although there are many studies, the research in mitigation measures for obstacles in claims & legal matters management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what mitigation measures for obstacles in claims & legal matters management would assist graduate architects in the local context. A new approach is therefore needed to establish mitigation measures for obstacles in claims & legal matters management faced by graduate architects in Malaysia.

2.8.2 To instill project management knowledge

This theme consists of 4 variables which are 'project management', 'financial planning', 'valuation studies', and 'environmental studies'. Construction projects naturally grow in scale, involving vast numbers of professionals, long life cycles, and complex interfaces (Gray et al., 2006; Guo and Zhang, 2022). Project management was developed in response to these challenges by facilitating project implementation and delivery (Gray et al., 2006; Guo and Zhang, 2022).

Project management knowledge includes the following aspects of management: integration, scope, time, cost, quality, human resources, risk, communication, and procurement (Love and Edwards, 2004; Lock, 2017). The scope of the project refers to the deliverables, the time refers to the schedule, the cost refers to the budget, and the quality refers to the performance outcome (Love and Edwards, 2004; Lock, 2017).

Human resources are the individual participants in a project, communication refers to communications associated with the performance of the project, risk is the risk associated with a project, and procurement refers to the acquisition of goods and services from organizations other than the one carrying out the project (Oberlender and Oberlender, 1993; Guo and Zhang, 2022).

To instill project management knowledge in graduate architects is to integrate unifying, consolidating, articulating, and integrating actions (Salleh et al., 2016). There are generic areas of knowledge that graduate architects are usually expected to acquire by various Accreditation Bodies (Salleh et al., 2016). Academic programs in project management cover a significant proportion of the outlined knowledge areas (Mahasneh and Thabet, 2015; Zaman et al., 2023).

Since projects generally form part of a functional organization, much of the additional knowledge will include Finance and accounting, Sales and marketing, Strategic planning, Tactical planning, Operational planning, organizational behavior, personnel administration, conflict management, personal time management, stress management (Mahasneh and Thabet, 2015; Zaman et al., 2023).

Project Management Body of Knowledge (PMBoK) proposed 10 knowledge areas for project management and Construction extension proposed an additional four that consist of project integration management, project scope management, project time management, project cost management, project quality management, project human resources management, project communication management, project risk management, project procurement management, project stakeholder management, project safety management, project environmental management, project financial management and project claim management (Lock, 2017).

Graduate architects are encouraged to utilize the concepts and areas of the Project Management Body of Knowledge Guide (PMBoK) to enable them to devise better project management solutions (Gray et al., 2006; Guo and Zhang, 2022). They may prioritize project risks, set up risk management procedures, organize frequent safety training sessions, enhance awareness for safety, set work safe procedures, adopt zero accident policies, enhance cost performance through determining critical milestones and cost breakdown structures, develop progress monitoring curves, etc (Lock, 2017)**.**

The majority of prior research has applied that project management knowledge will improve work performance. Project management knowledge is wide and general. Although there are many studies, the research on mitigation measures for obstacles in project management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what mitigation measures for obstacles in project management would assist graduate architects in the local context. A new approach is therefore needed to establish mitigation measures for obstacles in project management faced by graduate architects in Malaysia.

2.8.3 To instill communication and relationship management knowledge

This theme consists of 10 variables which are 'structural engineering', 'town planning', 'civil engineering', 'quantity surveying', 'landscape', 'interior design', 'IT for construction', 'geotechnical engineering', 'mechanical engineering', 'electrical engineer'.

Communication and relationship management knowledge is important in the realization of a construction project (Hoezen et al., 2006; Gamil and Rahman, 2023). This is because construction is a complicated industry with architects, engineers, project managers, and laborers all combining to bring unique skill sets, and understanding of their interconnected vocabularies (Chappell et al., 2008; Krishna, 2023).

Every profession in construction has several unique terms that people use to describe their jobs, activities, and what needs to be done (Thakur, 2009; Krishna, 2023). Understanding these terms will assist graduate architects in a good place when discussing the fundamental aspects and activities being performed on construction sites (Levy, 2018). It could encompass all aspects of architecture and building construction during the contract implementation phase.

Subject areas covered by terminology can be identified as building materials and methods, components and finishes, tools, trades and crafts, building construction and other technical aspects, building services, plumbing, acoustics, conservation, and restoration, project management and professional practice: contract and site practice, regulations etc (Hai et al., 2012; Krishna, 2023). We are perceived and evaluated by others based on our written, graphical, and conversational dexterity (Hai et al., 2012; Krishna, 2023). Hence, it is crucial to understand construction terms as it serves interactions, communications, and careers incredibly well. Clear communication keeps projects from failing (Wasserman et al., 2000; Krishna, 2023).

The majority of prior research has applied that communicating knowledge will improve work performance. Although there are many studies, the research on mitigation measures for obstacles in communication and relationship management from the graduate architects' point of view remains limited.

Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what mitigation measures for obstacles in communication and relationship management would assist graduate architects in the local context. A new approach is therefore needed to establish mitigation measures for obstacles in communication and relationship management faced by graduate architects in Malaysia.

2.8.4 To instill Design management knowledge

This theme consists of 2 variables which are 'architecture', and 'feasibility study'. Design management involves understanding, coordinating, and synthesizing a wide range of inputs while working alongside a diverse cross-section of multidisciplinary colleagues and concerned with interfaces (people, places, processes, and products) (Best, 2010; Gunduz et al., 2022).

In most design processes, several design organizations with specialized knowledge are contracted by the employer for the development of the design: architectural designers, specialist designers, and technical advisors (Cooper and Press, 1995; Gunduz et al., 2022). Graduate architects need to improve their design management knowledge due to the factors below (Best, 2010; Gunduz et al., 2022):

1) Excessive delay in the project being completed – poor predictions of project duration and the failure to discuss with employers the potential reasons for delay. The graduate architect should clarify with the employer regarding the project duration and measures to take to ensure the project is complete within the time frame.

2) Employer expectations were raised too high – graduate architects when support building contract administrator discusses design possibilities that are beyond the scope of the budget due to unsure of the exact cost in the market. Graduate architects should advise employers to engage quantity surveyors during the design phase to furnish a realistic estimation of construction costs when the design mature
3) The employer was expected to pay for mistakes/errors made by designers – Graduate architects should acknowledge when made a mistake and use quality management systems and good design management practices to mitigate the number and extent of errors. Tracking the cause of design changes and variations will help to identify those that were a result of an error and those requested for other reasons
4) Attempted work outside area of competence – The graduate architect is unsure of the extent of services that they are experienced and qualified to undertake. Open and frank discussions with the employer will assist to explore areas of uncertainty and identify the need for additional services from consultants
5) Failure to reply to employer's letters/emails or telephone calls – One of the biggest complaints is the failure to advise employer about increased costs. Design management is tackling problems and taking the initiative to contact clients before they discover problems from another source

With the increasing building production and technical complexity, the number of design specialists involved rises leading to the need for the management of the design process (Best, 2010; Gunduz et al., 2022). In this context mainly interpreted as the management of information handling between the participants in the design team (Cooper and Press, 1995; Gunduz et al., 2022).

Aspects within this process that require improvement of the information exchange flows are (Cooper and Press, 1995; Gunduz et al., 2022):

1) Design object aspects: complexity and volume of architectural projects, growth of the volume of information, changes and risks to mistakes in design
2) Team aspects: time pressure to the design process, number as well as globalization of the design partners, differences in information behavior of design partners
3) Information exchange aspects: number and variety of digital and non-digital information systems, double, incomplete, or not updated information in different information systems as well as changes to information systems, speed of technological progress

In the recent past, most efforts to cope with these developments directed graduate architects to master design management knowledge (Best, 2010; Gunduz et al., 2022). This knowledge includes planning the design process backward from the date when these deliverables are due to be released to the client or contractor (Best, 2010; Gunduz et al., 2022). A master program is produced and distributed to the design team who plan their work within the framework of the master program (Best, 2010; Gunduz et al., 2022).

In addition, design management knowledge also includes concurrent working, targeted solution workshops, and timely design reviews which encompass design planning, scheduling, and control (Best, 2010; Gunduz et al., 2022):

1) Planning – determining the required activities to meet the design criteria, the relationship between the activities, and optimal sequencing
2) Scheduling – assessing the status of their readiness to be performed, assigning resources, and determining the start time, duration, and completion time for each activity
3) Control – assessing the status of activities after completion of work and calculating resource usage in terms of time and cost

Another way to instill design management knowledge is through a study on post-occupancy evaluation (POE) (Cooper et al., 2009; Gunduz et al., 2022). POE is a mechanism for linking feedback on newly built buildings with pre-design decision-making; the goal is to make improvements in building design, construction, and delivery (Tilley, 2005; Gunduz et al., 2022). POE can be conducted through methods to enhance design skills (Huber et al., 2022):-

a. Walkthrough and observation of how the space is performing.
b. Interviews with individuals
c. Use of questionnaires
d. Informal discussions with users

The majority of prior research has applied that knowledge in planning and control design will improve work performance. Although there are many studies, the research on mitigation measures for obstacles in design management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what mitigation measures for obstacles in design management would assist graduate architects in the local context. A new approach is therefore needed to establish mitigation measures for obstacles in design management faced by graduate architects in Malaysia.

2.8.5 To instill Quality and assessment Management Knowledge

This theme consists of 2 variables which are ‘construction methods’, and ‘building materials’. Quality and assessment management knowledge is to concur issues such as lack of proper planning during the design phase, under reinforcement, not adhering to project specifications, lack of use of standard materials, use of unqualified professionals, insufficient management staff, and the team responsible for controlling quality, errors owing to poorly detailed design, speedy construction, share ignorance, etc (Burati Jr et al., 1991; Alawag et al., 2023).

Based on the foregoing, instilling quality and assessment management knowledge in graduate architects is a measure to mitigate the various defects being raised by purchasers after vacant possession in Malaysia (Khodeir and Nessim, 2020). This could be done by standardizing the specification when implementing the project. The aims of building specification are (Bukola et al., 2018):

1. To spelt out the quality of materials, method execution, and workmanship quality
2. As a guide for quality assessment
3. To protect the owner’s interest against substandard materials, bad workmanship
4. To facilitate the contractor to procure quality material, adequate tools and appliances, machinery, and plant for work
5. For estimation of the amount of work and provision of funds for the project
6. For tenderer to quote rates of work

The benefits of implementing quality and assessment management knowledge are improving communication problems, minimizing mistakes, reducing rework and wastage of materials, and exercising better control of the main contractor and consultants (Arditi and Gunaydin, 1997; Wong et al., 2007; Agbaxode et al., 2021).

Thus, the productivity, profitability, and market share gradually increased which enabled contractors to meet employers' requirements (Burati Jr et al., 1991; Alawag et al., 2023).

The majority of prior research has applied that knowledge in building specification and construction methods will assist graduate architects in improving work performance (Burati Jr et al., 1991; Alawag et al., 2023). Although there are many studies, the research in mitigation measures for obstacles in quality and assessment management from the graduate architects' point of view remains limited. Most studies have relied on building contract administrators whereas the person doing all the work behind the scenes is the graduate architects. The question now is what mitigation measures for obstacles in quality and assessment management would assist graduate architects in the local context. A new approach is therefore needed to establish mitigation measures for obstacles in quality and assessment management faced by graduate architects in Malaysia.

Table 2.9 shows the outcome of types of obstacles, root causes, and mitigation measures proposed from the literature review in BCA works. In legal and claims matters, there are a total of 4 variables in obstacles, 1 variable in root causes, and 2 variables in mitigation measures. Project management has a total of 5 variables of obstacles, 2 variables in root causes, and 4 variables in mitigation measures. Communication & relationship has a total of 9 variables of obstacles, 5 variables in root causes, and 10 variables in mitigation measures. Quality assessment and management has a total of 11 variables of obstacles, 3 variables in root causes, and 2 variables in mitigation measures. Design management has a total of 11 variables of obstacles, 2 variables in root causes, and 2 variables in mitigation measures. All variables are then screened and filtered with a pilot study to ensure they fit into the local context.

Table 2.9: Summary variables for types of obstacles, root causes, and mitigation measures in BCA from literature reviews

Theme	Types of obstacles	Root causes	Mitigation measures
Claims & Legal matters management	**Deficient in Claims & Legal matters management** (Kasi, 1998; Gunduz and Elsherbeny, 2020; Abotaleb & El-Adaway, 2017; Weng&Ahmad, 2015; Mari et al., 2019, etc) a. Poor contract management knowledge, b. Discrepancy of contract forms, c. Unaware of legal policy, d. Unclear building contract	**Inadequate Claims & Legal matters management skill**s (Fenn et al., 1997; Koc and Gurgun, 2022; Verma, 1998; Tariq and Gardezi, 2023, etc) a. Inadequate Conflict management skill	**Instill Claims & Legal matters management knowledge** (Malak and Khalife, 2017; Mari et al., 2019, etc) a. Construction contract law b. Authority approving process
Project management	**Deficient in Project management** (Pinto, 2002; Lock, 2017; Madon, 2005; Ajator, 2017; Love and Edwards, 2004; Kerzner, 2022, etc) a. Inexperienced b. Lack of guidance proper documentation c. Conventional management protocol d. Ineffective management e. Incomplete Documentation during award	**Inadequate Project management skills** (Darwish, 2005; Kezer and Guzer, 2022; Kerzner, 2022; Walker, 2015, etc) a. Poor Writing Skill b. Poor Project management	**Instill Project management knowledge** (Gray et al., 2006; Guo and Zhang, 2022; Love and Edwards, 2004; Lock, 2017, etc) a. Project management b. Financial planning c. Valuation studies d. Environmental studies
Communication & relationship management	**Deficient in Communication & relationship management** (Zerjav and Ceric, 2009; Krishna, 2023; Hoezen et al., 2006; Gamil & Rahman, 2017, etc) a. Miscommunication b. Lack information c. Lack coordination d. Design degrade e. Lack of information on drawings f. Incomplete design information g. Lack of understanding of client's requirements h. Poor information use i. Uncertainty advises other stakeholders	**Inadequate Communication & relationship management skills** (Jena & Satpathy, 2017; Zuo et al., 2018; Gamil and Rahman, 2023, etc) a. Difficult to Understand clients' aspiration b. Inadequate Technical coordination c. Poor Oral skill d. Inability to chair the meeting e. Inadequate Interpersonal skill	**Instill Communication & relationship management knowledge** (Kamara et al., 1999; Krishna, 2023; Weippert et al., 2002; Wahyuni et al., 2018, etc) a. Structural engineering b. Town planning c. Civil engineering d. Quantity Surveying e. Landscape f. Interior design g. IT for construction h. Geotechnical engineering i. Mechanical engineering j. Electrical engineering

Theme	Types of obstacles	Root causes	Mitigation measures
Quality management	**Deficient in Quality assessment & management** (Salleh et al., 2016; Pressman, 2006; Alawag et al., 2023; Mari et al., 2019, etc) a. Delay reply queries b. Delay confirming alternative materials c. Unsure of alternative material proposal d. Inappropriate performance measurement e. Non-integrated project delivery f. Unable to keep track of inspection g. Poor site supervision and inspection h. Low priority to quality performance i. Searching for alternative building material j. Non-compliance to specification k. Inadequate site inspection	**Inadequate Quality assessment & management skills** (Allen & Iano, 2019; Mari et al., 2019; Alawag et al., 2023; Celadyn, 2020, etc) a. Inadequate Quality management b. Unable to resolve technical problem c. Inadequate Technical skill	**Instill Quality assessment & management knowledge** (Burati Jr et al., 1991; Alawag et al., 2023; Khodeir and Nessim, 2020; Bukola et al., 2018; Arditi and Gunaydin, 1997; Wong et al., 2007; Agbaxode et al., 2021, etc) a. Construction methods b. Building materials
Design management	**Deficient in Design Management** (Pooworakulchai et al., 2017; Mohammed, 2021; Cooper and Press, 1995; Gunduz et al., 2022, etc) a. Slow decision b. Poor specification c. Insufficient design detail d. Poor design management e. Unworkable detail f. Constant design changes g. Attending to client-drive design changes h. Design and detail error i. Construction complexities j. Impractical design k. Error design drawings	**Inadequate Design management skills** (Best, 2010; Gunduz et al., 2022; Latif Rauf & S Shareef, 2019, etc) a. Unable to Adapt changes b. Unable to Make a decision	**Instill Design management skills knowledge** (Best, 2010; Gunduz et al., 2022; Cooper and Press, 1995; etc)) a. Architecture b. Feasibility study

2.9 Relationship between obstacles-root causes-mitigation measures to develop building contract administration framework

Architectural practice is much more complex than was the case 60 years ago (Ostime, 2019). It is impossible to write in detail on such a wide subject but pinpointing the relevant sources for this and other allied subjects is doable (Chappell & Dunn, 2015). The expansion and the preceding recession assisted in spawning the emergence of graduate architects in nontraditional practice (Kavanagh & Miers, 2021).

Practice of architecture is complex and the knowledge required to plan, design, and administer the construction phase of a new building has always required a depth of knowledge but each year new building types, design concepts, materials, systems, digital tools, construction techniques, and many other important areas of technical knowledge have to be mastered by architects and graduate architects (Ostime, 2019a). Knowledge development in such areas as project management, and design management becomes important (Tilley, 2005; Gunduz et al., 2022).

During the deep building recession of the early 2008s graduate architects sought to regain a position in the design and construction industry (Ostime, 2019). Project delivery was a rallying point and new approaches were introduced that called for graduate architects to participate in building contract administration (Ostime, 2019).

However, projects have become more sophisticated in terms of the design and construction expertise required and processes have become more demanding in terms of information flow, coordination, and programming (Ostime, 2019). Graduate architects need to evolve to meet new expectations (Ostime, 2019a). Graduate architects began to adapt their practices, refining and improving their project delivery methods (Salleh et al., 2016).

Indication of the practice and procedure with which the graduate architects need to be acquainted is required if they are to follow their profession with success (Ostime, 2019). They must be responsible for a good deal of administrative work in connection with construction contracts and familiarize themselves with the law, the general structure of the construction industry, requirements of authorities who exercise control over their daily work (Demkin, 2001; Hayes, 2014; Jafari, 2021).

Graduate architects supporting BCA have to be effective managers of their projects by adopting a vast body of knowledge (Ostime, 2019). This knowledge is usually compressed into one course- a practical training course – for one semester. It is impossible to cover the architect's professional practice in any depth in one semester, but all graduate architects must get an introduction to the most important subjects so that they can gain the skills required to be effective professionals (Khodeir and Nessim, 2020).

A framework that presents concepts and other fundamental information that guide the day-to-day needs of graduate architects and other building design professionals will be essential (Khodeir and Nessim, 2020). The framework will consist of types of checklists, letter writing, and examples to illustrate necessary items in building contract administration (Khodeir and Nessim, 2020). It contains a comprehensive management framework for architectural practice, and management projects, and adheres to current standards, legislation, client requirements, and information on development and learning (Khodeir and Nessim, 2020). The content of the framework has been determined based on results from quantitative and qualitative methods. It can be used for a wide variety of purposes such as (Jafari, 2021),

1) Enhance project management abilities
2) Obtain guidance for running a project

3) Understand the legal aspects of the project

4) Support professional licensing exam

5) Find other sources of relevant practice information

There are many variables to develop the BCA framework. The variables formed by types of obstacles, root causes, and mitigation measures from the literature review have been categorized into independent variables (IV), dependent variables (DV), and mediation variables (MV). Each category of variables consists of different themes. Hence, the relationship between obstacles (IV) and mitigation measures (DV) through root causes (MV) will be analysed.

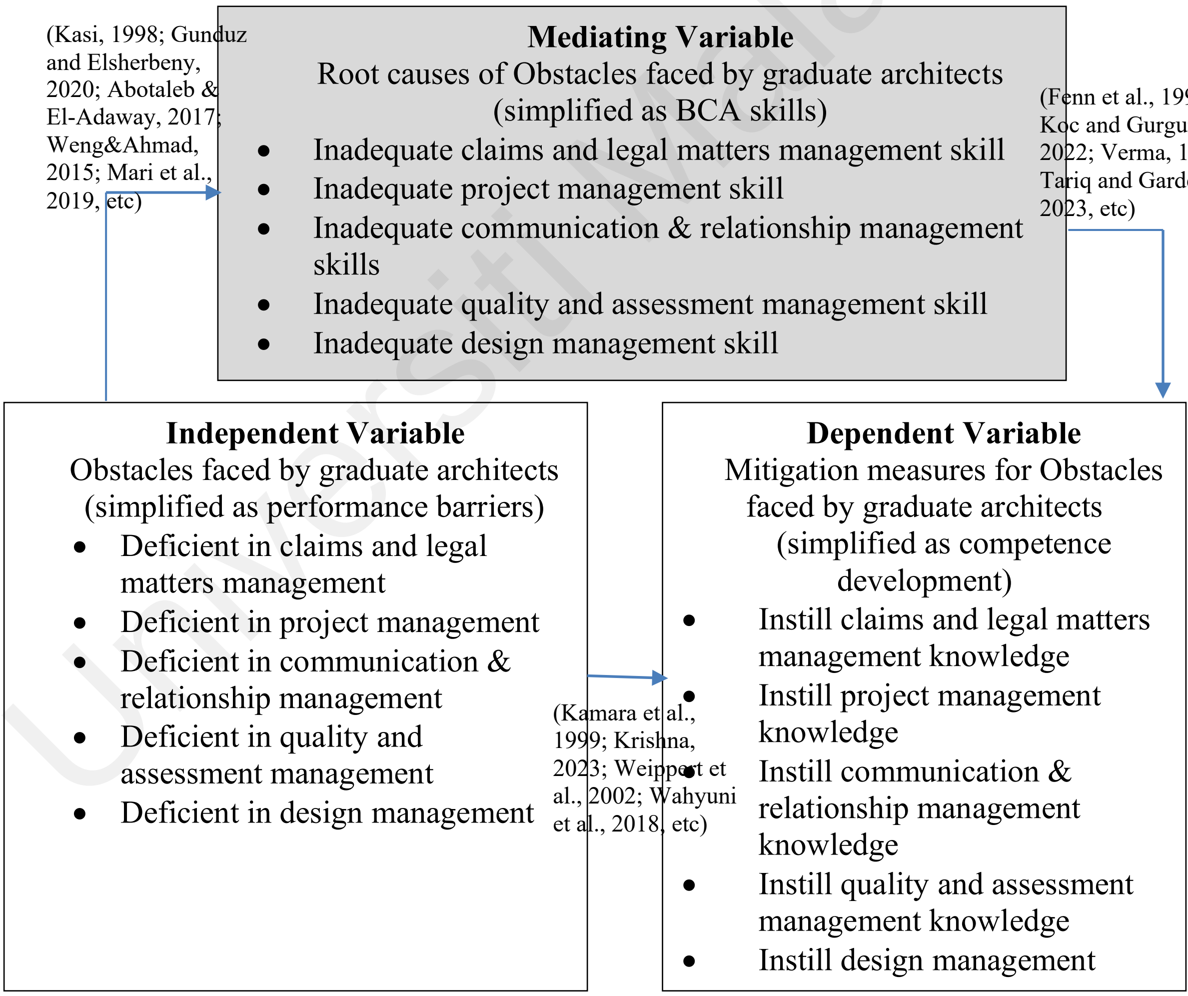


Figure 2.2: Summary of relationship among variables of obstacles (IV), root causes (MV), and mitigation measures (DV) extracted from literature review

2.10 Summary

The chapter has furnished literature on variables that affected the work performance of graduate architects while supporting BCA of housing projects in Malaysia as shown in Figure 2.2. It has covered topics regarding construction in Malaysia, housing development and policy in the nation, the problem of housing projects in Malaysia, types of contracts, construction project teams, the role of building contract administrator, involvement of graduate architects, and their performance in support of BCA of housing projects in Malaysia. Literature reviews on types of obstacles faced by graduate architects while supporting BCA work, root causes of obstacles, mitigation measures for the obstacles, relationship between types of obstacles, root causes, and mitigation measures found in the literature review have been discussed in detail. All variables were identified from the literature review. The next chapter presents and discusses about research methodology adopted for this study.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter presents the mixed methodology that was applied during the research, where the quantitative method was used to collect data for RO1-RO4, and the qualitative method was used to collect data for RO5. In the quantitative method, there are a total of 127 completed surveys collected. In the qualitative method, 7 housing projects at Klang Valley have been selected as case studies, 11 types of archive documents have been reviewed, and 20 participants have been selected for semi-structured interviews. In light of this, this chapter explained the areas of study, the reasons that underpin the choice of area, the research design and approach, the population, sample, and sampling procedures, how instruments were validated, and how data was collected and analysed.

3.1 General concept of Research methodology

There are many issues and subjects which have incomplete knowledge. Research is to fill the incomplete knowledge and increase the performance of human life (Walker, 1997), by learning and sharing the process which closely related to or something the researcher is passionate about (Creswell & Creswell, 1994), or seeks the answer of certain questions which have not been answered. It is the most important process for advancing knowledge promoting progress and enabling man to relate more effectively to his environment to accomplish his purpose and resolve his conflicts (Walker, 1997). The research provides a way of establishing, formulating, and strengthening revising theory (Walker, 1997). Researchers will learn and find new things advancing knowledge through conducting research (Walker, 1997).

Research philosophy is the set of beliefs, assumptions, and principles that underline the way researcher approach their study (Fellows et al., 2021). There are 3 types of research philosophy/paradigms: positivism, interpretivism, and pragmatism.

1) Positivism refers to hard science, direct results based on quantitative data, and knowledge obtained through objective observations and measurements (Fellows et al., 2021).
2) Interpretivism based on qualitative methods, understands people's lived experiences.
3) Pragmatism is focused on the potential usefulness and applicability of the research findings based on mixed methodology (Fellows et al., 2021).

The research philosophy for this study is pragmatism where the quantitative method is used to collect data for RO1 – RO4 to determine the sub-themes and sequence arrangement framework while the qualitative method is used to collect data for RO5 to determine the content framework.

Research methodologies are certain assumptions made by researchers about how they will learn and what they will learn during their inquiry (Creswell & Creswell, 1994). Philosophically, researchers make claims about what is knowledge (ontology), how we know it (epistemology), what values go into it (axiology), how we write about it (rhetoric), and the processes for studying it (methodology) (Creswell & Creswell, 1994).

The selection of research methodology depends upon the nature of the research problem (Walker, 1997). There are two basic methodological traditions of research in social science, namely positivism and post-positivism (phenomenology) (Walker, 1997.

Positivism studies the role of the researcher limited to data collection and interpretation where the research findings are usually observable and quantifiable (Walker, 1997). Hence, positivism is more closely associated with the quantitative method of analysis (Walker, 1997).

1) The quantitative approach included elaborate structural equation models that incorporated causal paths and the identification of the collective strength of multiple variables using experiments and surveys. Experiments include random assignment of subjects to treatment conditions, as well as quasi-experiments that use nonrandomized designs (Keppel, 1991).
2) Surveys include cross-sectional and longitudinal studies using questionnaires for data collection, with the intent of generalizing from a sample to a population.

Post-positivism emphasizes theories, hypotheses, background knowledge and values of the researcher can influence what is observed, and requires a qualitative approach (Walker, 1997; Noor, 2008). The qualitative approach includes the following (Baden and Major, 2023):-

1) Ethnographies in which the researcher studies an intact cultural group in a natural setting over a prolonged period by collecting observational data (Creswell & Creswell, 1994);
2) Ground theory is when the researcher attempts to derive a general, abstract theory of a process, action, or interaction grounded in the views of participants in a study;
3) Case studies in which the researcher explores in depth a program, an event, an activity, a process, or one or more individuals;

4) Phenomenological research is in which the researcher identifies the essence of human experiences concerning a phenomenon, as described by participants in a study, and narrative research where a form of inquiry in which the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives. This information is retold by a researcher into a narrative chronology.

Mixed methods research is a method for collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies to better understand research problems (Creswell & Creswell, 2003). The advantage of collecting both forms results in quantitative data yielding generalizable trends and qualitative data providing in-depth voices and experiences of individuals within specific settings or contexts (Schoonenboom, 2023). Procedures for conducting mixed methods research can be classified into four types (Schoonenboom, 2023):

1) Quantitative and qualitative data could be combined to: use results from one method to elaborate on results from the other method (complementary);
2) Use results from one method to help develop or inform the other method (development);
3) Recast results or methods from one method to questions or results from the other method (initiation); and
4) Extend the breadth or range of inquiry by using different methods for different inquiry components (Creswell & Creswell, 2003).

3.2 Justification Selection of study and research methods

This section describes the justification for selecting graduate architects, private housing development, strata housing type, and construction phase as focus research. There is less analysis of graduate architects' data regarding work performance. Evaluating this data specifically focusing on the graduate architects supporting the building contract administration work will provide valuable insight into how to improve graduate architects' work performance in the future.

3.2.1 Reason for selecting graduate architects for this research

Building contract administrator plays a major part as he/she is the one who leads the consultants' team to ensure the end product meets the requirements (Gunduz and Elsherbeny, 2020).

The building contract administrator is typically granted considerable powers, and numerous responsibilities and is required to carry out various duties by the provisions of the contract (Lau, 2020). They are the agents of the employer and carry out various decision-making functions to exercise independent judgment and act fairly between the contracting parties (Ostime, 2022). Attributes of building contract administrators are important as they will determine the success/failure of a project (Gunduz and Elsherbeny, 2020). The architect is the building contract administrator for the PAM contract. As the number of architects in Malaysia is insufficient, 1:15000 compared to the UNESCO standard, 1:4000 to 1:8000, and the number of housing development is increasing, architects rely heavily on graduate architects to support their building contract administration work (Mari et al., 2019). Graduate architects were then seen taking extensive duties in BCA (Salleh et al., 2016). GA with minimum 2 years working are selected to match criteria of LAM for part III professional exam. Therefore, this research selected graduate architects with minimum 2 years experiences as a focus study.

3.2.2 Reason for selecting Private housing developments for this research

Based on statistics from the National Housing Departments (2020), there are 85,946 house units approved for construction as of January – September 2020. From this quantity, only 4616 units were government housing units (Lau, 2020). The majority of the housing units belong to private development (Lau, 2020). Hence, private developers are the major contributors to providing housing units to fulfill the market demand in Malaysia (Lau, 2020). The selection of private housing development is interrelated with the standard forms of contract applicable for the construction.

The standard form of contract is a pre-printed form with a set of terms and clauses drafted by a professional for use in the construction project (Berema et al., 2023). The standard form of the contract contains terms and agreements (clauses) between the employer and contractor including rights, obligations, responsibilities, and work to be done (Berema et al., 2023). The employer acts as the owner of the project while the contractor acts implementer of the project (Berema et al., 2023). The standard of form contract consists of three sections namely (Berema et al., 2023):

1) The articles of agreement that spell out the overall information of the contract include when the contract is being formed, the parties in the contract, the scope, value, location, period of the contract, the definitions and interpretation of words, and phrases in the contract and the attestation space that act of witnessing the signing of the contract.
2) The condition of contract is the main body of the standard form of contract that spells out in particular clauses laying down the rights and obligations of the parties in the contract. All of the clauses are presented in a numbered format for ease of reference.

The clauses include the usual performance required from each contracting party, rules/procedures for conducting the contract, dealing with disputes, and terms of payment to the contractor.

3) The appendix contains the essential contract particulars such as the contract period, completion date, defect liability period, and the rates of liquidated damages. For some clauses, the default values will apply if there are no values made for example if no defect liability periods are inserted, then it will be 12 months

In Malaysia, most private sector housing projects are carried out using Pertubuhan Arkitek Malaysia (PAM) forms of contract which are administered by the '**Architect**'(Berema et al., 2023). Hence, the selection of private housing development as a focus study.

3.2.3 Reason for selecting Strata Housing for this research

The individual title is an ownership document issued to the sole owner of an entire piece of land reserved for landed properties such as semi-D houses, terrace houses, and bungalows (Kathitasapathy et al., 2023). Strata title is defined as a development or scheme where the building or land is carved out into different parcels (Ismail, 2023). This includes high-rise residences such as flats, apartments, condominiums, townhouses, and gated/guarded communities (Md Dahlan, 2018). Strata ownership allows optimum use of available land while simultaneously spreading the cost of construction (Hussin, 2006). Besides that, the strata title is to encourage more efficient construction of buildings and better utilization of land resources in the vicinity of densely populated metropolitan areas which was expensive and short supply (Kathitasapathy et al., 2023).

This research selected strata housing instead of individual housing because strata housing is much more complicated and complex compared to individual title housing (Chai and Yusof 2013). There are more components, more budget, and more time required to complete and the chances of rework are high for the strata housing projects (Chai and Yusof 2013). Rework is defined as an unnecessary effort of re-doing a process or activity which incorrectly completed for the first time (Asadi et al., 2021).

Developers of strata housing projects desire to achieve the project as soon as possible based on the market demand causing consultants to suffer time constraints for the preparation of tender drawings (Amarkhil et al., 2023). Severe issues occurred during construction due to a lack of complete design (Amarkhil et al., 2023). In addition, the contract documents for strata housing are more comprehensive, detailed, and complicated compared to landed housing (Amarkhil et al., 2023). Hence, this research selected the strata housing project as the scope of the study.

3.2.4 Reason for selecting the Construction Phase for this research

The housing development process involves three main stages which are the process of the pre-construction process (planning phase), followed by the construction phase, and finally, the post-construction phase (Nuruddin et al., 2015). Pre-construction process (planning phase) includes purchasing of land, land use conversion and subdivision, preparation of various plans, such as subdivision, earthwork, layout, building, engineering, and landscape, and approval of various plans (Sufian et al., 2008). The construction phase includes the commencement of work on-site, site progress, and work completion (Sufian et al., 2008). Post-construction phase includes vacant possession and defect liability period etc (Nuruddin et al., 2015).

This research selected the construction phase because this is the stage where the role of the building contract administrator requests the most assistance from graduate architects to deliver the project safely, to the specified quality standards, on time, and within the employer's budgetary constraints (Salleh et al., 2016). The building contract administrator relied on graduate architects to ensure the various project team members were aware and carry out the procedures set out in the contract during construction that concerns (Ostime, 2022):

1) Effectively managing day to day running of the project
2) Paying the contractor by the contract
3) Dealing with and valuing variations
4) Expediting timely completion of the project
5) Ascertaining and evaluating contractor's delay and loss and expense claim
6) Implementing prescribed supply chain procedures
7) Ensuring prescribed and necessary insurance is in place
8) Implementing procedures in the event of employer or contractor default or insolvency
9) Avoiding and resolving disputes

3.3 Research Methodology Framework

The process for conducting this research is divided into 5 main research stages. Figure 3.1 describes the research process and Figure 3.2 describes the research methodology framework for the study. Each stage of the research process is discussed in the following sections.

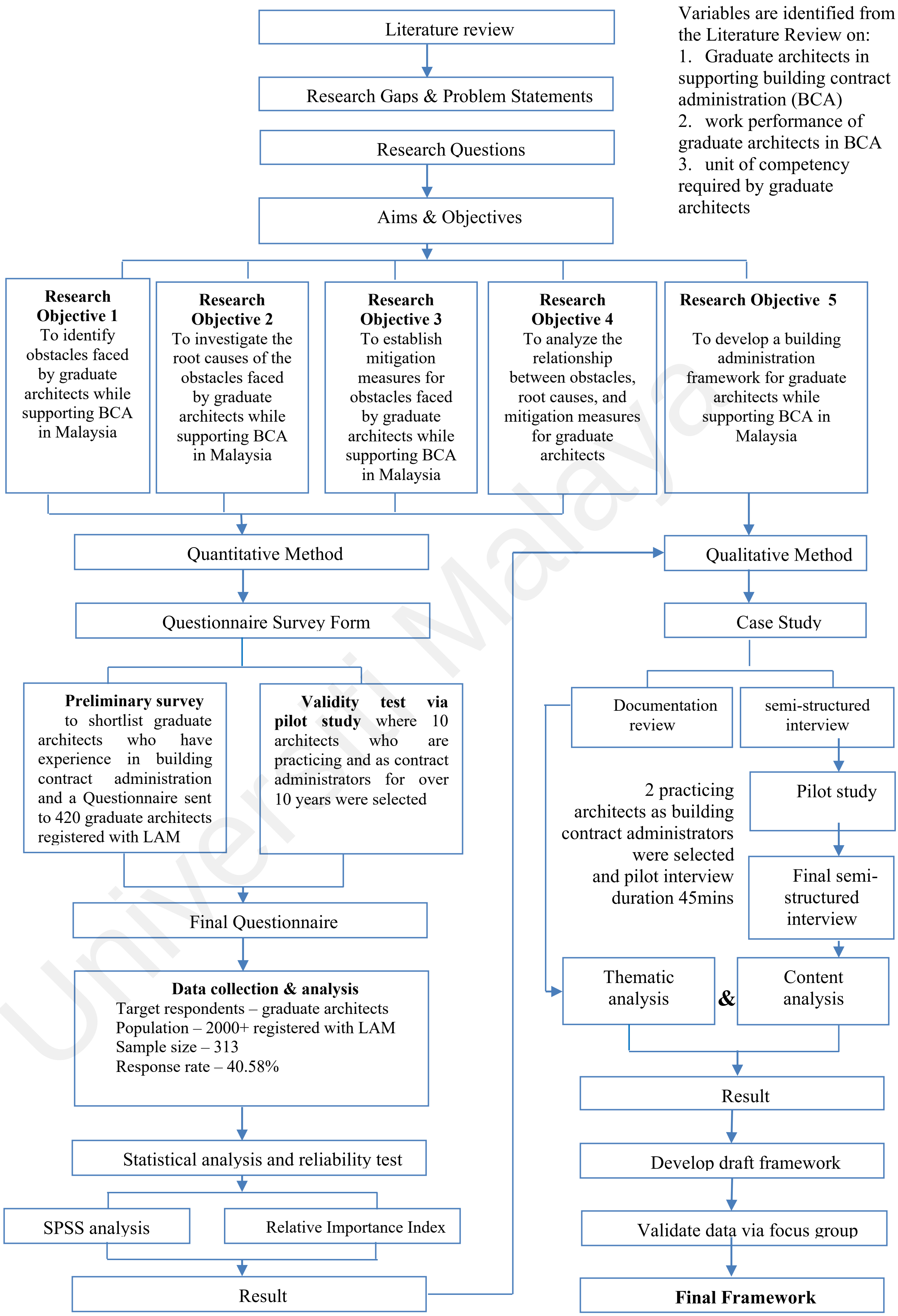


Figure 3.1: Research process diagram

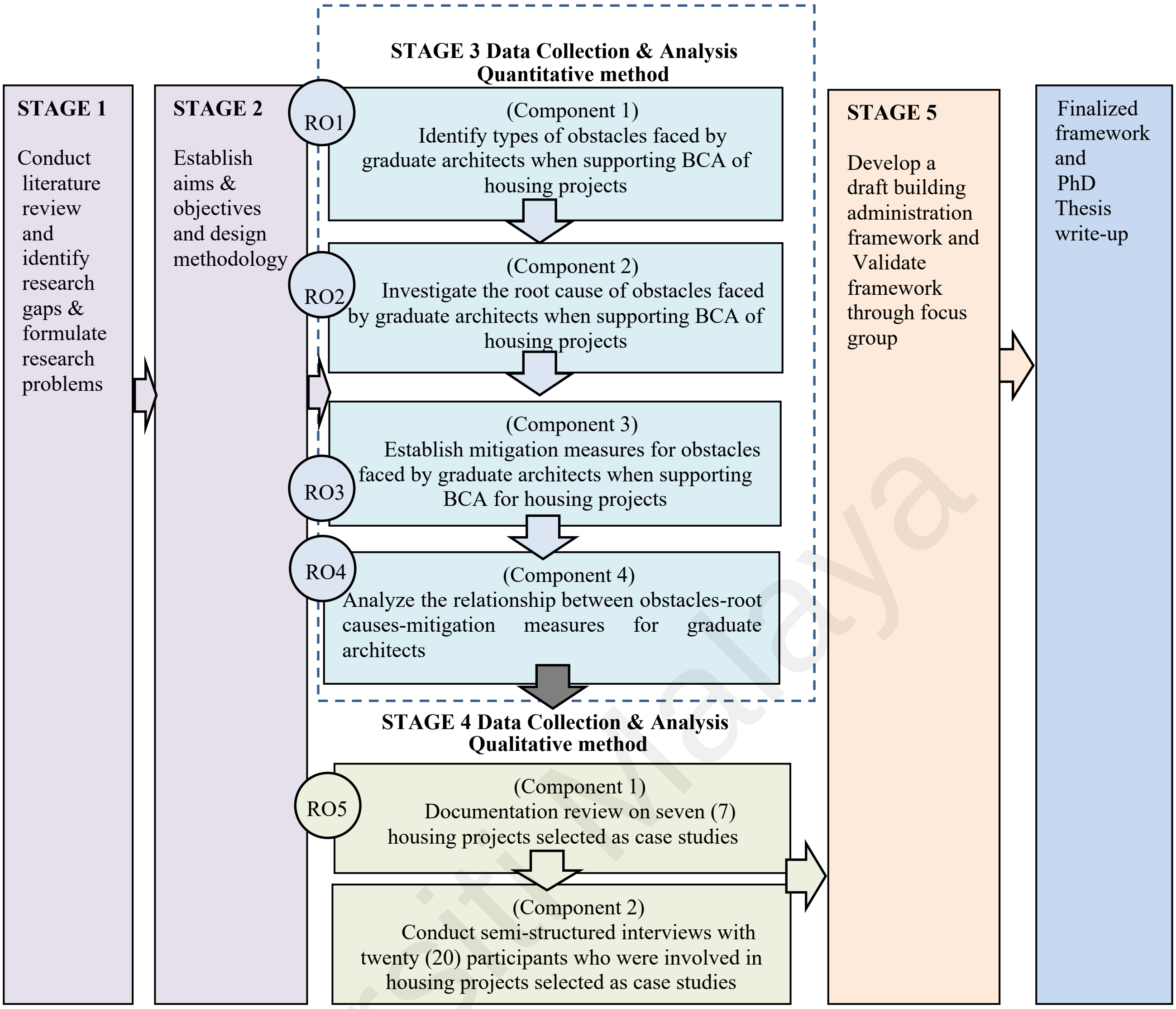


Figure 3.2: Diagram of the overall Research Framework
(Source: Author)

3.3.1 Stage 1 – Conduct a literature review and formulate research gaps & problem statements

A literature review is a well-planned review to answer specific research questions using a systematic and explicit methodology to identify, select, and critically evaluate the results of the studies included in the literature review (Rother, 2007).

Research gaps are identified after the literature review is conducted. There are a few points to identify research gaps which include listing the anomalies such as something that is not addressed in previous research about the chosen dependent and independent variables. Demarcate the variables of previous research based on location of study, population, unit of analysis, research philosophical paradigms, research approach, data collection methods, data collection time frames, sample size, sampling technique, and data analysis techniques.

The research problem is the issue being addressed in a study. The issue can be a difficult or conflict to eliminate, a condition to be improved, a concern to handle, a troubling question, or a theoretical or practical controversy that exists in the scholarly literature (Younas et al. 2023). Cresswell & Cresswell (2003) defined a research problem as a general education issue, concern, or controversy addressed in research that narrows the topic. Some research articles include the research problem in a passage called problem statement. Locating the research problem could be accomplished by asking the following questions:

1) What was the issue, problem, or controversy that needs to be addressed?
2) What controversy leads to a need for this study?
3) What was the concern being addressed behind this study?
4) Is there a sentence like "The problem addressed in this study is….."?

Problem formation begins with the determination of the questions that guided the literature review (Arias-Castrillón, 2020). These questions should be influenced significantly by the goal and focus of the review (Younas et al., 2023). The next step in problem formation is to explicitly determine the criteria for which articles to be included in the reviews and which articles to be excluded (Randolph, 2009).

The problem formulated in this research is graduate architects faced obstacles while supporting building contract administration of housing projects in Malaysia. There are various types of obstacles that hinder their work performance and subsequently cause hiccups in the overall work progress on site. To resolve the obstacles, root causes of the obstacles are to be investigated and mitigation measures for the obstacles faced by graduate architects need to be established based on local context. Later, the relationship between the types of obstacles, root causes, and mitigation measures is to be analysed to determine the sub-theme of the building contract administration framework for graduate architects. Hence, the research topic is established as 'Developing a Building Contract Administration Framework For Graduate Architects Managing Housing Projects'.

3.3.1.1 Systematic Literature Reviews

This research adopted a systematic literature review to summarise the available evidence with little or no bias on the types of obstacles, root causes, and mitigation measures of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. A systematic literature review is a well-planned review to answer specific research questions using an organized and explicit methodology to identify, select, and critically evaluate the results of the studies including the literature review (Rother, 2007). The adopted review process for this study is based on the recommended Rother et al. (2007).

(a) Review Question(s)

The research objectives are to investigate the types of obstacles, root causes, and mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. The review questions are as follows: -

1) What types of obstacles that graduate architects face while supporting BCA of housing projects in Malaysia?

2) What causes this obstacle to the graduate architect while supporting BCA of housing projects in Malaysia?
3) How to mitigate the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?
4) What is the relationship between the obstacles, root causes, and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?
5) How to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?

(b) ***Inclusion and Exclusion criteria***

The inclusion criteria were defined to include the following: -

1) All articles that are related to the graduate architects' current practice in the construction industry and the obstacles/root causes/mitigation measures relevant to BCA.
2) All available journals or conference papers or theses that are related to the obstacles/root causes/mitigation measures for obstacles in supporting BCA in housing projects during the construction phase.

The list was refined by establishing four selection criteria for exclusion:

1) The research was focused on project management in other industry
2) Literature was written in a language other than English
3) Research on the perceived obstacles/root causes/mitigation measures for obstacles by other non-construction professions was disregarded.
4) Studies of obstacles/root causes/mitigation measures faced in other phases, excluding the construction phase

(c) ***Search Strategy***

The initial step was to identify the relevant literature through searches of several databases (ISI Web of Science, SCOPUS, and Google Scholar), combining the following series of keywords and search terms: 'graduate architect', 'construction industry', 'building contract administrator', 'building contract', 'obstacles', 'root causes obstacles', 'mitigation measures obstacles', and 'architects'. This literature was supplemented by publications in the reference lists of the initial database.

(d) ***Screening***

The screening process includes the following: -

1) The results obtained from the database search were listed based on relevance.
2) Each article's title and abstract were checked to determine their relevance.
3) Relevant articles were saved to a specific folder using a reference management program (end note version 1.02103540).
4) The total number of relevant articles and types was recorded.

(e) ***Results of search***

The search results are described in Chapter 2.

(f) ***Data Extraction***

The data that have been extracted from multiple research articles require organization into themes for ease of reference. The content is divided based on different themes and is organized based on descriptive metrics for each reported case of obstacles, root causes, and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia.

(g) ***Quality/Rigour Evaluation***

The sources of articles that have been collected include books, book sections, conference papers, journal articles, and theses that suggest the different levels of rigor that influence the findings. Hence, they are all taken into consideration for this study.

(h) ***Synthesis***

The content of each article was read, analysed, and categorised into a theme or subtheme that is relevant to the research as shown in Figure 3.3.

(i) ***Reporting Findings***

The findings of the systematic review are reported in the following chapter.

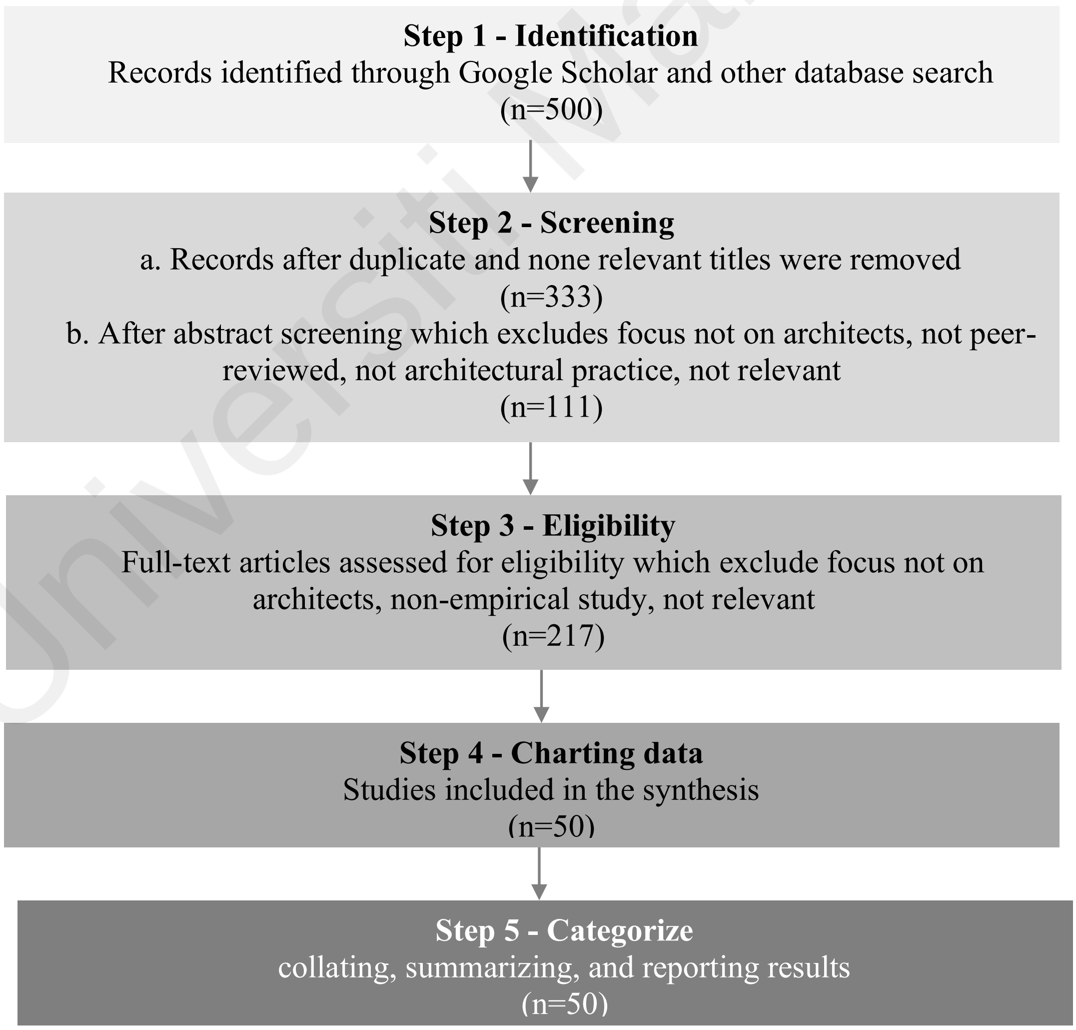


Figure 3.3: Study eligibility flow chart
(Source: Author)

3.3.2 Stage 2 – Establish Aim & research objectives and design methodology

Stage 2 of the research was the establishment of the research aim, objectives, and design methodology after the research gaps were clearly defined. The research aims, and objectives mentioned in Chapter 1 lead the research from the beginning to its completion.

3.3.2.1 Research Aim

According to Beckhingham (1974), the research aim is a statement on why a particular study is being conducted. The goal of a study might be to identify or describe a concept or to explain or predict a situation or solution to a situation that indicates the type of study to be conducted (Niiniluoto, 1993). In this research, the author focused on enhancing the performance of graduate architects while supporting BCA of housing projects in Malaysia.

3.3.2.2 Research Objectives

Research objectives are more specific than the aim and relate directly to the research question (Niiniluoto, 1993). Research objectives could be divided into primary and secondary objectives which cover all aspects of the problem, are specific, ordered in a logical sequence, achievable, and have taken into consideration the available resources, including time and mutually exclusive of each other (Niiniluoto, 1993). Research objectives are stated using action verbs that can be evaluated (Niiniluoto, 1993). Johnson & Christensen (2014) offer five typical research objectives: exploration, description, explanation, prediction, and influence.

1) Exploration involves using mainly inductive methods to discover a concept, construct, phenomenon, or situation and advance understanding, hypotheses, or generalizations.

2) Description involves identifying and describing the antecedents, and nature of a phenomenon.
3) The explanation involves developing a theory to explain the relationship among concepts or phenomena and determine reasons for the existence of events.
4) Prediction refers to using pre-existing knowledge or theory to predict what will occur at a later point in time.
5) Influence relates to the manipulation of the setting or variable to produce an anticipated outcome.

Criteria for setting research objectives according to Yin (2009) studies are:

1) Specific – be exact about what is going to be accomplished
2) Measurable – quantify the objectives
3) Appropriate – align with the needs of the target audience
4) Realistic – resource available to make objective happen
5) Time – duration to achieve the objective

The objectives of this research are:-

1) To identify types of obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia
2) To investigate the root causes of obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia
3) To establish mitigation measures for obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia
4) To analyze the relationship between obstacles, root causes, and mitigation measures for graduate architects supporting BCA of housing projects in Malaysia

5) To develop a building contract administration framework to resolve the obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia

3.3.2.3 Design Methodology

Research methods consist of three elements: the forms of data collection, analysis, and interpretation that the researchers propose for their studies (Sekaran and Bougie, 2016). The researcher may use quantitative methods like close-ended questions in data collection and use statistical analysis and interpretation methods to get the overall results (Sekaran and Bougie, 2016). Alternatively, the researcher may use qualitative methods like open-ended questions or interviews to collect data and use text and image analysis or themes and patterns interpretations to get the overall results (Sekaran and Bougie, 2016). Researchers also mix different methods to collect, analyze, and interpret data to get their results (Walker, 1997). Hence, a research design tends to be quantitative, qualitative, or mixed-method (Walker, 1997).

According to Creswell & Creswell (2003), different scenarios explain how the three elements make a specific research design. Selecting one design over the other depends on the objectives of the study, the researcher's personal experiences, and the research's audience (Walker, 1997).

In this research, a mixed-method design was selected to identify the obstacles, investigate the root causes, establish the mitigation measures, and analyze the relationships between obstacles, root causes, and mitigation measures to develop a BCA framework to resolve obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia.

Reason for selecting mixed methods research

This research involves quantitative and qualitative methods that are relatively complete on their own and used together to form essential components for this research (Sekaran and Bougie, 2016). Thus, each study is planned and conducted to answer a particular sub-question, and the results of the research are triangulated to form a comprehensive whole and each method maintains its worldview (Sekaran and Bougie, 2016). A quantitative method was chosen to collect data for types of obstacles (RO1), root causes of obstacles (RO2), mitigation measures for the obstacles (RO3), and the relationship between obstacles, root causes, and mitigation measures (RO4) for graduate architects while supporting BCA of housing projects in Malaysia because of the following:-

1) Samples are large and results are taken as if they constituted a general and sufficiently comprehensive view of the entire population
2) Focuses on objectivity
3) Variables are quantifiable measures
4) To determine the sub-themes and the sequence of arrangement in the BCA framework

A qualitative method was chosen to collect data for developing a draft building contract administration framework (RO5) due to:-

1) The information required needs to be more realistic than unable to experience numerical data and statistical analysis used in quantitative research
2) Provide a holistic view of the phenomena under investigation
3) Ability to interact with the research subjects in their language and terms

Both quantitative and qualitative methods are used to solicit information from the respondents to develop the building contract administration framework. The quantitative part of the research included two research questionnaires. The preliminary questionnaires to qualify respondents and the final questionnaires to quantify respondents. The reason for selecting the quantitative method first is to have general a understanding of the problems (types of obstacles), source of problems (root causes), and solution (mitigation measures) for the issue involved in data collection in Malaysia through large sampling, able to achieve the original objectives of the research, able to investigate casualty between different research phenomena and data obtained are consistent and reliable.

After the quantitative method, the results obtained had been used as an indication to investigate case studies which are the qualitative method to develop the content of the draft building contract administration framework. This method is selected because RO5 requires direct information on the context of the situation where the studied phenomenon occurs, encourages evolving and continuous investigation of the research phenomenon, and outcomes are not limited to those outlined in the original research proposal and the structured format.

3.3.3 Stage 3 – Data Collection & Analysis – Quantitative method

The quantitative method was used to answer RO1, RO2, RO3, and RO4 and the analysis of numerical data was performed through statistical procedures, using SPSS and Relative Important Index. Data was collected for 4 different research components to answer the research questions and objectives.

Component 1: To identify types of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. The types of obstacles were categorised into 5 themes: deficient in claims and legal matters management, deficient in project management, deficient in communication and relationship management, deficient in quality and assessment management, and deficient in design management.

Component 2: To investigate types of root causes of the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. The root causes were categorised into 5 themes: inadequate claims and legal matters management skills, inadequate communication and relationship management skills, inadequate project management skills, inadequate design management skills, and inadequate quality and assessment management skills.

Component 3: To establish mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. The mitigation measures were categorised into 5 themes: instill claims and legal matters management knowledge, instill project management knowledge, instill communication and relationship management knowledge, instill quality and assessment management knowledge, and instill design management knowledge.

Component 4: To analyze the relationship between obstacles, root causes, and mitigation measures for graduate architects supporting BCA of housing projects in Malaysia. Understanding the relationship between these variables determined the sub-theme to develop the building contract administration framework.

3.3.3.1 Selection of Respondents

In this research, a purposeful sampling method was used. The reason for the preference of this method is to gather more detailed information regarding the perception of types of obstacles, root causes, and mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. To select respondents for purposeful sampling, a particular criterion has been identified. The criterion for selecting respondents is as follows:-

1) The graduate architect who registered with Lembaga Arkitek Malaysia
2) The graduate architect who has worked 2 years and above in the construction industry;
3) The graduate architect who supported BCA during the construction phase
4) Graduate architect who manages strata housing projects

The following had been excluded: a. those who do not meet the above criteria; b. those who are not willing to participate in the study.

A sample design is a definite plan determined before any data are collected for obtaining a sample from a given population (Holton and Burnett, 2005). Samples can be probability samples or non-probability samples (Roopa & Rani, 2012). With probability samples each element has a known probability of being included in the sample which is those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling; non-probability samples are those based on convenience sampling, judgment sampling, and quota sampling techniques (Holton and Burnett, 2005).

Krejcie and Morgan (1970) stated that an appropriate sample size is required to represent the research population. They tabulated to determine the sample size from a given population to ease future researchers(Krejcie & Morgan, 1970). Krejcie and Morgan used the following formula to determine the sampling size:

$$\mathbf{s = X^2 NP(1\text{-}P)/d^2(N\text{-}1) + X^2P(1\text{-}P)}$$

s = required sample size
X^2 = the table value of chi-square for one degree of freedom at the desired confidence level
N = the population size
P = the population proportion (assumed to be .50 since this would provide the maximum sample size)
d = the degree of accuracy expressed as a proportion (.50)

Purposive sampling was used to select an accessible population of 2444 graduate architects registered under the Board of Architects in Malaysia as of December 2020. By Architect's Act 1967, graduate architects are defined as those who possess Part II accreditation in Architectural education and are registered with the Board. Based on Krejcie and Morgan's (1970) table for determining sample size, for a given population of 2444, a sample size of 331 would be needed to represent a cross-section of the population.

3.3.3.2 Preliminary questionnaire survey

A preliminary questionnaire survey was conducted to quantify respondents for this research. This approach was employed in this research because of the size of the population and the geographical spread covering the whole country. An email survey was identified as the suitable solution as respondents could be easily approached with minimum cost and fit to Coronavirus Disease 2019 (COVID) movement control conditions. It was important to carry out the preliminary questionnaire survey to identify graduate architects who have experience in supporting BCA housing projects in Malaysia.

The main objective of the preliminary questionnaire survey was to shortlist graduate architects who are involved in building contract administration for housing projects in Malaysia. Three fixed-choice questionnaires were prepared: *1. Are you supporting building contract administration work? 2. Do you manage strata housing projects? 3. Have you worked more than 2 years in the industry*? Questionnaires were sent to four hundred and twenty (420) graduate architects registered with Lembaga Arkitek Malaysia (LAM) through emails where they registered their contact in LAM's website. They are required to reply YES for graduate architects who have experience in supporting BCA of housing projects and NO for those who do not have any experience in supporting BCA of housing projects. The survey started on 2nd March 2022. A period of two (2) months was allocated to receive replies from the graduate architects. After sending reminder emails, there are a total of 343 replies, **81.67%.**

Two hundred and five (205) graduate architects replied to the questionnaire on 1st attempt, one hundred and thirty-eight (138) graduate architects replied after reminders, sixty-eight (68) graduate architects did not reply and nine (9) graduate architects had invalid email addresses. Out of three hundred and forty-three (343) graduate architects who replied only three hundred and thirteen (313) have experience in supporting BCA of housing projects. The summary of the details about the administration of the preliminary questionnaire survey is given in Table 3.1.

Table 3.1: Response Rate Preliminary Survey

Item	Description	Frequencies
1	Number of preliminary questionnaires sent out	420
2	Preliminary questionnaire returned on 1st attempt	205
3	The preliminary questionnaire was returned after a reminder	138
4	The preliminary questionnaire was returned due to an invalid email	9
5	Total returned preliminary questionnaire	343
	Percentage returned the preliminary questionnaire	81.67%
6	Respondents valid for final questionnaires	313
7	Percentage respondents qualify for final questionnaires	**74.52%**

The scope of this study is limited to graduate architects who support BCA of housing projects. From the total 420 preliminary surveys emailed out, we only received three hundred and thirteen (313) completed responses. This number of respondents is unable to fulfill the requirement based on Krejie and Morgan's table (1970).

However, Sekaran and Bougie (2009) noted that the return rates of online survey questionnaires are typically low. A response rate of 30 percent from the ideal respondent number 331 is acceptable for the research (Sekaran & Bougie, 2016). In other words, the response rate for an online survey should not be less than 30 percent to ensure its adequacy (Hoxley, 2008). Referring to the calculation, 30% of the total 331 equal 99.3 respondents. Hence, the minimum sample size for this research should be 100. The population of the study complied with the response rate as stated in Sekaran and Bougie (2009).

3.3.3.3 Pilot Study

A pilot study is a small sample, quantitative study conducted as a prelude to a larger-scale study or clinical trial (Teijlingen and Hundley, 2001). A pilot study has similar methods and procedures to the larger future study which yields data to help justify the larger study or test procedures for it (Teijlingen and Hundley, 2001). It is a small exploratory study and is designed to guide future studies (Teijlingen and Hundley, 2001). According to Morin (2013), a pilot study is conducted to test the adequacy, the level of ease at which respondents are able to complete the questionnaire without any problem, and the comprehensiveness of the identified obstacles with the help of the selected experts. In addition, the clarity of language, appropriateness, and logic of questions, as well as the relevance, complexity, layout, order, length, ease of navigation, and user-friendliness of the whole questionnaire should be examined during the pilot study (Morin, 2013).

The literature review and preliminary consultation with experts formed the basis of the questionnaire. Not all the variables found in literature reviews were captured in the final questionnaire as they are duplicate information, unclear terms, subjective terms, and incomplete sentences identified. Hence, a pilot study was carried out before finalizing the main questionnaire. Ten practicing architects who have been building contract administrators for more than 10 years in strata housing projects have been selected for a pilot study.

This pilot survey assisted in offering the respondents the opportunities to add further obstacles/root causes and mitigation measures required beyond the points identified in the literature to enable the construction of a robust list of building contract administration obstacles, root causes, and mitigation measures for the final questionnaire to suit the local context. The final version of the questionnaire done after includes modifications and shortenings according to the comments obtained in the pilot study. The summary of comments and suggestions for the pilot testing is as per Table 3.2 and Table 3.3.

Table 3.2: Comments and suggestions for pilot testing

No	Section	Remarks
1	Title	To be more captivating and attention-seeking to attract respondents to reply
2	Section A General information	To incorporate the definition of building contract administration, assistant architect, and project architect
3	Section C Types of obstacles during supporting the building contract administrator	To avoid more than one variable in the questionnaire to avoid confusion There are unclear term usage, incomplete sentences, subjective terms used, duplication of information, and usage of more than one variable. Hence, variables have been modified for better understanding. Refer to 'Remarks' in Table 3.3
4	Section D Root causes of the obstacles during supporting the building contract administrator	To add one question related to quality and assessment management skill One variable has been modified for better understanding. Refer to 'Remarks' in Table 3.3

Table 3.3: Summary of Variables after the pilot study

Theme	Types of obstacles	Root causes	Mitigation measures
Claims & Legal matters management	**Deficient in Claims & Legal matters management** a. Poor contract management knowledge, b. Discrepancy of contract forms, (Remarks: Unclear term usage. Hence, replaced with **Discrepancy in contract documentation**) c. Unaware of legal policy, d. Unclear building contract (Remarks: Subjective term used which is not advisable. Hence, to be deleted)	**Inadequate Claims & Legal matters management skill** a. Inadequate Conflict management skill	**Instill Claims & Legal matters management knowledge** a. Construction contract law b. Authority approving process

Theme	Types of obstacles	Root causes	Mitigation measures
Project management	**Deficient in Project management** ~~a.~~ Inexperienced (Remarks: Subjective term used which is not advisable. Hence, to be deleted) b. Lack of guidance and proper documentation c. Conventional management protocol d. Ineffective management e. Incomplete Documentation during award (Remarks: Duplication of info. Hence, replaced with **Incomplete documentation**)	**Inadequate Project management skill** a. Poor Writing skill b. Poor Project management	**Instill Project management knowledge** a. Project management b. Financial planning c. Valuation studies d. Environmental studies
Communication & relationship management	**Deficient in Communication & relationship management** a. Miscommunication (Remarks: Unclear term usage. Hence, replaced with **Communication breakdown**) b. Lack of information (Remarks: Incomplete term used. Hence, to be deleted) c. Lack of coordination (Remarks: Incomplete sentence, Hence, replaced with **lack of coordination between project stakeholders**) d. Design degradation (Remarks: subjective term being used which is not advisable. Hence to be deleted) e. Lack of information on drawings f. Incomplete design information (Remarks: Similar to 'lack information on drawings'. Hence, to be deleted) g. Lack of understanding of client's requirements h. Poor information use (Remarks: Unclear term usage. Hence, replaced with **misunderstanding terms**) i. Uncertainty advise other stakeholders (Remarks: subjective term used which is not advisable. Hence, to be deleted)	**Inadequate Communication & relationship management skills** a. Difficult to Understand clients' aspiration b. Inadequate Technical coordination c. Poor Oral skill d. Inability to chair the meeting e. Inadequate Interpersonal skill	**Instill Communication & relationship management knowledge** a. Structural engineering b. Town planning c. Civil engineering d. Quantity Surveying e. Landscape f. Interior design g. IT for construction h. Geotechnical engineering i. Mechanical engineering j. Electrical engineering

Theme	Types of obstacles	Root causes	Mitigation measures
Quality assessment & management	**Deficient in Quality assessment & management** a. Delay reply queries b. Delay confirm alternative materials (Remarks: Similar with delay reply queries. Hence to be deleted) c. Unsure of alternative material proposal d. Inappropriate performance measurement (Remarks: Unclear term usage. Hence, replaced with the **absence of a clear uniform standard of work acceptance**) e. Non-integrated project delivery f. Unable to keep track of inspection (Remarks: Subjective term used which is not advisable. Hence, to be deleted) g. Poor site supervision and inspection (Remarks: Subjective term used which is not advisable. Hence, to be deleted) h. Low priority to quality performance (Remarks: Subjective term used which is not advisable. Hence, to be deleted) i. Searching alternative building material (Remarks: Incomplete term used. Hence, to be deleted) j. Non-compliance to specification (Remarks: Unclear term usage. Hence, replaced with **unfamiliar with building specification**) k. Inadequate site inspection	**Inadequate Quality assessment & management skills** a. Inadequate Quality management b. Unable to resolve Technical problem (Remarks: Incomplete sentence. Hence, replaced with resolve technical problem) c. Inadequate Technical skill	**Instill Quality assessment & management knowledge** a. Construction methods b. Building materials

Theme	Types of obstacles	Root causes	Mitigation measures
Design management	**Deficient in Design management**	**Inadequate Design management skills**	**Instill Design management knowledge**
	a. Slow decision b. Poor specification (Remarks: subjective term used which is not advisable. Hence, to be deleted) c. Insufficient design detail d. Poor design management (Remarks: a subjective term used which is not advisable. Hence, to be deleted) e. Insufficient design (Remarks: similar with insufficient design detail. Hence, to be deleted) f. Unworkable detail g. Constant design changes h. Attending to client-drive design changes i. Design and detail error (Remarks: Usage of more than one variable. Hence, replaced with **design error**) j. Construction complexities (Remarks: a subjective term used which is not advisable. Hence, to be deleted) k. Impractical design (Remarks: subjective term used which is not advisable. Hence, to be deleted) l. Error design drawings (Remarks: subjective term used which is not advisable. Hence, to be deleted)	a. Unable to Adapt changes b. Unable to Make a decision	a. Architecture b. Feasibility study

3.3.3.4 Final questionnaire survey

The final questionnaire survey was chosen for the main data collection. The reasons why a mailed questionnaire survey (by Google form sent via email) was selected as the method for final data collection are as follows:

1) It allowed the collection of information easily and efficiently
2) The general configuration of the survey enables the collection of respondents' email address and limit the answers
3) Able to obtain unlimited questions and answers at no cost
4) Simple interface and is easy to use
5) The questionnaire can be completed at the respondents' convenient

The disadvantage of mailed questionnaires is participants may misinterpret items on the survey due to a lack of clarification from the researcher.

The final questionnaire survey was emailed to three hundred and thirteen (313) respondents who passed the preliminary survey. However, we only received 127 completed surveys.

3.3.3.5 Distribution of the final questionnaire

Some of the comments during the pilot survey were incorporated in the final version of the questionnaire, which was distributed on 28 March 2022. A sample of the final questionnaire is shown in the Appendix. The questionnaire was in the form of a link emailed to a total of three hundred and thirteen (313) respondents.

After one month, twenty-seven (27) completed questionnaires were returned. Reminder emails were sent to respondents who did not reply. The following month after the reminder, the number of completed questionnaires increased to one hundred and thirty (130). Filtration was undertaken to scrutinize the questionnaire that could be used to form a database for the final data analysis. One hundred and twenty-seven (127) questionnaires were identified as appropriate to be used for the final data analysis. Table 3.4 shows the response rate for the present study. The detailed analysis and results of the final survey are presented in Chapter 4 of the thesis.

Table 3.4: Response rate final questionnaire

Item	Description	Frequencies
1	Number of questionnaires sent out	313
2	Total returned questionnaire	130
3	Incomplete questionnaire returned	3
4	Complete questionnaire returned	127
5	Valid percentage returned	**40.58%**

3.3.3.6 The design and content of the final questionnaire survey

A structured questionnaire was employed to identify the obstacles before investigating the root causes to establish measures to mitigate the problems in local context as per Table 3.5, Table 3.6, and Table 3.7. The online questionnaire was built in Google Form and comprised of 5 sections according to the theoretical framework. This structure was adopted to avoid confusion for respondents and to ensure a smooth flow of the questions. The sections comprised:

Section A **Demographic**

This section is about the profile of respondents in terms of study background, job position, and respondents' experience in administering building contracts in housing projects

Section B **Project Information**

This section examined the projects, particularly in detail

Section C Types of obstacles faced by graduate architects while supporting building contract administration of housing projects in Malaysia

This section contained 5 themes that were adopted from several authors.

Table 3.5: Questionnaire development for types of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

No.	Types of obstacles	References
C1	**Deficient in claims and legal matters management** *Consists of information related to building contracts and authority submission*	
C1.1	There is a correct procedure for managing the building contract	(Niazai & Gidado, 2012)
C1.2	Discrepancy in the contract documents and contract drawings is a norm	(Abotaleb & El-Adaway, 2017)
C1.3	It is difficult to follow the latest amendments required by authorities as they constantly changing	(Demkin, 2001)
C2	**Deficient in project management** *Consists of information related to project documentation*	
C2.1	It is difficult to reply to contractor's queries within the time frame	(Love & Edwards, 2004)
C2.2	It is easier to have a personal filing system rather than an office standard	(Ajator, 2017)
C2.3	Proper storage of documents according to office standard protocol is important	(Romano & Nunamaker, 2001)
C2.4	It is difficult to retrieve documents stored in the office	(N. Stanton, 1990)
C3	**Deficient in communication and relationship management** *Include attributes and personality traits that assist in interaction with others and success in the workplace. Examples include the ability to communicate with prospective clients, mentor co-workers, lead a team, negotiate a contract, follow instructions, and get a job done on time*	
C3.1	Communication breakdown among project stakeholders will delay the work progress	(Kavanagh & Miers, 2021)
C3.2	A low attendance rate for technical meetings will cause a lot of design discrepancies among consultants	(Asadi et al., 2021; Dinakar, 2014; Yap et al., 2017; Ye et al., 2015)
C3.3	Difficulty in understanding terms used by contractors when discussing design details	(Zerjav & Ceric, 2009)
C3.4	Graduate architects should be able to answer client's queries regarding their opinion on construction matters	(Emmitt & Gorse, 2009)
C3.5	Unable to obtain information will cause the contractor to make their assumptions during construction	(Urrutia, 2021)
C4	**Deficient in Quality and assessment management** *Quality planning, quality assurance, and quality control*	

C4.1	The end product constructed should be similar to the design stage	(Love & Edwards, 2004)
C4.2	The workmanship acceptance standard is unclear as not stated in the contract	(Nicol & Pilling, 2000)
C4.3	The end product usually differs from the version presented to the client	(Ndekugri & Rycroft, 2014)
C4.4	Understanding building specifications incorporated into sales and purchase agreements is important	(Ayodeji et al., 2016)
C4.5	Understanding what to inspect during the site walk is important	(Tzonis, 2014)
C5	**Deficient in Design management** *Involve coordination of all the design work required during construction projects, manage the production of technical drawings and plans used to build a structure*	
C5.1	It is difficult to convince clients to adopt a design solution proposal	(Love et al., 2004)
C5.2	The contractor frequently requests for design detail drawings	(Aiyetan, 2013)
C5.3	Clients often request to redesign certain building elements during construction	(Warnock, 2019)
C5.4	Request variation order is a norm during construction	(Warnock, 2019)
C5.5	Contractors often highlight unworkable designs found in drawings	(Gunduz & Elsherbeny, 2020)

Section D Root causes of the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

This section measures the root causes of obstacles in work performance for graduate architects. In this study, these variables become the dependent variable. There were five (5) themes identified where the root causes are inadequate certain types of skills among graduate architects.

Table 3.6: Questionnaire developed for root causes of the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

No.	Types of root causes of obstacles	References
D1	**Inadequate claim and legal matters management skill**	
D1.1	Art of conflict management is required to resolve possible disputes that arise between contractor and client *e.g. strategies that allow two disputing parties to work toward a mutually satisfactory agreement*	(Alias et al., 2012; Murdoch & Hughes, 2002)

D2	**Inadequate project management skill**	
D2.1	Written skills (e.g. letter writing, meeting minutes, report writing) are required for better performance when running a project	(Alias et al., 2012; N. Stanton, 1990)
D2.2	Project management skills are required to do a good job *e.g. leadership, ability to negotiate and resolve conflicts, building commitment with team*	(Alias et al., 2012)
D3	**Inadequate communication and relationship management**	
D3.1	Understanding clients' aspirations is important to avoid numerous changes requested at a later stage *e.g. clear about the client's expectation*	(Alias et al., 2012)
D3.2	Technical coordination skills are important for better interaction among project stakeholders *e.g. ability to manage efficiently, quickly, and purposefully design in construction*	(Alias et al., 2012)
D3.3	Oral skills are important for running projects more efficiently *e.g. active listening, asking for clarification*	(Alias et al., 2012)
D3.4	The ability to chair project meetings is crucial *e.g. client consultant meeting, site meeting*	(Alias et al., 2012)
D3.5	Interpersonal skills are crucial for the project to run smoothly *e.g. behaviours and tactics people use to interact with others effectively*	(Alias et al., 2012)
D4	**Inadequate quality and assessment management skill**	
D4.1	Quality management skill is required to monitor work progress more efficiently *e.g. act of overseeing all activities and tasks that must be accomplished to maintain a desired level of excellence*	(Alias et al., 2012)
D4.2	Resolving technical problem skills is important *e.g. act of defining a problem, selecting alternatives, and implementing a solution*	(Alias et al., 2012)
D4.3	Technical skills are required to resolve site issues	(Alias et al., 2012)
D5	**Inadequate design management skill**	
D5.1	The skill to adapt to changes is important *e.g. proactive make the most of changes to benefit your organisation*	(Alias et al., 2012)
D5.2	Skills to make decisions are required to advise clients accordingly e.g. *reasoning, intuition*	(Alias et al., 2012)

Section E Mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

This section describes mitigation measures in the form of knowledge instilment to resolve the root causes of obstacles that exist in work performance for graduate architects. In this study, these variables become the instrument to improve the work performance of graduate architects. The items were adapted from several authors. There are five (5) themes identified where the mitigation methods are to instill certain types of knowledge among graduate architects.

Table 3.7: Questionnaire developed to mitigate the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

No.	Types of mitigation measures for obstacles	References
E1	**Instill claim and legal matters management knowledge**	
E1.1	It is important to know the authority approving process for better project planning *e.g. submission of DO/BP/permit*	(Alias et al., 2012; Murdoch & Hughes, 2002)
E1.2	It is important to know construction contract law when managing a project *e.g. law that deals with matters relating to building construction, engineering, and related fields*	(Alias et al., 2012)
E2	**Instill project documentation knowledge**	
E2.1	It is important to know project management (all aspects) to do a good job *e.g. project time management, project cost management, project quality management, project resource management, project risk management, project communication management, etc*	(Alias et al., 2012)
E2.2	It is important to know valuation studies for ease of advising clients when required *e.g. assessment of benefits brought by something about the resources needed to achieve it*	(Alias et al., 2012)
E2.3	It is important to know financing planning to control estimated costs during construction *e.g. cost plan to control estimated costs during the construction phase of the project*	(Alias et al., 2012)
E2.4	It is important to know environmental studies for better site management control *e.g. dust generation, noise pollution, operations with vegetation removal, air pollution*	(Alias et al., 2012)

E3	**Instill communication and relationship management knowledge**	
E3.1	It is important to know structural engineering when discussing solutions for construction issues *e.g. physics of nature such as wind, and water on buildings, the effects of gravity, and the weight of the structure*	(Alias et al., 2012)
E3.2	It is important to know Town Planning for Development Order (DO) submission *e.g. process of managing land resources*	(Alias et al., 2012)
E3.3	It is important to know electrical engineering services for better coordination between project stakeholders *e.g. electrical systems for buildings, transport systems, and power distribution networks*	(Alias et al., 2012)
E3.4	It is important to know Mechanical engineering services for better coordination among project stakeholders *e.g. related to plumbing / fire-fighting / ACMV system etc*	(Alias et al., 2012)
E3.5	It is important to know quantity surveying when conducting site valuation *e.g. all aspects of construction costs, financial and contractual administration*	(Alias et al., 2012)
E3.6	It is important to know interior design to check whether the ID design matches with building's *e.g. transforming newly developed buildings into inhabitable places for residents*	(Alias et al., 2012)
E3.7	It is important to know the Landscape to check whether the landscape design matches with building's *e.g. initiating site improvement, Indigenous vegetation, installing a drainage system*	(Alias et al., 2012)
E3.8	It is important to know geotechnical engineering (e.g. engineering behaviors of the earth and materials	(Alias et al., 2012)
E3.9	It is important to know civil engineering during construction *e.g. proper knowledge of different tests of building materials*	(Alias et al., 2012)
E3.10	It is important to know IT for construction e.g. REVIT, BIM when managing a project	(Alias et al., 2012)
E4	**Instill quality and assessment management knowledge**	
E4.1	It is important to know construction methods for ease of inspection during site walk *e.g. procedure and techniques used during the building process – bricklaying, plastering, skim coating, etc*	(Alias et al., 2012)

E4.2	It is important to know building materials to detect substandard materials on-site *e.g. knowledge of selection available materials, technical properties, sustainability and experiential qualities and ways of processing the required materials and tools*	(Alias et al., 2012)
E5	**Instill design management knowledge**	
E5.1	It is important to know architecture when preparing a design solution proposal *e.g. architecture design, a design decision*	(Alias et al., 2012)
E5.2	It is important to know the feasibility study before preparing a design proposal *e.g. assess the financial viability of developed land and whether it will be a success or failure*	(Alias et al., 2012)

There are several forms of questions asked in a questionnaire, such as open-ended items or close-ended items. In this study, close-ended questions that include multiple choice questions and Likert-scale questions were used. Saunders et al.(2009) stated that close-ended questions are simple and easy to answer for respondents meanwhile assisting researchers to code the information easily for data analysis (Sekaran & Bougie, 2016). A sample of multiple-choice questions is stated as follows:

How many housing projects that you have managed throughout your career?
[ ] Below 3 projects [ ] 3 projects [ ] 4 projects [ ] 5 or above projects

In Likert-scale questions, researchers arrange the choices on a continuum, with extreme positions at the endpoints. Five(5) points scale is the most used scale in the questionnaire (Sekaran & Bougie, 2016). For this questionnaire, the importance of each type of obstacle was rated on a five-point scale, where 1 represents ‘of little important’ and 5 represents ‘very important’. Simultaneously the graduate architects were also asked to rate the level of criterion of competency on a five-point scale, where 1 represents ‘of little important’ and 5 represents ‘very important’.

Of little important	1	2	3	4	5	*Very important*
	○	○	○	○	○	

Reason for selecting the Likert Scale Questionnaire

Likert scale instruments are used to measure psychological constructs that are linguistic, affective, or personality-based, and they are conceptualized as extending from one extreme to another – low to high, small to large, negative to positive, or weak to strong. The 5-point Likert scale is comparatively easier to understand, ideal scale for big surveys, and fabricates better data distribution. This research did not use 7 points Likert scale as it concerned more options that make respondents weary and distracted which could impact the responses of the respondent.

The starting point for questionnaire development is to arrive at a thorough understanding of the target construct, primarily by reading academic literature on the topic. Other advantages of Likert scale questionnaire are:

1) Data can be gathered relatively quickly from large numbers of respondents
2) Provide highly reliable personal ability estimates
3) Validity of the interpretations from the data could be established through a variety of means
4) Data provided could be compared, contrasted, and combined with qualitative data-gathering techniques

The questionnaire consists of a total of 67 questions: 6 demographic questions, 5 project information questions, 22 obstacles-type questions, and 33 root causes and mitigation measures questions. The duration to complete the whole questionnaire survey took about 10 minutes. Although there were 67 questions, the questionnaire was set out clearly with an applicable margin, a suitable font size, and spacing. All the questions were arranged systematically to minimize the length of the questionnaire.

The first page provided instructions to the respondents on how to complete the survey. It provided information about the study title, aims, participation criteria, information about the kind of questions that respondents would be asked during the survey, how the confidentiality of collected data would be assured, etc. After demographic information was collected, respondents were asked to rate the importance of the types of obstacles that hinder their performance, the root causes of the obstacles, and mitigation measures for the obstacles based on their perception relation to support BCA. Data had been evaluated using sub-dimension means, with a high score indicating that the relevant sub-dimension is a career obstacle / main root cause / effective mitigation measures (Chenail, 2011).

All participants were informed of the study purpose, their participation was voluntary, and withdrawal was allowed at any time without penalization or loss of benefits. Agreement to participate was assumed based on returning the completed questionnaire. Other standard ethical guidelines (e.g. protecting the anonymity of the participants and the confidentiality of the data) were also followed.

3.3.3.7 Analysis Quantitative Data

The data collected from the survey of this study were analysed using the Microsoft Excel application and Statistical Package for the Social Sciences (SPSS). SPSS is a statistical package that undertakes both comparison and correlational statistical tests in the context of univariate, bivariate, and multivariate analysis for both the parametric and non-parametric statistical techniques (Subramani & Rajiv, 2016). This research selected SPSS instead of AMOS, PLS or other software is due to SPSS is user-friendly, and could be conducted with various statistical tests. Table 3.8 summarizes the method used for statistical analysis using SPSS.

Table 3.8: Statistical analysis using SPSS

Method	Purpose
Data screening test	To test whether the data collected is close to the mean or data spread out over a large range of values
Normality test	To determine whether a sample data has been drawn from a normally distributed population
Reliability test	To test the consistency a test measures characteristics and determines the quality of the research
Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity	To examine the appropriateness of factor analysis based on a sample study
Factor analysis	To reduce or summarize a large number of variables in different smaller factors that made up of the initial set of variables
Pearson correlation test	To measure relations between two continuous variables
Multi collinearity Diagnosis	To diagnose the presence of inter-association or inter-relation between two or more independent variables in a model
Multiple Linear regression	To test if there is any statistical significance for the indirect effect and estimate the point effect

Data collected was analyzed using a data screening test, followed by a normality test, reliability test, preliminary tests, factor analysis, relative importance index, assumption tests, and mediation analysis.

3.3.3.8 Data screening Test

The respondents' input was screened against careless responses and outliners. The careless response pattern for which a respondent might indicate the same response option for several consecutive items, while outliers indicate observations that are different or dissimilar. Careless responses were measured through standard deviation and group rating in comparison to average factor ratings.

3.3.3.9 Normality Test

A normality test was conducted to assess the data distribution. The normality of data for this research was examined by Skewness and Kurtosis. Skewness measures the balance or lack of balance in the data. Kurtosis exhibits normal distribution and measures its symmetry or lack thereof. Based on a study done by Garson (2012), data is considered normal distribution when the skewness value is near zero and the kurtosis falls within the range of ±3.0.

3.3.3.10 Reliability Analysis

In line with the advice of many social scientists, a Cronbach's Alpha coefficient of reliability should be calculated when using the Likert scale in a questionnaire, to determine the consistency of the factor and criteria contained in the questionnaire. The aim is to confirm whether the factors and criteria and their associated Likert scale are measuring the construct that was intended to measure, which is a type of obstacles, root causes, and mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects. By using the SPSS software, the Cronbach's alpha coefficient can be computed and obtained easily.

Cronbach's Alpha coefficient is usually between 0 and 1; as a rule of thumb, George and Mallery (2019) suggested that a value of 0.7 is acceptable, while 0.8 indicates good internal consistency. Meanwhile, Sekaran and Bougie (2009) stated that a coefficient less than 0.60 is considered poor reliability (Nunnally, 1978).

3.3.3.11 KMO Measure and Bartlett's test of Sphericity

To ensure suitability for conducting factor analysis, this research used the Kaiser-Meyer-Olkin (KMO) index and Barlett's test of sphericity. The KMO test measures the adequacy of a sample in terms of the distribution of values for the execution of factor analysis.

Bartlett's test of sphericity must be significant ($p<0.05$) indicating the presence of relationships among variables, and the KMO index should have a minimum value of 0.50 to indicate an adequate level of sampling adequacy (Pallant, 2020). Both of the test's acceptable values should be greater than 0.5. Bartlett's test of sphericity determines if the correlation matrix is an identity matrix. If there exists any identity matrix, factor analysis is meaningless.

3.3.3.12 Factor analysis

Factor loadings are the correlations of the variables with the factor. High factor loading implies that the factors and variables are critical. To determine the number of factors, both the eigenvalues approach and the percentage of variance approach were used. In the eigenvalues approach, factors with relatively large eigenvalues are ignored. One criterion that has been suggested is that the eigenvalues for a factor greater than 1.00 should be retained. For the percentage of variance approach, all of the factors extracted should account for at least 60% of the total variance. Based on this rule, the scree plot and initial eigenvalues for this research are referred to.

As there are 3 sections in this research, the scree plot and eigenvalue approaches are divided into types of obstacles, root causes of obstacles, and mitigation measures for obstacles faced by graduate architects.

3.3.3.13 Pearson's correlation Test

Pearson's correlation coefficient ® is the most widely used correlation statistical to measure the degree of the relationship between two variables. Different studies show that the correlation coefficient of two variables greater than 0.8 is described as a strong relationship, whereas a correlation less than 0.5 is a weak relationship between categorised variables (Hair et al., 2010).

3.3.3.14 Multicollinearity Diagnostics

The primary objective of regression analysis is to understand how each independent variable and the dependent variable interact. Multicollinearity refers to the correlation of numerous independent variables in a model. Multicollinearity increases the standard errors on the coefficients, which later makes the coefficients statistically non-significant. To detect multicollinearity, the Variance Inflation Factor (VIF)with its tolerance value was examined to detect the multicollinearity problems. Hair et al. (2019) proposed multicollinearity was a concern if the VIF value is more than 5 and the tolerance value is less than .20.

3.3.3.15 Analysis Using Descriptive Statistic

The research design was later analysed using frequency distribution and relative importance index after factor analysis because multiple attributes are highly correlated with no apparent reason, complicate the naming of the factors, and data-driven structure without theory.

3.3.3.16 Frequency distributions and descriptive statistic

Statistical simplification involving computing frequencies for most nominal and ordinal data. Frequency distribution is a method to organize the data into categories, which is shown in table format. Since the data obtained from the questionnaire are nominal and ordinal data, frequency distributions were adopted for data analysis in this study. Frequency analysis is a part of descriptive statistics where it records the number of times an event occurs. Frequency analysis analyzes measures of central tendency, dispersion, percentiles, etc.

1) The measure of central tendency describes the set of data through a value that represents the central position within the data set, e.g. mean, median, and mode. Mean is the average value of the data set, median is the middle observation in the data set and mode is the value that occurs the most number of times in a data set.
2) The measure of dispersion reflects the variability of data within a data set. The most popular measures of dispersion used for frequency analysis are standard deviation, variance, and range.
3) Percentile values show what percent of values in a data set fall below a certain percent. Percentile values such as quartiles, deciles, and percentiles are commonly used in frequency analysis.

Reason for using frequency distribution for data analysis

Part of the research was analysed using the frequency distribution method. "Frequency" indicates the number of times a value occurs. The collected information is named as data and the reasons for selecting this method are:-

1) Displays the frequency of each data set in an organized way
2) Assist in finding patterns in data
3) Enable analysis of the data using measures of central tendency and variance

3.3.3.17 Relative Importance Index

The relative importance index (RII), is the mean for a factor that gives weight to the perceptions of respondents (Johnson and LeBreton, 2004). The factor with the highest weight has RII=1, while the next factor with lower weight has RII=2 (Johnson and LeBreton, 2004). RII value is calculated based on the formula below:-

$$RII = \sum W / (A * N)$$

W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case) and N is the total number of respondents. The higher the value of RII, the more impact on the obstacles, root causes, or mitigation measures for the graduate architects.

The result of responses is calculated and ranked using the Relative Index method which represents the strength of response from 0.2 to 1.0 for each statement where 1.0 indicates 100% rated very important by all respondents and 0.2 is 100% of little important variable. This technique using RII has been used by Holt (1995) in the same context of the application.

Reason for Using Relative Importance Index for Data Analysis

A ranking scale was used that integers in descending order. Data collected from the quantitative method is analysed using the relative importance index which is used to describe the relative importance of the specific types, causes, and measures based on the likelihood of occurrence and effect on the project. This approach has been adopted because:-

1) To rank the types of obstacles, root causes, and mitigation measures according to their relative importance.
2) The sequence arrangement of the framework is based on the ranking from the survey
3) Ease for reference on the relative importance of the types of obstacles/root causes/mitigation measures as perceived by the respondents and
4) Give an overall picture of the level of importance/effectiveness for the types of obstacles/root causes/mitigation measures for obstacles that hinder graduate architects' work performance in the Malaysia region.

3.3.3.18 Regression Analysis

Regression analysis is a statistical technique for estimating the relationship among variables that have reason and result relation. The main focus is to analyze the relationship between a dependent variable and one independent variable and formulate the linear relation equation between the dependent and independent variable. According to Higgins (2005), regression models with one dependent variable and more than one independent variable are called multiple linear regression. Sekaran & Bougie (2003) stated the R^2 explained the dependent variable which is known as multiple regression. The analysis estimates the unique contribution of each independent variable to the dependent variable and provides coefficients indicating the strength and direction of this relationship (J. M. Stanton, 2001).

In this research, data for multilinear regression analysis is obstacles (performance barriers), root causes (BCA skills), and mitigation measures for obstacles (competence development). Assumptions of linear regression analysis – normality, linearity, no extreme values, and missing value analysis were examined. The statistical significance of the regression model is the p-value which in this research should be less than 0.05 to conclude that the indirect effect between obstacles and mitigation measures via root causes of obstacles is statistically significant (p-value$\leq$0.05).

3.3.3.19 Mediation Analysis (process Hayes macro analysis)

The mediator is known as a process of method where the influence of an independent variable on the dependent variable is transmitted through a mediating variable. The mediator variable is affected by the independent variable (IV) and affects the dependent variable (DV). According to Hayes (2018), the process of macro analysis is used to analyze causal linkages to determine the extent to which variation in an independent variable leads to variation in a dependent variable.

This research has adopted the process of Hayes macro analysis to measure the relationship between variables for types of obstacles (IV) with types of variables for mitigation measures (DV) through the mediator effect from types of variables for root causes of obstacles (IV). To interpret the Hayes test result, $p<0.05$, indicates a significant mediation effect.

In Figure 3.3, all the variables for obstacles have been simplified as performance barriers (IV), all the variables for root causes of obstacles have been simplified as BCA skills (MV), and all the variables for mitigation measures have been simplified as competence development (DV). The simplified terms were determined based on variables from literature review.

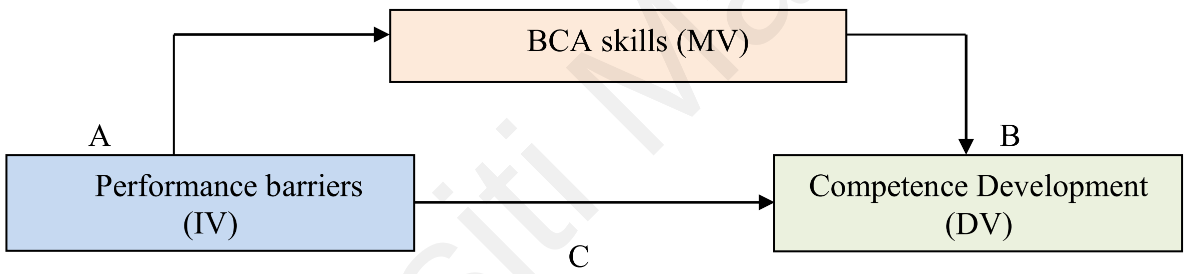


Figure 3.4: Mediation analysis diagram

The parameters of the framework is determined by significant variables. Hence, the relationship of the variables is analysed to determine which variables influenced the other variables. **The most significant variables found would be selected as the sub-theme to develop framework.**

3.3.4 Stage 4 – Data collection and analysis – Qualitative Method

Qualitative methods including case studies were adopted in this study. Yin (2009) stated that the qualitative method may be part of research to compare or validate the quantitative results. However, the reasons this research adopted the qualitative method to achieve RO5 are:

1) To provide an in-depth and interpreted understanding of the content of building contract administration framework of research respondents by learning about their experiences, perspectives, and histories
2) Samples are small in scale and purposively selected based on salient criteria
3) Close contact between the researcher and the research respondents is required for interactive and developmental and allows for emergent issues to be explored
4) The data required should be detailed, information-rich, and extensive
5) The analysis is open to emergent concepts and ideas that produce detailed descriptions and classifications or develop typologies and explanations
6) Outputs focus on the content of building contract administration framework through the interpretation of the social world of respondents.

A case study is a form of qualitative research that informs professional practice or evidence-informed decision-making in both clinical and policy realms. It allows the researcher to explore individuals or organizations, simply through complex interventions, relationships, communities, or programs (Yin, 2009) and supports the deconstruction and the subsequent reconstruction of various phenomena.

Reason for selecting case studies as a qualitative method

A case study has been described as an intensive, systematic investigation of a single individual, group, community, or some other unit in which the researcher examines in-depth data relating to several variables (Flyvbjerg, 2011).

This method of approach allows the researcher to take a complex and broad topic narrow it down into manageable research questions and increase the understanding of the complex phenomena in a natural setting (Flyvbjerg, 2011). By collecting qualitative data sets about the phenomena, the researcher gains more in-depth insight into the phenomena than would be obtained using one type of data (Flyvbjerg, 2011).

Case studies offer more complex and more detailed descriptions of phenomena than other conventional research designs (Yin, 2009). A multiple case study design was applied to allow for cross-case comparisons and inductive analysis of the phenomena to validate the contract administration framework (Flyvbjerg 2011). In addition, Graziano and Raulin (2010) noted that case studies provide information about events that have occurred and these records could be used to determine variables, observe contingencies, calculate correlations, and make predictions about future events based on those correlations. Therefore, the data obtained from case studies are suitable to insert into the draft building contract administration framework.

For this research, a case study is used as an illustration and assessment to explore how it met the aims of creating solutions that were purposeful and meet the demands of the profession in a supportive environment that fostered development (Yin, 2009). The case studies were selected if fulfill **ALL** the following criteria:

1) Suite apartments/service apartments under residential
2) Strata housing – high-rise buildings where the building height is more than 30m
3) Project under contract implementation and management phase/construction phase
4) Private development using PAM contract
5) The architect had been appointed as the building contract administrator

All case studies selected must fulfill all criteria as mentioned above. In Malaysia, there are a total of 2430 residential projects registered with KPKT in 2022. For those that are under construction, there are approximately 1000+ residential projects. Those that are not strata development, not high-rise buildings category, and do not apply PAM contract have been filtered. From the remaining, seven (7) ongoing housing projects that met ALL the above criteria had been chosen for this research as stated in Table 3.9.

Table 3.9: 7 Housing projects selected as Case studies

Name of Project	Location of Project	Size of Project
Project A	Kuala Lumpur	3 blocks 33 floors apartments
Project B	Kuala Lumpur	2 blocks 23 floors apartments
Project C	Petaling Jaya	1 block 31-storey service apartment
Project D	Kuala Lumpur	1 block 31-storey affordable apartment
Project E	Kuala Lumpur	2 blocks 42 storey service apartment
Project F	Kuala Lumpur	2 blocks 32-45 story service apartment
Project G	Kuala Lumpur	2 blocks 42 storey service apartment

Table 3.9 shows details of the seven selected housing projects as case studies. The housing projects selected are high-rise developments located in Klang Valley and amid construction. The housing projects were selected from Klang Valley as it can represent the massive development in the nation due to the fast-growing metropolitan with a dense population. These housing projects fall under strata development and the duration of completion for the development requires a minimum of 36 months. Developers selected the conventional type of contract – PAM 2006 (with/without quantities) to be implemented and the architect is the contract administrator.

From the housing projects selected as case studies for this research, two out of seven projects (project A and Project D) are low-cost housing, and other projects (project B, project C, project E, project F, and project G) are medium cost housing. Low-cost and medium-cost housing types were selected because they are the common type of housing in Klang Valley.

Variations in these seven case studies enhanced the validity of the research results and provided insight for future in-depth research. Due to privacy and confidential concerns, the names of buildings would be represented in alphabetical order.

Details of the case studies that include no. of blocks, story, types of building, GFA, no. of units, location, etc is shown in Table 3.10. These details are required to detect the similarity among the projects and they represent the general of strata housing developments in Malaysia. Project A to Project G are all strata housing projects, high rise category, minimum 1-3 blocks of 20-40 over-storey buildings. Gross floor area consists of 300,000 – 2,000,000 sqft with 200 – 2000 units. All selected case studies were located in Klang Valley with a construction period ranging from 30-72 months. Contract sum range from RM80,000 – RM80,000,000. Layout of the buildings are linear-form and there are all under construction projects.

Table 3.10: Detail of housing projects selected for case studies

	Project A	Project B	Project C	Project D	Project E	Project F	Project G
No. of blocks	3	2	1	1	2	2	2
No. of story	33	22-23	31	35	34	32-45	42
Types of building	Residential	Service apartment	Service apartment	Residential	Service apartment	Service apartment	Service apartment
Gross Floor area (sq ft)	2,280,635	485,199	377,813	450,286	692,205	830,090	649,861
No. of unit	2000	429	228	515	584	705	681
Location	Mukim Setapak	Mukim Kuala Lumpur	Mukim Sg. Buloh	Mukim Setapak	Mukim Batu, KL	Mukim Batu, KL	Mukim Batu, KL
Month of construction	36 months	72 months	27 months	25 months	72 months	30 months	30 months
Contract Period / Completion Date	15 August 2017 – 14 August 2020	15 August 2016 – 15 February 2021	8 December – 7 March 2019	8 June 2018 – 8 July 2020	1 November 2014 – 31 July 2021	3 August 2020 – 2 February 2023	8 March 2018 – 1 December 2021
Contract sum	310,191,993	Confidential	211,580,000	81,212,000	638,000,000	160,930,000	140,000,000
Building layout	L shaped	Cluster form	Linear	Linear	Linear	Linear	Linear
Current status	Under construction	Under construction	Under construction	Under construction	Under construction	Under construction	Under construction

3.3.4.1 Selection of archive documents

Eleven (11) types of archive documents regarding variables of obstacles (simplified as performance barriers) from case studies were reviewed. Table 3.11 shows documents selected are authority submission records, certification records, construction drawings, correspondence records, meeting minutes, request for information submittal forms, architect's instructions, method statements, design proposals, shop drawings, non-compliance records, material sample submissions, contract document/BQ, etc. The documents are categorised into 5 themes: claims and legal matters management, communication and relationship management, project management, quality and assessment management, and design management.

Table 3.11: Types of documents reviewed in case studies

Rank	Types of obstacles	Documents to review
1	**Deficient in Claims & Legal matters management**	
	1. Unaware legal policy – relevant to authority submission 2. Poor contract management knowledge – relevant to building certification 3. Discrepancy in contract documentation – relevant to the contract	**Authority submission record** – to understand types of submission required, checklist, submission process, etc **Certification record** – To understand the sequence of certification issued to avoid litigation claims in the future, certificate/event certificate
2	**Deficient in Communication & relationship management**	
	1. Communication breakdown – relevant to meeting 2. Lack of coordination between project stakeholders – relevant to coordination 3. Lack of information in drawings – relevant to coordination 4. Lack of understanding of client's requirements – relevant to coordination 5. misunderstanding terms – relevant to meeting	**Meeting minutes –** to understand the types of meetings and necessary content to be incorporated in minutes **Request for Information submittal forms –** To understand the types of coordination required to resolve discrepancies highlighted

Rank	Types of obstacles	Documents to review
3	**Deficient in Project management**	
	1. Conventional management protocol – relevant to contract documentation 2. Incomplete documentation – relevant to contract documentation 3. Ineffective management – relevant to letter writing 4. Lack of guidance proper documentation – relevant to contract documentation	**Correspondence record –** to understand the types of letters required when managing housing projects
4	**Deficient in Design management**	
	1. Insufficient design detail – relevant to the design brief 2. Constant design changes – relevant to building material 3. Design error – relevant to the design brief 4. Unworkable detail – relevant to the design brief **5.** Slow decision – relevant to the design brief	**Architect's Instruction –** To check on the variation order of design **Construction drawings** – To understand the types of drawings issued based on the drawing list
5	**Deficient in Quality assessment & management**	
	1. Inadequate site inspection – relevant to building details 2. Unfamiliar with the building specifications – relevant to the building details 3. Absence of clear uniform standard of work acceptance – relevant to the quality standard 4. Non-integrated project delivery – relevant to building details 5. Delay reply queries – relevant to contractors' submission	**Method statements, design proposals, shop drawings –** to understand about work sequence, counter proposal design, etc **NCR record** – to check on compliance of contract documents/specifications **Material sample submission** – to understand the types of material used for housing projects **Contract document/BQ** – to understand types of workmanship requirements or special requirements for work done

3.3.5 Documentation review

The documentation reviewed based on the 5 themes and reasons for reviewing are stated in Table 3.11. Details of claims & legal matters management, project management, communication and relationship management, quality assessment and management, and design management from each of the projects were explored below.

Claims & legal matters management –Types of authority submission and construction contracts were discussed in this section. Authority submission record and the comments received for each case study were reviewed such as from development order (DO), building plan submission (BP), amendment development order (ADO), amendment building plan (ABP), earthwork submission, road & drain submission, BOMBA passive and active submission, car park JPIF submission, IWK (PDC 1,2,6), AIR selangor submission, building name submission, postal address submission, SWCorp submission, temporary building permit, SKMM submission, internal plumbing, TNB submission, street lighting submission, telephone layout tapping submission, landscape submission, POS submission, SIFUS submission, COB submission, KMB submission, Borang B submission, hoarding and signboard submission were identified.

Meanwhile, issues recorded during the construction contract that have been reviewed include event certificates such as certificate of practical completion, certificate of non-completion, certificate of sectional completion, certificate of partial completion, certificate extension of time, certificate of making good defects, and payment certificates such as final certificate, interim certificate, penultimate certificate.

Project management – this section discussed contract documentation which includes a project quality plan, health and safety plan, logistic plan, schedule of shop drawing submission, schedule of material submission, schedule of proposed manpower, machinery & equipment, schedule of method statement submission, masterwork program, site organization chart, progress report format, certificate registration with CIDB, JKKP registration, project cash flow, list of subcontractor, etc. Information could be retrieved from the letter of appointment/letter of award of the main contractor.

Communication and relationship management – this section discussed letter writing, types of meetings, and coordination checklists which include architecture, civil & structure, mechanical, electrical and plumbing, landscape, interior design, etc. Information could be retrieved from the RFI (request for information) submitted by the contractor.

Quality assessment and management – this section discussed about types of non-compliance reports issued, types of material submission, and site inspection checklists from case studies. The importance of reviewing these documents is to tabulate a list of common errors made on-site for improvement in the future. Information could be retrieved from NCR issued to the contractor.

Design management – this sector discussed about the completeness of construction drawings issued based on the number of requests for information submitted by the contractors. The list of construction drawings consists of base drawings, waterproofing key plan & detail drawings, bathroom drawings, unit layout drawings, part plan drawings, M&E room detail drawings, architectural detail drawings, door, window, sanitary, ironmongery schedules, etc. Information could be retrieved from AI (architect's instruction) and RFI (request for information) submitted by the contractor.

There is information required for the development of the BCA framework but is not recorded in surveys or documents as showed in Table 3.12. Hence, semi-stuctured interviews were conducted to cover information lacking either from documentation review or questionnaire survey.

Table 3.12: Information required but lacked during documentation review

Rank	Types of obstacles	Documents to review	Information lack
1	**Deficient in Claims & Legal matters management**		
	1. Unaware legal policy 2. Poor contract management knowledge 3. Discrepancy in contract documentation	a. **Authority submission record** – to understand types of submission required, checklist, submission process, etc b. **Certification record** – To understand the sequence of certifications issued to avoid litigation claims in the future, certificate/event certificate	• Items to take note of during submission • Types of errors usually made during certification
2	**Deficient in Communication & relationship management**		
	1. Communication breakdown 2. Lack of coordination between project stakeholders 3. Lack of information in drawings 4. Lack of understanding of client's requirements 5. misunderstanding terms	**a. Meeting minutes –** to understand the types of meetings and necessary content to be incorporated in minutes b. **Request for Information submittal forms –** To understand the types of coordination required to resolve discrepancies highlighted	• Types of items that need to be recorded but often missed out in meeting minutes • Types of discrepancy that often occur in housing projects
3	**Deficient in Project management**		
	1. Conventional management protocol 2. Incomplete documentation 3. Ineffective management 4. Lack of guidance and proper documentation	**a. Correspondence record** To understand the types of letters require when managing housing projects	• The 'dos' and 'don't' when issuing letters
4	**Deficient in Design management**		
	1. Insufficient design detail 2. Constant design changes 3. Design error 4. Unworkable detail **5.** Slow decision	a. **Architect's Instruction –** To check on the variation order of design **b. Construction drawings** – To understand the types of drawings issued based on the drawing list	• Types of items that normally clients request to add-on/design enhance at a later stage • Types of design details/items that normally missed out during design

Rank	Types of obstacles	Documents to review	Information lack
5	**Deficient in Quality assessment & management**		
	1. Inadequate site inspection 2. Unfamiliar with building specification 3. Absence of clear uniform standard of work acceptance 4. Non-integrated project delivery **5.** Delay reply queries	a. **Method statements, design proposals, shop drawings –** to understand about work sequence, counter proposal design, etc b. **NCR record** – to check on compliance of contract documents/specifications c. **Material sample submission** – to understand the types of material used for housing projects d. **Contract document/BQ** – to understand types of workmanship requirements or special requirements for work done	• Items that need to be considered during assessing MOS, design proposal, and shop drawings • Items that need to be taken into consideration during site inspection • Items that need to be considered for counter-proposed materials • Items that often missed out/ that should be incorporated in BQ

3.3.5.1 Semi-structured interview

A semi-structured interview is defined as open, allows new ideas to be brought up during the interview, and has a framework of themes to be explored (Brinkmann, 2014). According to Marshall and Rossman (2006), an interview allows the researchers to explore in uncover respondents' views. The respondents' perspectives on the phenomena of interest should be stated as the respondents' views (Brinkmann, 2014).

Reason for conducting semi-structured interviews as a qualitative method

Semi-structured interviews conform to a standardized list of questions, a standardized sequence of questioning, and finally, systematized ratings of the respondents' replies. In summary, semi-structured interviews were generated by the need to standardize questions and provide explicit guidelines for categorizing or coding responses.

This method is adopted to increase coverage of questionnaire survey/ documents/information that otherwise might be overlooked during literature review/documentation review, enhance the graduate architects' ability to accurately determine if a particular information presented is valid or invalid, and reduce variability among interviewers. The advantages of conducting semi-structured interviews are (Brinkmann, 2014):

1) Provide researcher with reliable, comparable qualitative data
2) Interviewees can provide reasons for their answers during interviews
3) Attract a high response rate
4) A better understanding of the relationships between variables revealed from a descriptive study
5) Gather more detailed information to validate the contract administration framework developed in this study

In semi-structured interviews, the initial questions are asked verbatim to the respondent, the wording of probes used to follow up on initial questions and the interviewer has substantial latitude to follow up on responses by modifying existing questions and probes and even devising new, innovative questions to more accurately rate specific symptoms based on different housing projects selected as case studies.

Before conducting the semi-structured interview, guideline questions were designed to be used during the interview based on the result from the documentation review as shown in Table 3.12. The questions designed for respondents were to take not more than 45 minutes to reply. A pilot study (preliminary interview) with two (2) candidates was conducted to ensure the interview process ran smoothly.

A proper pilot study interview would offer clear guidelines and help the interviewer develop interviewing skills, learn proper techniques, increase confidence, and ensure the interview could be done within the time frame (Sekaran & Bougie, 2016). The selection criteria of the respondents for the pilot study were as follows:

1) Architect who is registered with the Board of Architects Malaysia (LAM)
2) Architect who has worked in BCA of housing projects for 10 years and above

In this study, purposive sampling was used where graduate architects who had been involved in the case study for more than 2 years were selected. The reason for selecting graduate architects with a minimum of 2 years of working experience is to match the criteria for part III professional examination conducted by LAM.

Purposive sampling is a form of non-probability sampling in which the samples are taken by researchers based upon several criteria including special knowledge of the research issue or the capacity and willingness to participate in the research. The selection criteria of the respondents for the semi-structured interviews were as follows:

1) A graduate architect who is registered with the Board of Architects Malaysia (LAM) and the Association of Architects Malaysia (PAM)
2) Graduate architect with working experience in BCA for 2 years and above
3) Having experience in handling housing projects in Malaysia
4) Involve in housing projects selected as case study for this research

According to Berg (1998), the number of respondents for the interview should be between twenty (20) and forty (40) respondents to have sufficient views of the expert. Twenty (20) qualified respondents were identified based on willingness in this study. During the interviews, the researcher found that the answer given by the respondents reached saturation point with no new information, after twelve (12) interviews. However, the interview process was continued until all twenty (20) respondents were interviewed to develop the framework. Interviews were conducted over 1 month in July 2022. Twenty (20) graduate architects in Kuala Lumpur were involved in the interviews. The duration of interviews ranged from 30 minutes to a maximum of 45 minutes. All interviews were conducted in the respondents' office.

Several actions were taken to eliminate the issues of response bias and reliability. Sekaran and Bougie (2009) stated that the willingness of individuals to take part in the interview may response bias. Hence, the researcher requested permission and asked about willingness to take part in the interview.

A consent form was distributed to the respondents to acknowledge their rights when participating in the interview. The twenty (20) respondents were coded as per Table 3.13.

Table 3.13: Coding of interview respondents based on project basis

Projects selected as case studies	Coding of respondents
Project A	Respondents G1, G11, G18
Project B	Respondents G2 and G14
Project C	Respondents G3, G16, G17
Project D	Respondents G9, G10, G12, G15
Project E	Respondents G4, G6, G7, G8
Project F	Respondents G5, G13, G19, G20
Project G	Respondents G5, G13, G19, G20

Note: there are 3-4 graduate architects involved in one particular project because job rotation is imposed by the Architect. Therefore, some graduate architects are only involved in particular stages of the projects.

An interview guide was developed focusing on the following five key aspects:

1) Respondent's description of improvement in claims and legal matters management through experience from the project selected as a case study
2) Respondent's description of improvement in project management through experience from the projects selected as a case study
3) Respondent's description of improvement in communication and relationship management through experience from the projects selected as a case study
4) Respondent's description of the improvement in quality assessment management through experience from the projects selected as a case study
5) Respondent's description of the improvement in design management through experience from the projects selected as a case study

Open-ended questions around the aforementioned five aspects were used, and follow-up questions such as "Could you please give me an example?" "Could you explain further?" were asked throughout each interview to further explore the meanings attached to the respondent's statements. The semi-structure interview questions are asked as follows:-

1) What are the items need to take note of during authority submission? What about:
    a. Project title
    b. The scale of Submission drawings
    c. Paper size
    d. Calculation of processing fees
    e. Documents and drawings requirement

2) What types of errors are usually made during certification? What causes the errors? How do you resolve this issue?

3) What items are usually missed out in meeting minutes? What about:
    a. Attendance record
    b. Follow-up action
    c. Work progress record

4) What types of discrepancies often occur between contract documents and contract drawings? What about:
    a. Demarcation scope of work
    b. Material specification
    c. Work method statement

5) What are the Dos and Don’ts when issuing a letter? What about:
    a. Language form
    b. Contract terms
    c. Relevant details

6) What types of items that normally client requested to add on during construction? What about:
    a. Material revision
    b. Design detail revision
    c. Design improvement

7) What types of design details that normally missed out in drawings? What about:
    a. Design termination details
    b. Material specification

8) What items need to be considered when assessing the method statement/ design proposal or shop drawings? What about:
    a. Tools/equipments
    b. Work sequence
    c. Material utilize
    d. Labor
    e. Protection for completed work

9) What items need to be taken into consideration during site inspection? What about:
    a. Safety on site
    b. Site cleanliness
    c. Workmanship standard

10) What items to consider when receiving counter-proposed materials from a contractor? What about:
    a. Manufacturer years of establishment
    b. Cost saving
    c. Project references of manufacturers

11) What items are normally missed out in BQ? What about:
    a. Types of warranty
    b. Types of as-built drawings
    c. Types of operation and manual

All the interviews were conducted in the respondent’s workplace within 45 minutes. The analyses based on these seven housing projects are used to paint a general picture of current practices and to draft a contract administration framework for graduate architects. The interview questions were prepared to match mainly the research objectives. All the interviews were recorded with permission and were transcribed literally. The interview’s transcript was extracted and tabulated into ‘Respondent’, ‘Interview Text’, ‘Interpretation of the Underlying Meaning’, and ‘Descriptive Code’.

Content analysis is used to analyze the ‘Interview Text’ which interprets and summarises the ‘Underlying Meaning’ of the ‘Interview Text’. It is then coded as the ‘Descriptive Code’ to outline the theme of the research which is mapped to develop the draft contract administration framework of the study.

3.3.5.2 Thematic Analysis and Content Analysis

Data collected from the documentation review is analysed using thematic analysis. Thematic analysis was conducted based on six phases described in Braun and Clarke (2006). The first phase is becoming familiarized with the data. Data collected was read, re-read, and transcribed to highlight initial ideas based on all responses. The second phase is to generate the initial codes from the data. The third phase is to arrange the codes according to the themes. The fourth phase is to review whether the codes match the themes. To ensure saturation of the data, sub-themes were continually reviewed, defined, and re-defined to check if themes worked in relation to the coded extracts and the entire data set. The fifth phase is to define and name the themes. The final phase is to report the output of the analysis.

The data gathered from semi-structured interviews is analysed using content analysis. The coding and analysis process was carried out manually without the use of any software program.

The meaning of the interview texts was condensed into an interpretation of the underlying meaning which is summarized and manifests the content of the responses. The underlying meaning of the interpretation is abstracted into descriptive codes where the condensed text is encrypted. In this study, the descriptive code represents the key feature for developing the framework.

Reason analysis using thematic & content analysis

Marshall and Rossman (2006) stated that thematic & content analysis is an unobtrusive method, as can be conducted without interfering with the setting in any way which applies to analyzing newspapers, recording interviews, archive documents, and others. This method aims to analyze textual information and systematically identify its properties, such as the presence of certain keywords, concepts, characters, themes, number figures, or sentences. All justifications for the selections are summarized and shown in Figure 3.5.

3.3.6 Stage 5 –Develop a Draft Building contract administration framework

Formulation of the contract administration framework took place in Stage 5 of the study. In this stage, the sequence arrangement of the contract administration framework was developed through the results acquired from a questionnaire survey (Stage 3), and the content of the framework was developed through case studies (Stage 4) which consisted of documentation review and semi-structured interviews. Upon validation, the draft structure of the building contract administration framework was established into the final framework.

3.3.6.1 Validate framework through focus group study

The contract administration framework developed in Stage 5 is validated through a focus group study. A focus group was conducted in March and Dec 2023 to further localize the building contract administration framework in Malaysia.

Purposive sampling has been used to recruit participants based on the recommendations from experts (Oyedele & Tham, 2007). The selection criteria of the respondents for the focus group study were as follows:

1) Architect who is registered with the Board of Architects Malaysia (LAM) – active member
2) Architect who registered and worked 10 years and above in the construction industry
3) Architect who active in building contract administration
4) Architect who manages strata housing projects
5) Architects who supervise graduate architects selected as participants in the semi-structured interview

Based on a study conducted by Hennink (2019), sample sizes of focus group studies vary significantly depending on the characteristics of the study. Therefore, theoretical saturation focuses on the adequacy of a sample to provide conceptual depth and richness to validate the emerging theory, rather than on sample size per se (Corbin and Strauss, 2015; Birks and Mills, 2011). Hence, five architects who are in practice were invited to obtain their feedback on the building contract administration framework generated from the survey analysis, and case studies. Each respondent was contacted by email to invite them and provide information about the focus group: date, location, start and end times of sessions, and contact information of the facilitator. A response of confirmation was needed so that the focus group was conducted properly.

This focus group had been arranged in one session which lasted about 60 minutes, and this group was made up of registered architects. Mini-demographic surveys and consent forms were collected before the session started. The session began with explaining the purpose of the focus group followed by a round of introductions.

During this session, the facilitator (the author) led the focus group to discuss 5 themes (claims and legal matters management, project management, communication and relationship management, design management, and quality assessment and management) and take notes of the discussions.

The facilitator ensured consensus was achieved upon the point being discussed before moving to the next point during the session, questions related to the suggestions of the building contract administration framework were answered at the end of the session and debriefed at the final stage.

Questions about the improvement of the draft building contract administration framework rating were: What is your opinion? Should be included/excluded from our list? Why? Why not? Consensus was required from all the participants for each type of suggestion to be eligible for inclusion in the list. The mode of language to be in English.

The facilitator of the focus group was required to have the background and expertise relating to the subject of licensure. The facilitator was not allowed to be a person of authority who intimidate the respondents from answering the questions or be in direct conflict of interest with the respondents such as being their superior. The facilitator ensured consistency throughout the focus group session and summarized the main concepts and quotes from the discussion.

The purpose of this phase is to act as a final validation for the initial draft framework in the local context. Transcriptions obtained from focus group discussions had been audio-recorded. The names of participants and the facility had been replaced by number codes to ensure anonymity. The analytical process of the qualitative content approach was used.

A coding system was designed to identify, code, and group the raw data, using consistent coding (Rother, 2007). The codes were grouped according to similarities and overlapping of concepts of interest and then sorted into potential themes. Afterward, the content was validated and refined to ensure the data within the defined themes and sub-themes form a logical and meaningful connection (Rother, 2007).

Any commonalities and differences in the coding had been identified. Subsequently, the process of data analysis was taken in the form of clustering similar data. Ultimately, the findings were related to the study's aim. This is the final stage of the research process where the research outcomes are written up and dispersed. Figure 3.5 shows a flow chart of the process of thinking throughout the research process. Table 3.14 shows the summary of the entire research process and Figure 3.6 shows the research process diagram for ease of understanding.

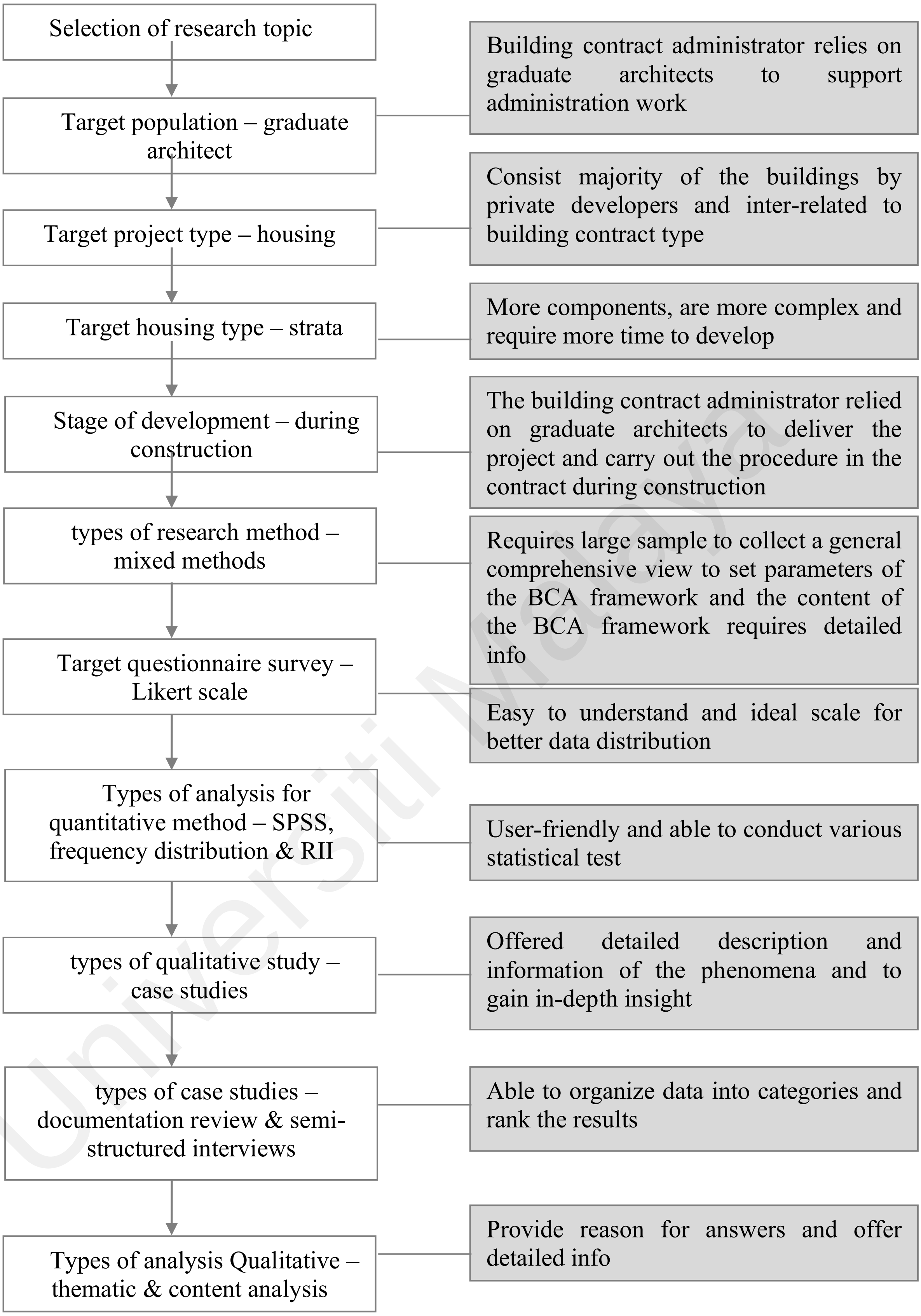


Figure 3.5: Flow chart of the process and rationale in making selection in the research

Table 3.14: Summary of the research process

Stage	Research questions	Approach for analysis			Purpose	Chapter
		Instruments	Method	Tools/ techniques analysis		
Stage 1		Literature review	Systematic literature review	Content analysis	Identify research gaps and formulate research problems	Chapter 2
Stage 2		Literature review	Narrative literature review	Content analysis	Establish aims, research objectives, and design methodology	Chapters 2 & 3
Stage 3	RQ 1: What type of obstacles are faced by graduate architects while supporting BCA of housing projects in Malaysia? RQ 2: What causes these obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia? RQ 3: How to mitigate the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?	Practicing Graduate architects support building contract administrators of housing projects	Quantitative method – A questionnaire survey	Reliability analysis/ Frequency distribution analysis/ relative importance index analysis	RO 1: To identify obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia RO 2: To investigate the root cause of the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia RO 3: To establish mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Chapter 4

Stage 3	RQ 4: What is the relationship between obstacles, root causes, and mitigation measures for graduate architects while supporting BCA of housing projects in Malaysia?	Practicing Graduate architects under building contract administrator of housing projects	Quantitative method – A questionnaire survey	Regression Analysis	RO 4: To analyze the relationship between obstacles, root causes, and mitigation measures for graduate architects while supporting BCA of housing projects in Malaysia	Chapter 4
Stage 4	RQ 5: What type of framework is adequate for graduate architects while supporting BCA of housing projects in Malaysia?	7 housing projects selected for case studies	Qualitative method – Case study: Documents review and Semi-structured interview	Thematic analysis/ Content analysis / manual coding/ themes	RO 5: To develop a building contract administration framework to resolve obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Chapter 5
Stage 5			Focus group study	Thematic analysis/ Content analysis/ manual coding/ themes	To validate the framework developed	Chapter 6

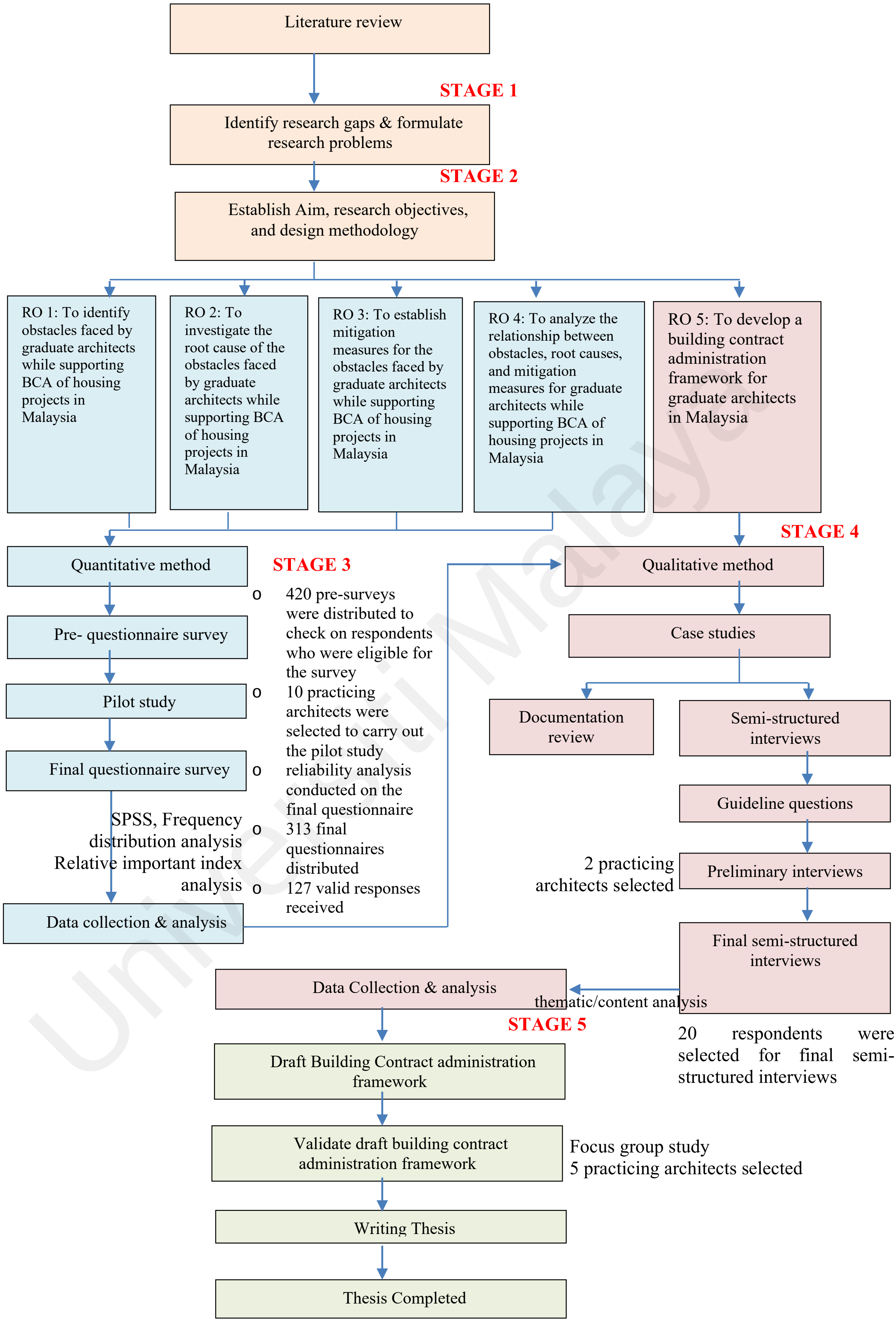


Figure 3.6: Research process diagram

3.4 Ethical Issues

The use of ethical research methods is critical in academic research. This extends to the safeguarding of respondents' rights where informed consent, confidentiality, and protection of data are issues of particular concern. To comply with scholastic standards and rigor necessary in research, this research has taken the following measures to safeguard the respondents in the aforementioned areas.

3.4.1 Informed consent

The consent form was distributed and was obtained through the completion of the forms from the respondents. The form consists of a write-up explaining the purpose of the research and an interview questionnaire was sent to the respondents during email contact for Stage 4. A copy of the same consent form was given to the respondents and collected at the end of the actual interviews. The consent form stated the voluntary nature of the interview and assured respondents' right to withdraw consent or refuse to participate in the interview at any time. A copy of the form is attached in the Appendix for reference.

3.4.2 Participants' confidentiality

Each respondent was assigned a code in the reporting of data to provide anonymity to the respondent. The code allows the reader to gain an understanding of the respondents through his or her affiliation and background while keeping the actual identity confidential.

3.4.3 Storage of collected data

Audio recordings of the interviews are kept in digital format and saved separately from manuscripts and analysis. All data collected was archived for at least 7 years and when subsequently discarded, was carried out properly.

3.5 Summary

This chapter elaborates on the adopted research design – mixed methods for this research. The methodologies adopted comprised quantitative method-questionnaire surveys and qualitative method-case studies. The identification and selection criteria of the research population for the survey and selection of projects for case studies were explained in detail. The final questionnaire survey was distributed to 313 participants who passed the preliminary survey and only 127 completed the survey collected for RO1-RO4. Data collected was analysed using a screening test, normality test, reliability test, factor analysis, relative importance index, assumption testing, and mediation analysis. Seven (7) housing projects at Klang Valley were selected as case studies, 11 types of documents were reviewed, and 20 participants were invited for semi-structured interviews to collect data for RO5. Data collected from the qualitative method was analysed using thematic analysis and content analysis. All the findings are presented in the following chapters.

CHAPTER 4: QUANTITATIVE DATA & ANALYSIS

This chapter provides a detailed description of the data analysis of research findings as a result of various statistical tests. The findings and analysis are presented according to the research objectives. Research objectives 1, 2, 3, and 4 were used to determine the sequence arrangement and sub-themes of the building contract administration framework. Questionnaires were used as a major tool for data collection in this study. A sample of 127 completed responses was used for the experimentation as described in the previous chapter. The data collected were analysed using a screening test, normality test, reliability test, factor analysis, relative importance index, assumption testing, and mediation analysis. The next section begins with a description of the respondents' demography, projects' profiles, data screening, and other SPSS tests before proceeding with analysis and findings for RO1, RO2, RO3, and RO4.

4.1 Data Analysis

The collected data was analysed using IBM SPSS Statistics 28.0 Software, descriptive, and Relative Importance Index to gain insights. SPSS was used to assess the reliability of data collected and explore relationships between the variables to understand the strength and direction of these relationships by employing correlation analysis, regression analysis, and factor analysis.

Descriptive analysis was used to assess the respondents' demographic profile to have a better understanding of the sample composition. A screening test was used to check outliers, a normality test to check the distribution of data, a reliability test to verify the consistencies of variables, factor analysis to counter check correlation of variables, relative important index was used to rank the perceptions of respondents, and mediation analysis was used to test the relationship between variables.

4.1.1 Respondent Particular and Background

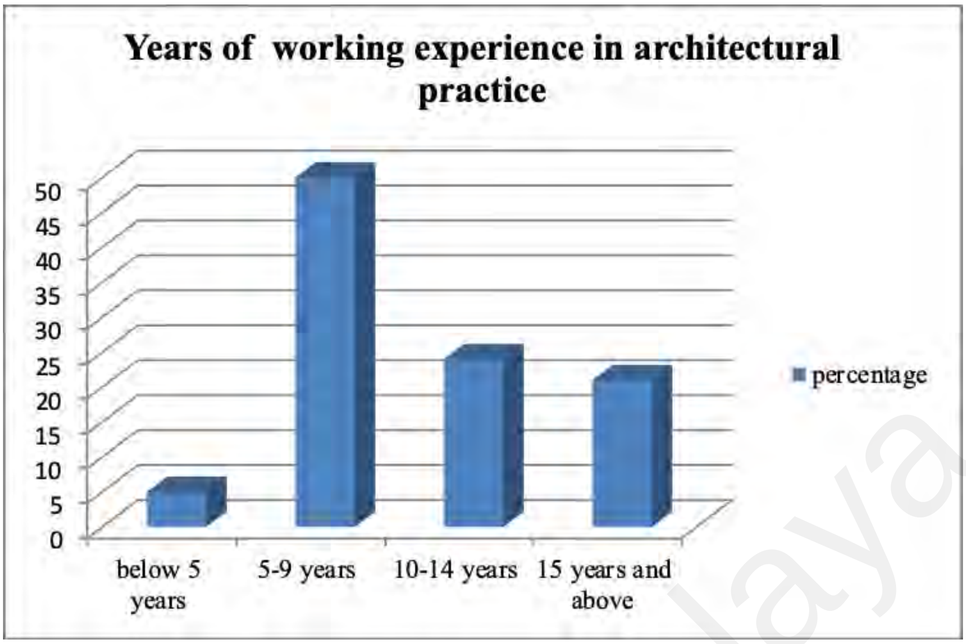


Figure 4.1: Years of working experience of respondents in architectural practice

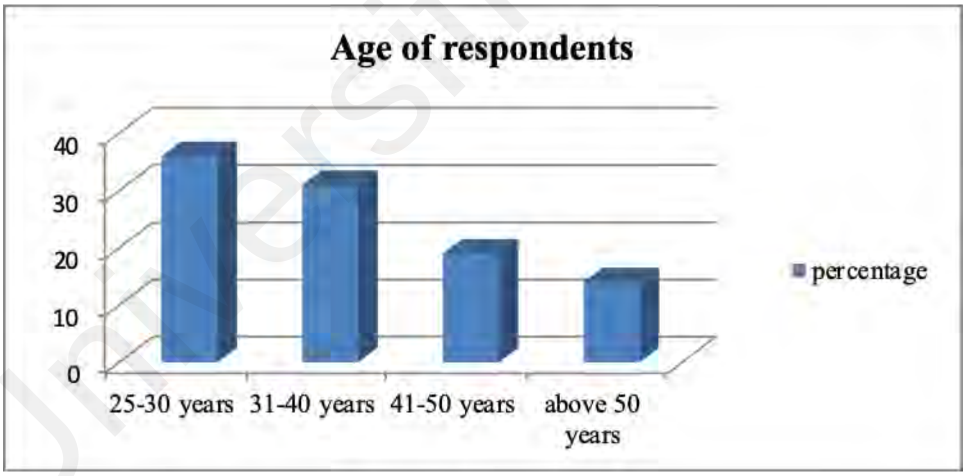


Figure 4.2: Age of respondents

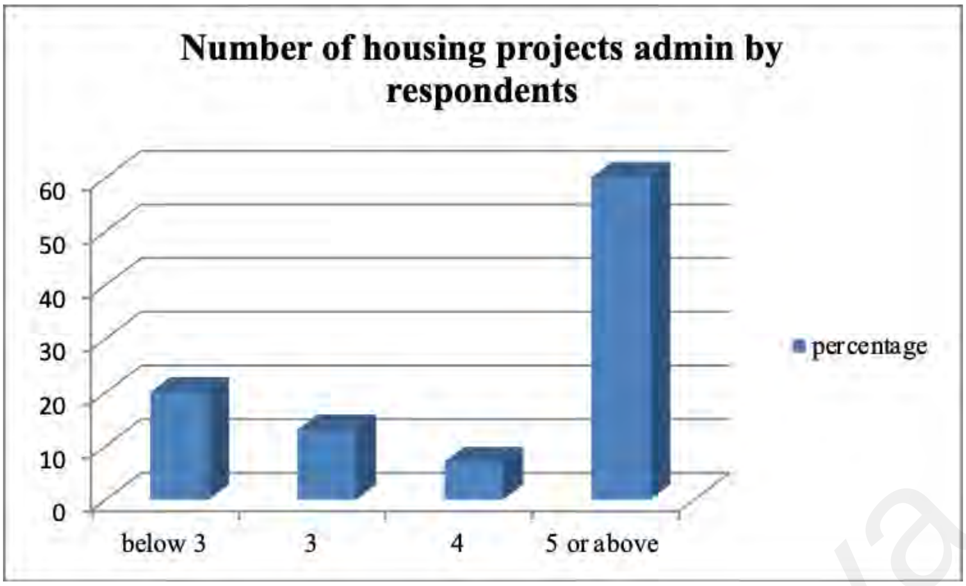


Figure 4.3: Number of housing projects managed by respondents when supporting building contract administration work

Figure 4.4: Years of respondents supporting building contract administration work

An analysis of the graduate architects' profile in Table 4.1 showed that 50% have construction experience spanning 5-9 years, and 45% of the graduate architects have construction experience of over 10 years. This suggests that the respondents have sufficient industry experience to provide valuable insights into graduate skill expectations and observed competencies.

Further, the result showed that 60% of the graduate architects have 5 or above housing projects suggesting that the graduate architects are actively engaged in supporting BCA practice.

The results of the graduate architects' age profile revealed that 36% were 30 years and below, while 31% of the respondents were in the 31-40 years age bracket, and 33% were above 40 years of age. This suggests that the respondents are mature and enable to provide constructive views regarding their working experience.

Regarding the duration of employment, 10% have had 1-5 years of supporting BCA experience, 65% between 6 – 10 years, and 26% of the respondents have worked in supporting BCA for more than 10 years. Hence, it is expected that they are conversant with graduate architects' obstacles, and the likely causative factors and enable to provide mitigation measures to resolve the obstacles. The profile and background of respondents are shown in Figure 4.1 to Figure 4.4.

Table 4.1: Analysis of Respondents' particular and study background

Years of Experience in architectural practice	Frequency	% of total
Below 5 years	6	5%
5-9 years	63	50%
10-14 years	31	24%
15 years or above	27	21%
Total	**127**	**100%**

Age	Frequency	% of total
25 – 30 years	46	36%
31 – 40 years	39	31%
41 – 50 years	24	19%
Above 50 years	18	14%
Total	**127**	**100%**

Number of housing projects	Frequency	% of total
Below 3	26	20%
3	16	13%
4	9	7%
5 or above	76	60%
Total	**127**	**100%**

Years in supporting building contract administration work	Frequency	% of total
1 – 5 years	13	10%
6 – 10 years	82	65%
11 – 15 years	1	1%
16 – 20 years	30	24%
Above 20 years	1	1%
Total	**127**	**100%**

4.1.2 Housing projects particular

Table 4.2 shows the results of particular housing projects where the BCA work was supported by respondents. An analysis was made on the type of housing project, selling price range, construction contract period, contract sum, and clients' background data collected from the respondents. Figure 4.5 to Figure 4.9 shows the profile of housing projects managed by respondents.

The particulars of housing projects were explored in this research to assess the types of experience that respondents encountered while supporting BCA which contributed to the reliability of the data.

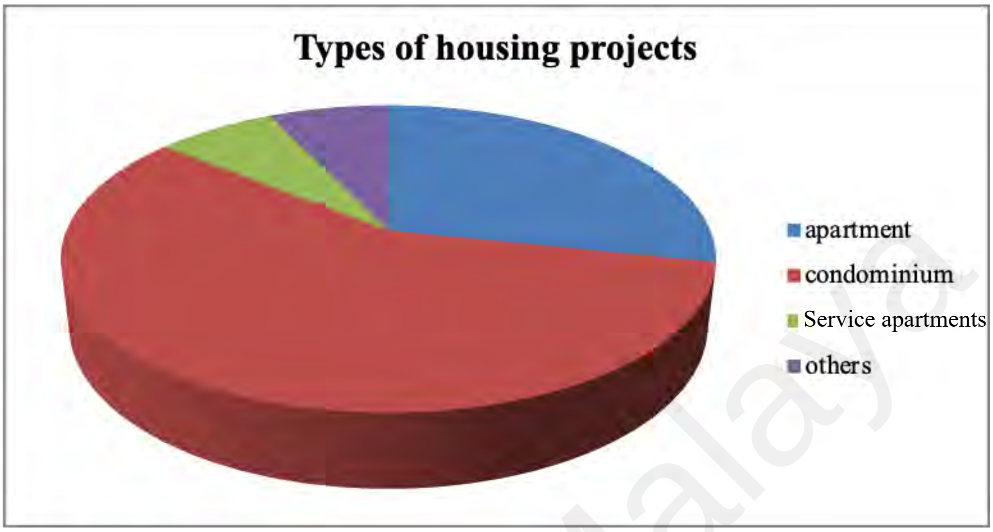


Figure 4.5: Types of housing projects involved by respondents

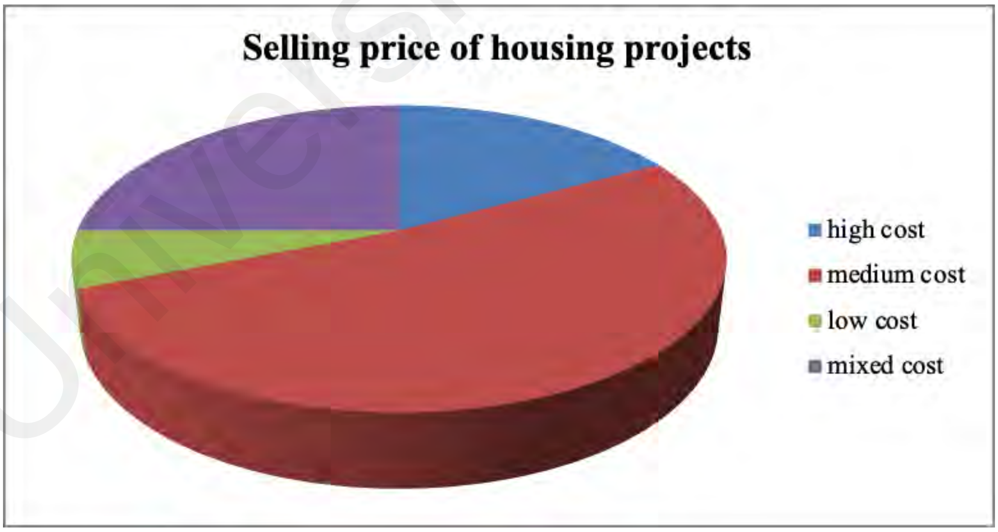


Figure 4.6: The selling price of housing projects involved by respondents

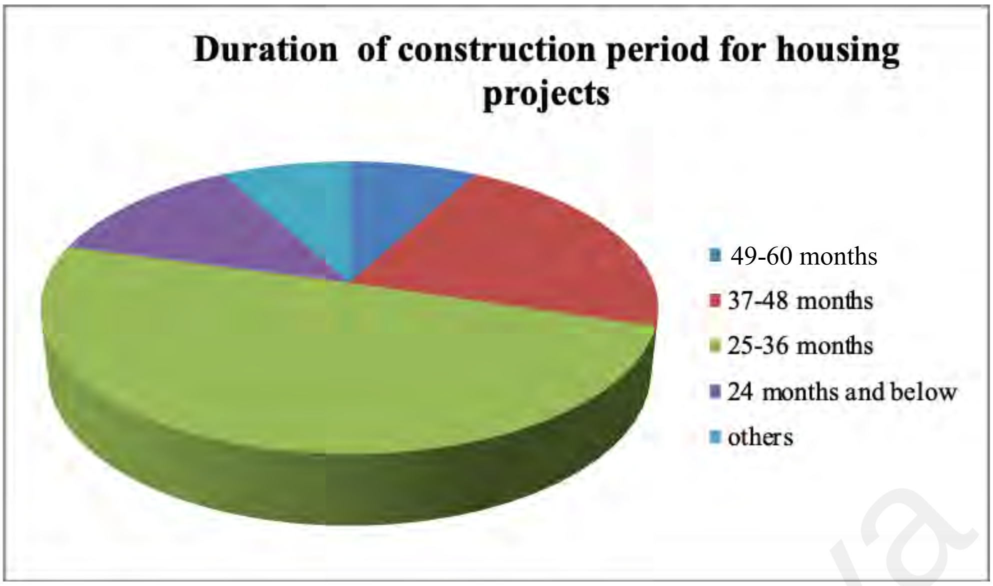


Figure 4.7: Duration of construction period for housing projects involved by respondents

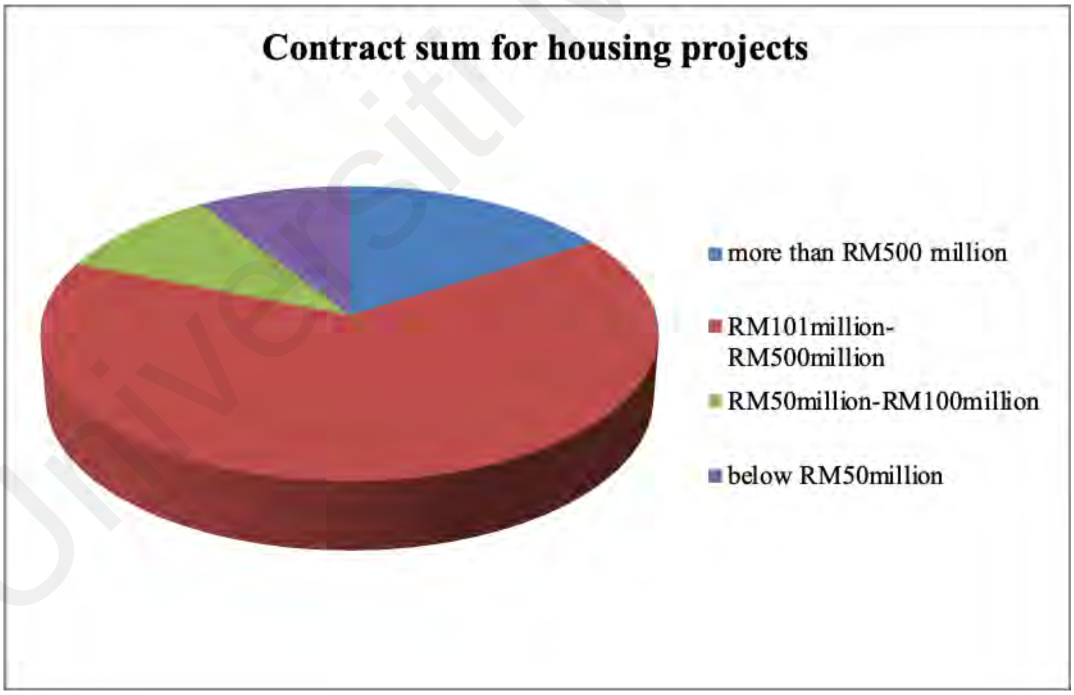


Figure 4.8: Contract sum for housing projects involved by respondents

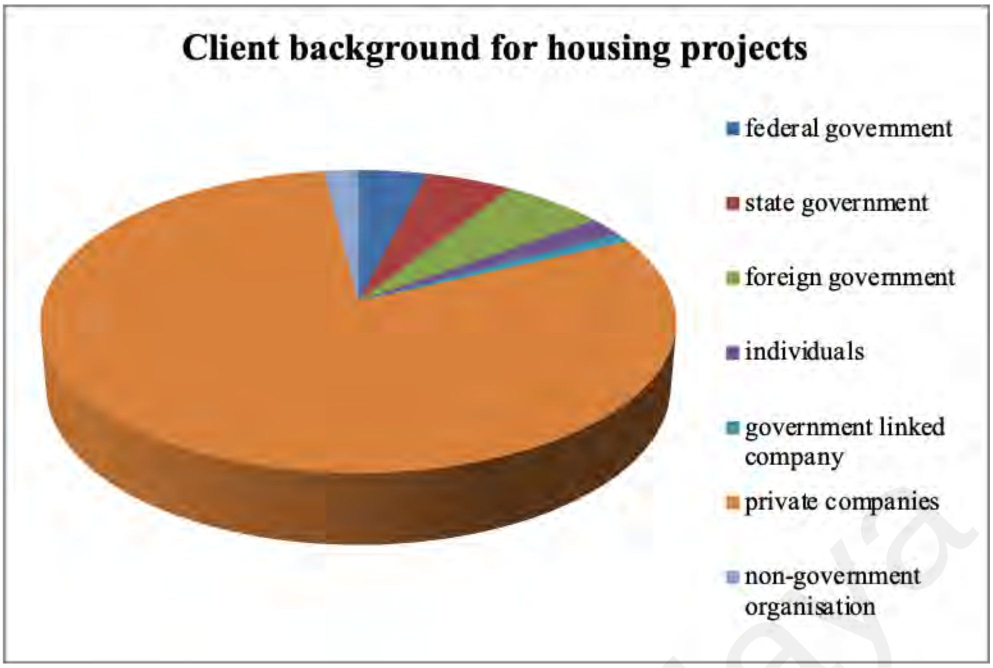


Figure 4.9: Client background for housing projects involved by respondents

Analysis from the data collected for the type of housing projects that were involved by respondents show that 28% of the housing projects fall under apartment, 57% of the housing projects fall under condominium, whereas service apartments and others have the same percentage of housing projects which is 7%. Different types of housing projects consist of different contract specifications and requirements. This result indicates that respondents have varied experience in different types of housing projects.

Results of the range of selling prices for the housing projects involved by respondents show that 17% of the housing projects are high-cost buildings, 52% of the housing projects are medium-cost buildings, 6% of the housing projects are low-cost buildings, and 25% of the housing projects are mixed cost building. The analysis shows that the majority of housing projects involved by respondents are medium-cost buildings.

Medium-cost building consists of average standard and general provisions such as standard fit-out excluding air-conditioning, kitchen cabinets, and home appliances in the project. This shows that respondents have experience in dealing with different types of project requirements based on budget constraints.

The result of the total construction period for housing projects involved by respondents shows that 8% of the projects require 49-60 months to complete, 22% of the projects require 37 to 48 months to complete, 50% of the projects require 25 to 36 months to complete, 13% of the projects require 24 months to complete, and 8% of the projects require others duration. Refer to the Housing and Development Act 1966, there is a time frame to complete the housing projects and hand them over to purchasers. The standard duration to complete high-rise strata is 36 months and the other strata is 24 months. This result indicates that more than half of the projects in the survey were delivered within a time frame.

The resulting outcome for the value of contract sum awarded to contractors indicates that 16% of housing projects involved by respondents are more than RM500 million, 65% of housing projects admin by respondents are between RM 100 million to RM 500 million, 10% of housing projects admin by respondents are between RM50 million to RM 100 million, and 9% of housing projects involved by respondents are below RM50 million. Based on the contract sum data collected from the respondents, the majority of the housing projects involved by respondents are under large-scale projects. These results show that respondents are experienced and capable of proposing measures to mitigate the obstacles faced by graduate architects.

Results of the client background from the data show that 4% of the respondents' client form by the federal government, 5% of the respondents' client forms by the state government, 6% of the respondents' client forms by a foreign government, 2% of respondents' client forms by individuals, 1% of respondents' client form by government-linked company, 80% of respondents' client form by private companies and 2% of respondents' client form by a non-government organization (NGO). This reflects the respondents have varied experiences to accommodate the needs of different clients and respondents are familiar with private contract requirements.

Table 4.2: Analysis of housing project particulars

			% of
1	**Housing type**	**Frequency**	**total**
	Apartment	36	28%
	Condominium	73	57%
	Service apartment	9	7%
	Others	9	7%
	Total	**127**	**100%**

			% of
2	**Price range**	**Frequency**	**total**
	High cost	22	17%
	Low cost	7	6%
	Medium cost	66	52%
	Mixed mode	32	25%
	Total	**127**	**100%**

			% of
3	**Total Construction period**	**Frequency**	**total**
	49-60 months	10	8%
	24 months	16	13%
	25-36 months	63	50%
	37-48 months	28	22%
	Others	10	8%
	Total	**127**	**100%**

			% of
4	**Contract sum**	**Frequency**	**total**
	< RM50 million	11	9%
	RM 50 million < x < RM 100 million	13	10%
	RM 100 million < x < RM 500 million	83	65%
	>RM 500 million	20	16%
	Total	**127**	**100%**

			% of
5	**Client background**	**Frequency**	**total**
	Federal government	5	4%
	State government	6	5%
	Foreign government	8	6%
	Individuals	3	2%
	Government-linked company	1	1%
	Private companies	102	80%
	Non- government organization (NGO)	2	2%
	Total	**127**	**100%**

4.2 Data Screening

The respondents' input was screened against careless responses and outliers. Careless responses were measured through standard deviation and group rating in comparison to average factor ratings.

4.2.1 Mean and Standard deviation

Data from127 respondents is close to the mean of the factor (i.e. standard deviation was <1.00- clustered around the mean) within each corresponding group. There are 5 types of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. Deficient in claims and legal matters has the higlighest mean value of 3.78 (SD=0.73). This means graduate architects are unsure about certification and authority submission which had affected their work performance in BCA. Deficient in communication and relationship management with the mean of 3.73 (SD=0.87) ranks second in types of obstacles implying graduate architects failed to convey messages to the right party for execution and subsequently caused rework. Deficient in design management with the mean of 3.69 (SD=0.67) implying graduate architects unable to furnish workable designs and obtain design confirmation from employers, and deficient in project management with the mean of 3.68 (SD=0.73) implying graduate architects unable to manage projects systematically and delayed the construction project rank third and forth in types of obstacles faced graduate architects. Though the mean of 3.49 (SD=0.82) for deficient in quality and assessment management which implying graduate architects are unsure to assess contractor's submission and monitor work progress on site is still the lowest of all obtained mean values in this category.

There are 5 root causes found to the obstacles faced by graduate architects while supporting BCA work. Inadequate communication and relationship management skills have the highest mean value of 4.48 (SD=0.55). This finding reflects a lot of rework and clashes between building services were caused by a lack of communication skills. Inadequate design management skills with a mean of 4.44 (SD=0.48) ranks second in types of root causes. This finding reflects that graduate architects had difficulty understanding clients' aspirations, unable to adapt to changes. Inadequate quality assessment and management skills with a mean of 4.43 (SD=0.51) reflect that failure in controlling the workmanship quality and the conformance of specifications and inadequate claims and legal matters management skills with a mean of 4.34 (SD=0.75) reflects many wrongful certification and dispute cases that occurred during construction rank third and forth in types of root causes. Though the mean of 3.32 (SD=1.00) for inadequate project management skills reflects graduate architects' lack of writing skills and documentation control is still the lowest of all obtained mean values in this category.

There are 5 mitigation measures for obstacles faced by graduate architects while supporting BCA housing projects in Malaysia. Instil project management knowledge has the highest mean value of 4.50 (SD=0.65). This means that this knowledge is required for graduate architects to be more organized and systematic while supporting BCA. Instill claims and legal matters management knowledge with a mean of 4.43 (SD=0.55) ranks second in types of mitigation measures. This means that instilling legal knowledge for graduate architects is required to assist in resolving the majority of the certificate claims and dispute issues.

Instil quality and management knowledge with the mean of 4.38 (SD=0.61) reflects that this knowledge is required for graduate architects in assessing contractor's submission and ensuring the end product is constructed as per design intention and instill communication and relationship management knowledge with the mean of 4.04 (SD=0.69) reflects that knowledge in networking for graduate architects is required in teamwork rank third and forth in types of mitigation measures. Though the mean of 3.95 (SD=0.65) for instill design management knowledge is required for graduate architects to furnish workable design details for construction is still the lowest of all obtained mean values in this category.

Table 4.3 presents the mean scores (M) and standard deviations (SD), which summarize the central tendency and dispersion of the variables related to the work performance of graduate architects. Next, the distribution of data is tested with a normality test.

Table 4.3: Mean (M) and Standard Deviation (SD) of variables (n=127)

Variable	Mean (M)	Standard Deviation (SD)
Types of obstacles		
Deficient in claims and legal matters management	3.78	0.73
Deficient in project management	3.68	0.73
Deficient in communication & relationship management	3.73	0.87
Deficient in quality and assessment management	3.49	0.82
Deficient in design management	3.69	0.67
Root causes of obstacles		
Inadequate claims and legal matters management skill	4.34	0.75
Inadequate project management skill	3.32	1.00
Inadequate communication & relationship management skills	4.48	0.55
Inadequate quality and assessment management skill	4.43	0.51
Inadequate design management skill	4.44	0.48
Mitigation measures for obstacles faced		
Instil claims and legal matters management knowledge	4.43	0.55
Instil project management knowledge	4.50	0.65
Instil communication & relationship management knowledge	4.04	0.69
Instil quality and assessment management knowledge	4.38	0.61
Instil design management knowledge	3.95	0.65

4.2.2 Data Normality

The skewness values ranged from -0.238 to -1.179, indicating a negative skewness and a longer left tail. The kurtosis values ranged from 1.761 to -0.766, indicating a leptokurtic distribution with heavier tails compared to a normal distribution. All the variables fall under the acceptable range of ±3.0. Therefore, the variables meet the benchmark for normal distribution of skewness and kurtosis and the variables demonstrate approximate normality, allowing for further statistical analysis and interpretation. Table 4.4 provides a summary of the skewness and kurtosis values for each variable.

Table 4.4: Summary of skewness and kurtosis

Variable	N	Skewness		Kurtosis	
		Statistic	Std. Error	Statistic	Std. Error
Types of obstacles					
Deficient in claims and legal matters management	127	-.445	.215	.415	.427
Deficient in project management	127	-.238	.215	.027	.427
Deficient in communication & relationship management	127	-1.179	.215	1.729	.427
Deficient in quality and assessment management	127	-.610	.215	.549	.427
Deficient in design management	127	-.660	.215	1.761	.427
Root causes of obstacles					
Inadequate claims and legal matters management skill	127	-.762	.215	-.400	.427
Inadequate project management skill	127	-.261	.215	-.204	.427
Inadequate communication & relationship management skills	127	-.879	.215	.146	.427
Inadequate quality and assessment management skill	127	-.356	.215	-.717	.427
Inadequate design management skill	127	-.377	.215	-.766	.427
Mitigation measures for obstacles					
Instil claims and legal matters management knowledge	127	-.702	.215	.192	.427
Instil project management knowledge	127	-1.14	.215	.932	.427
Instil communication & relationship management knowledge	127	-.537	.215	.555	.427
Instil quality and assessment management knowledge	127	-.571	.215	-.593	.427
Instil design management knowledge	127	-.413	.215	.257	.427

4.2.3 Reliability analysis

In the sample (n=127), the variables demonstrated a high level of internal consistency, with Cronbach's alpha values ranging from 0.60 to 0.84. Sekaran and Bougie (2009) stated that a coefficient less than 0.60 is considered poor reliability. From the result in Table 4.5, all Cronbach's alpha coefficients are above 0.6, hence acceptable, making all variables reliable.

Table 4.5: Reliability coefficient of research instrument

Variable	No. of items	Cronbach's Alpha (α) (n=127)
Types of obstacles		
Deficient in claims and legal matters management	5	0.64
Deficient in project management	5	0.60
Deficient in communication & relationship management	4	0.82
Deficient in quality and assessment management	4	0.75
Deficient in design management	4	0.67
Root causes of obstacles		
Inadequate claims and legal matters management skill	3	0.72
Inadequate project management skill	2	0.72
Inadequate communication & relationship management skills	3	0.74
Inadequate quality and assessment management skill	2	0.67
Inadequate design management skill	3	0.84
Mitigation measures for obstacles faced		
Instil claims and legal matters management knowledge	3	0.73
Instil project management knowledge	2	0.73
Instil communication & relationship management knowledge	4	0.84
Instil quality and assessment management knowledge	3	0.73
Instil design management knowledge	2	0.63

4.2.4 Preliminary Analysis

Table 4.6 exhibits the results of the KMO measures and Bartlett's test. The KMO value is 0.802, which is above 0.5. This indicates a good level of sampling adequacy. The Barlett's test had an approximate chi-squared value of 211.339 with 10 degrees of freedom. The associated p-value is 0.000 ($p<0.05$) indicating that the correlation matrix is significantly different from an identity matrix. Both tests indicated the suitability of the variables for factor analysis.

Table 4.6: KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		.802 (p>0.5)
Barlett's test of spherity	Approx. Chi-Square	211.339
	df	10
	Sig.	.000 (<0.05)

4.2.5 Correlation relation of variables

Pearson's correlation coefficient is to measure the degree of the relationship between two variables and a correlation coefficient of two variables less than 0.5 is a weak relationship (Hair et al, 2019). The Pearson's correlation coefficient (r) of types of obstacles in Table 4.7 indicates a significant correlation because the value is >0.5. This showed that the more variation in the types of obstacles reflected the more they affect the work performance of graduate architects.

Table 4.7: Correlation between types of obstacles categorised variables

Variables	**Communication obstacles**	**Design obstacles**	**Project obstacles**	**Quality obstacles**	**Legal matters obstacles**
Communication obstacles	1.000				
Design obstacles	.695	1.000			
Project obstacles	.538	.662	1.000		
Quality obstacles	.764	.681	.692	1.000	
Legal matters obstacles	.607	.566	.512	.622	1.000

Note: The correlation coefficient of performance barriers lies between ±0.5 to ±0.8 which showed to be a strong correlation.

The Pearson's correlation coefficient (r) for root causes of obstacles in Table 4.8 indicates a significant correlation because the value is >0.5 except for project management skills. This variable has a weak relationship between categorised variables as the value is <0.5 (Hair et al, 2019). This result is contradicted by previous studies (Brown, 2000; Zuo et al., 2018). To improve the result in the future, more questions relevant to project management skill should be raised in the survey.

Table 4.8: Correlation between root causes of obstacles categorised variables

Variables	**Project skill**	**Quality skill**	**Design skill**	**Legal matters skill**	**Communication skill**
Project skill	1.000				
Quality skill	.102	1.000			
Design skill	.065	.651	1.000		
Legal matters skill	.107	.526	.458	1.000	
Communication skill	.088	.643	.588	.579	1.000

Note: The correlation coefficient of CCA skills lies between ±0.5 to ±0.8 showing a strong correlation except for project management skills which need further improvement.

The Pearson's correlation coefficient (r) for competence development in Table 4.9 indicates a significant correlation because the value is >0.5 except for project management knowledge. This variable has a weak relationship with the categorised variable as the value is <0.5. This result is contradicted by the previous study (Chou and Yang, 2012). To improve the result in the future, more questions relevant to project management knowledge should be raised in the survey.

Table 4.9: Correlation between mitigation measures for obstacles categorised variables

Variables	Project knowledge	Communication knowledge	Legal matters knowledge	Quality knowledge	Design knowledge
Project knowledge	1.000				
Communication knowledge	.442	1.000			
Legal matters knowledge	.340	.513	1.000		
Quality knowledge	.343	.524	.518	1.000	
Design knowledge	.354	.733	.595	.525	1.000

Note: The correlation coefficient of competence development lies between ±0.5 to ±0.7 showed a strong correlation except for project management knowledge. More questions should be raised about project management knowledge to improve the result.

4.2.6 Content validity test

Content validity tests the extent to which a constituent variable belongs to its corresponding respondents. Content validity is unable to be tested by using statistical tools, hence, an in-depth literature survey is necessary to keep the researcher's judgment on the right track. An extensive literature survey has been conducted to specify the variables that define the types of obstacles, root causes, and mitigation measures for the obstacles faced by graduate architects. The model has been tested in a pilot study administered to qualified architects, and content validity is thus achieved.

A total of 10 architects in the pilot study were asked to comment on the type of obstacles, root causes, and mitigation measures. They all reported back with the judgment that understanding the types of obstacles, root causes, and migration measures appears to be a good measure for setting up the sequence arrangement and sub-themes to develop the BCA framework to enhance the work performance of graduate architects.

4.2.7 Multicollinearity Diagnosis

There are 2 sets of data for VIF values in this study. Table 4.10 shows the dependent variable is mitigation measures for the obstacles and the independent variables are types of obstacles. Table 4.11 shows the dependent variable is mitigation measures for the obstacles and the independent variables are the root causes of obstacles. The results in Table 4.10 indicated that the VIF values ranged from 1.814 (lowest) to 3.435 (highest) and results in Table 4.11 indicated that the VIF values ranged from 1.015 (lowest) to 2.201 (highest). Both results indicated VIF values less than 10. Hence, there is no multicollinearity symptom.

Table 4.10: Multicollinearity coefficients for types of obstacles

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	2.651	.295		8.984	.000		
Deficient in claims and legal matters management	.173	.086	.228	2.017	.046	.551	1.814
Deficient in project management	.204	.096	.268	2.122	.036	.442	2.261
Deficient in communication & relationship management	.122	.092	.193	1.337	.184	.339	2.946
Deficient in quality and assessment management	-.226	.105	-.334	-2.147	.034	.291	3.435
Deficient in design management	.035	.111	.042	.312	.756	.389	2.569

Dependent Variable: mitigation measures for obstacles

Table 4.11: Multicollinearity coefficients for root causes of obstacles

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.444	.410		1.083	.281		
Inadequate claims and legal matters management skill	.097	.067	.131	1.437	.153	.619	1.617
Inadequate project management skill	.044	.040	.079	1.102	.273	.985	1.015
Inadequate communication & relationship management skills	.606	.104	.061	.584	.560	.476	2.103
Inadequate quality and assessment management skill	.309	.114	.287	2.701	.008	.454	2.201
Inadequate design management skill	.272	.113	.237	2.400	.018	.524	1.910

Dependent Variable: mitigation measures for obstacles

4.2.8 Factor Analysis

From the result for types of obstacles faced by graduate architects while supporting BCA, five (5) themes are extracted, and these themes account for almost 64.7% of the total variance. It indicates a model with these five themes is considered adequate to represent the data.

4.2.8.1 Factor loading for types of obstacles faced by graduate architects

Principal theme factor analysis with Varimax rotation conducted on the 22 obstacle variables produced 5 underlying themes as shown in Figure 4.10. Table 4.12 shows the factor loadings of these obstacle variables on these five themes. The factor loading is the correlation coefficient between an original variable and an extracted theme. The larger the factor loading, the greater the variable contributes to the theme. Factor loadings greater than 0.5 are considered significant in contributing to the interpretation of the theme.

As shown in Table 4.12, all factor loadings were greater than 0.5. The extracted five themes were extracted and renamed based on the results of the analysis. The purpose is to better distinguish between the extracted themes and obstacle variables mentioned in previous sections. In summary, the five themes were summarized as follows:-

Theme 1 consists of 10 variables: inadequate site inspection, communication breakdown, unfamiliar building specification, poor contract management, non-integrated project delivery, insufficient design detail, lack of understanding of client's aspirations, ineffective management, constant design changes, and slow decision. These variables are mostly related to obstacles faced by graduate architects during managing the project. Therefore, this theme can be termed deficient in project management. This theme accounts for the greatest variance (36.8%) among all the themes.

Theme 2 includes five variables: absence of a clear uniform standard of work acceptance, incomplete documentation, a conventional management protocol, delayed reply queries, and non-integrated project delivery. These variables mostly emphasize the work quality assessment and management type of obstacles. Hence, this theme is termed deficient in quality assessment and management.

Theme 3 has three variables: lack of coordination between project stakeholders, lack of information in drawings, and unworkable detail. Coordination and information sharing are related to communication and social networks with project stakeholders. Unable to communicate properly that cause misunderstanding and errors conveying messages that subsequently cause rework. Consequently, this theme can be considered deficient in communication and relationship management.

Theme 4 comprises two variables: unworkable detail and insufficient design detail. Detail drawings were generated during the design and tender stage.

However, a lot of design details were missing due to insufficient time to produce, and this caused difficulty during the construction stage. Therefore, this theme is termed deficient in design management.

Theme 5 comprises one variable: constant design changes. Frequent design changes requested by an employer for cost saving or contractor counter proposed an alternative design for time and cost saving had been an obstacle to graduate architects as these changes had constituted variation orders and are subject to dispute if one party refuses to honor payment at a later stage. Thus, this theme is called deficient in claims and legal matters management. This theme accounts for the least variance (5.2%) among all the themes from a statistical point of view.

The five extracted themes represent the types of obstacles faced by graduate architects. Some of the variables appeared more than 1 theme, e.g. ‘non-integrated project delivery’. ‘constant design changes’, and ‘unworkable detail’. This showed that most themes are strongly interrelated with each other.

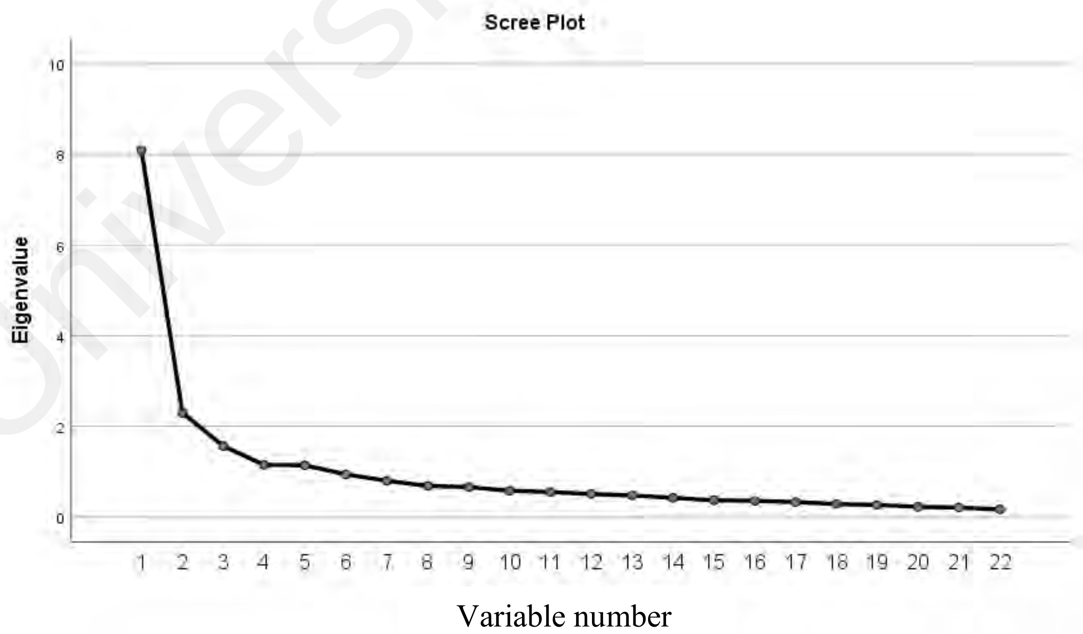


Figure 4.10: Scree plot for obstacle variables faced by graduate architects

Table 4.12: Factor loading for obstacle variables faced by graduate architects while supporting BCA of housing projects in Malaysia

Themes	Code	obstacles variables	Factor loading
1) Deficient in Project management	OB12	Inadequate site inspection	.865
	OB1	Communication breakdown	.861
	OB32	Unfamiliar building specification	.791
	OB5	Poor contract management	.751
	OB19	Non-integrated project delivery*	.746
	OB27	Insufficient design detail	.712
	OB33	Lack of understanding client's aspirations	.709
	OB28	Ineffective management	.607
	OB34	Constant design changes*	.527
	OB2	Slow decision	.480
2) Deficient in Quality assessment and management	OB17	Absence of clear uniform standard of work acceptance	.789
	OB36	Incomplete documentation	.738
	OB25	Conventional management protocol	.734
	OB4	Delay reply queries	.662
	OB19	Non-integrated project delivery*	.627
3) Deficient in Communication and relationship management	OB3	Lack of coordination between project stakeholders	.783
	OB6	Lack of information in drawings	.546
	OB26	Unworkable detail*	.507
4) Deficient in Design management	OB26	Unworkable detail*	.500
	OB27	Insufficient design detail	.793
5) Deficient in Claims and legal matters management	OB34	Constant design changes *	.473

*variables appeared in more than 1 theme

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

4.2.8.2 Factor loading of root causes for obstacles faced by graduate architects

Main theme factor analysis with Varimax rotation conducted on the 13 root causes variables produced two underlying themes as shown in Figure 4.11. Table 4.13 shows the factor loadings of these root causes variables on these two themes. The factor loading is the correlation coefficient between an original variable and an extracted theme. The larger the factor loading, the greater the variable contributes to the theme. Usually, factors with loadings greater than 0.5 are considered significant in contributing to the interpretation of the theme. As shown in Table 4.13, all factor loadings were greater than 0.5. The extracted two themes were renamed based on the results of the analysis. In summary, the two themes were summarized as follows:-

Theme 1 consists of seven variables: oral, making decisions, ability to chair meetings, writing, conflict management, technical problems, and adapting to changes. These variables are closely related to communication and relationship management that graduate architects lack while supporting BCA. Therefore, this theme can be termed inadequate communication and relationship management skills. This theme accounts for the greatest variance (46.3%) among all the components.

Theme 2 includes six variables: technical, project management, interpersonal, quality management, understanding clients' aspirations, and technical coordination. These variables mostly emphasize skills that are crucial but missing from graduate architects in BCA. Hence, this theme is termed inadequate project management skills. This theme accounts for the least variance (9.8%) among all the variables from a statistical point of view.

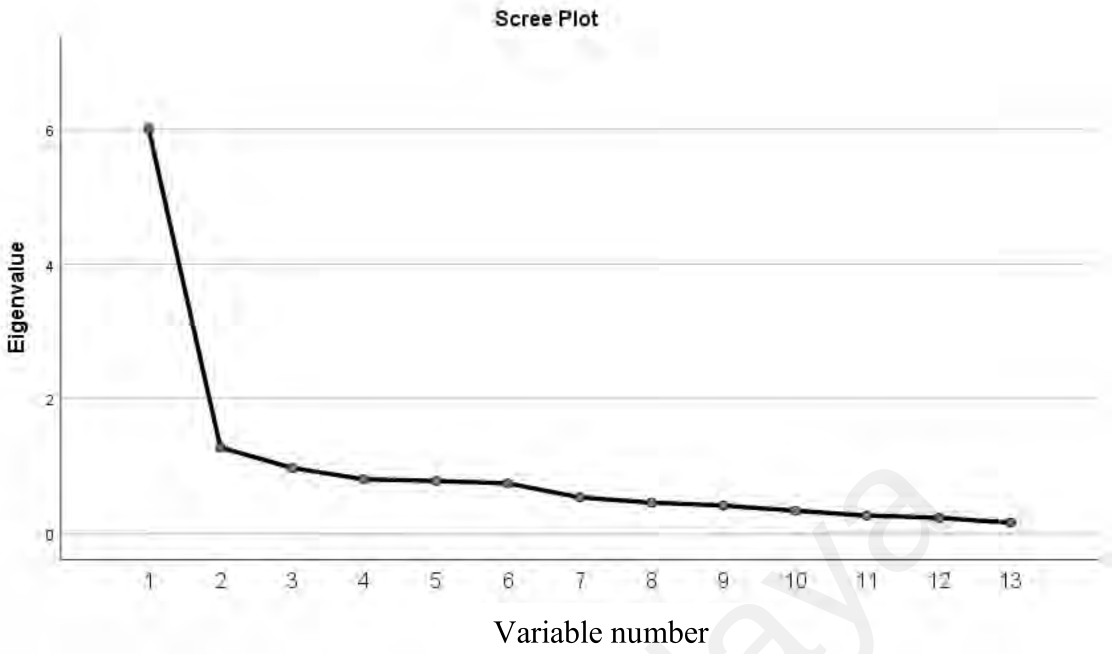


Figure 4.11: Scree plot of the root causes variables faced by graduate architects

Table 4.13: Factor loading of root causes variables faced by graduate architects while supporting BCA of housing projects in Malaysia

Theme	Code	Root causes variables	Factor loading
Inadequate Communication and relationship management skills	RC11	Oral	.825
	RC13	Make decision	.784
	RC12	Ability to chair the meeting	.743
	RC10	Writing	.730
	RC9	Conflict management	.674
	RC8	Technical problem	.567
	RC5	Adapt changes	.478
Inadequate Project management skill	RC2	Technical	.790
	RC1	Project management	.741
	RC3	Interpersonal	.710
	RC6	Quality management	.636
	RC4	Understand clients' aspirations	.546
	RC7	Technical coordination	.539

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

4.2.8.3 Factor loading of mitigation measures for graduate architects

From the result of mitigation measures for obstacles faced by graduate architects while supporting BCA, four (4) themes are extracted, and these themes account for almost 66.6% of the total variance. It indicates a model with these four themes is considered adequate to represent the data. Principal components factor analysis with Varimax rotation conducted on the 20 mitigation measures variables produced four underlying themes as shown in Figure 4.12. Table 4.14 shows the factor loadings of these mitigation measures variables on these four themes. The factor loading is the correlation coefficient between an original variable and an extracted theme. The larger the factor loading, the greater the variable contributes to the theme. Usually, variables with loadings greater than 0.5 are considered significant in contributing to the interpretation of the theme. As shown in Table 4.14, all factor loadings were greater than 0.5. The extracted four themes were renamed based on the results of the analysis. In summary, the four themes were summarized as follows:-

Theme 1 consists of six variables: electrical engineering, mechanical engineering, geotechnical engineering, structural engineering, civil engineering, and quantity surveying. These variables are closely related to the knowledge required for coordination purposes. Therefore, this theme can be termed instill communication and relationship management knowledge. This theme accounts for the greatest variance (45%) among all the themes.

Theme 2 includes eight variables: quantity surveying, interior design, financial planning, valuation study, landscape, building material, environmental studies, and construction methods. These variables mostly emphasize on knowledge required when graduate architects manage design. Hence, this theme is termed Instill design management knowledge.

Theme 3 has three variables: architecture, project management, and town planning. This knowledge is crucial for graduate architects when managing housing projects. Consequently, this theme can be considered instill project management knowledge.

Theme 4 comprises three variables: feasibility studies, authority approving process, and IT construction. Disputes could be minimized if graduate architects conducted feasibility studies, and IT construction and were familiar with the authority approving process. Thus, this theme is called instill claims and legal matters knowledge. This knowledge accounts for the least variance (5.74%) among all the variables from a statistical point of view.

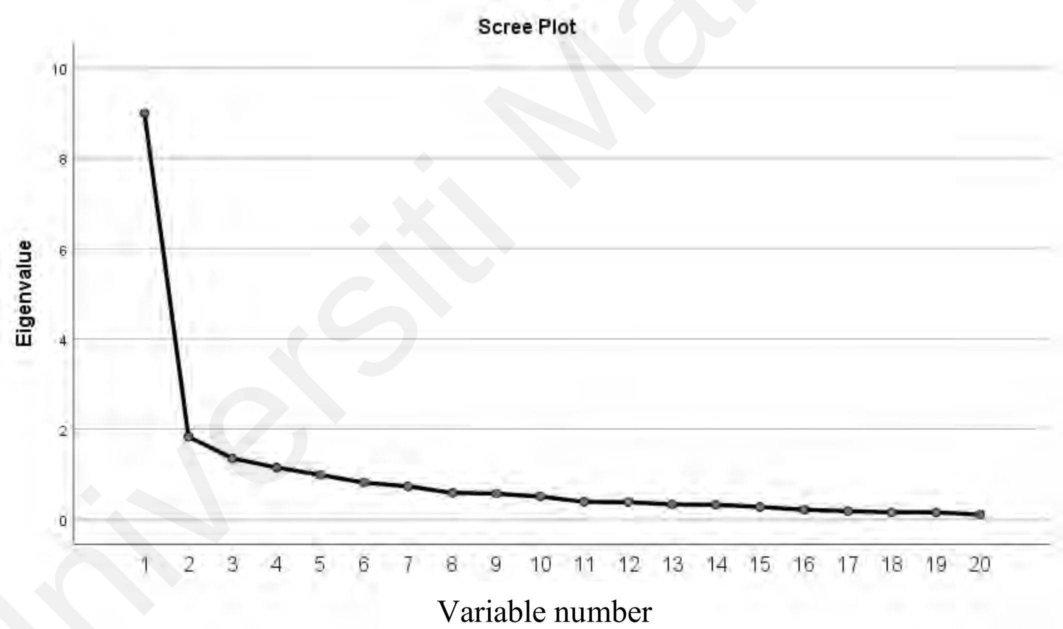


Figure 4.12: Scree plot of mitigation measures variables faced by graduate architects

Table 4.14: Factor loading of mitigation measures variables faced by graduate architects while supporting BCA of housing projects in Malaysia

Theme	Code	Mitigation measures variables	Factor loading
Instill Communication & relationship management knowledge	MM6	Electrical engineering	.856
	MM5	Mechanical engineering	.834
	MM8	Geotechnical engineering	.742
	MM7	Structural engineering	.714
	MM4	Civil engineering	.707
	MM9	Quantity Surveying	.558
Instill Design management knowledge	MM9	Quantity Surveying *	.519
	MM14	Interior design	.779
	MM15	Financial planning	.715
	MM16	Valuation study	.699
	MM13	Landscape	.625
	MM12	Building material	.609
	MM17	Environmental studies	.574
	MM11	Construction methods	.501
Instill Project management knowledge	MM2	Architecture	.782
	MM1	Project management	.725
	MM3	Town planning	.681
Instill Claims & Legal matters management knowledge	MM19	Feasibility studies	.820
	MM18	Authority approving process	.708
	MM20	IT Construction	.484

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

In factor analysis, the variables of obstacles, root causes, and mitigation measures were grouped based on the level of correlation among them. Some of the variables are grouped without any relation. In addition, factor analysis did not determine factor ranking and assigning priorities. Therefore, the level of importance of the types of obstacles, root causes, and mitigation measures for the obstacles were then calculated based on the Relative Importance Index.

4.3 Research Objective 1 – "To Identify Types Of Obstacles Faced By The Graduate Architects While Supporting BCA Housing Projects In Malaysia"

The Likert scale and ranking analysis were applied to rate the type of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. In the literature review presented in the previous chapter, there are 5 main obstacles when graduate architects are supporting BCA of housing projects considered in this research. The obstacles are:

1) Deficient in claims and legal matters management
2) Deficient in communication and relationship management
3) Deficient in project management
4) Deficient in design management
5) Deficient in quality and assessment management

The respondents were asked to rate the degree of importance of the obstacle in a housing project. The Likert scale of 5, from which 1 indicates of little important obstacle to 5 very important obstacle was applied.

The result of graduate architects' responses is calculated and ranked using the Relative Index method which represents the strength of response from 0.2 to 1.0 for each theme where 1.0 indicates 100% means very important obstacle by all respondents and 0.2 is 100% means of little important by respondents.

Table 4.15 explains in detail the result of types of obstacle such as deficient in claims and legal matters management, deficient in project management, deficient in communication and relationship management, deficient in quality and assessment management, and deficient in design management.

The overall result of the types of obstacle while graduate architects supporting BCA of housing projects shows that the top three themes are 'deficient in claims and legal matters management, followed by 'deficient in communication and relationship', and 'deficient in project management'. To determine the scale of research variables to achieve a certain level, RII classification is to be provided. The average index is classified into the following:

<0.73 – Of little important obstacle

0.73 – Slightly important obstacle

0.74 – Moderately important obstacle

0.75 – Important obstacle

>0.75 Very important obstacle

Table 4.15: RII results from respondents for types of obstacles faced by GA while supporting BCA of housing projects in Malaysia

Code	Obstacles	Frequency						Relative Important Index	Average Index	Level of obstacle	Rank
		1	2	3	4	5	Total				
Deficient in Claims and legal matters management											
OB5	Poor contract management	4	11	22	47	43	127	0.779528	0.759055	Very important obstacle	1
OB10	Discrepancy in contract documentation	5	14	44	35	29	127	0.708661			
OB15	Unaware of legal policy	1	10	31	38	47	127	0.788976			
Deficient in project management											
OB21	Lack of guidance and proper documentation	20	22	30	35	20	127	0.620472	0.740944	Moderately important obstacle	3
OB25	Conventional management protocol	2	3	10	31	81	127	0.892913			
OB28	Ineffective management	14	23	40	33	17	127	0.625197			
OB36	Incomplete documentation	1	7	22	42	55	127	0.825197			
Deficient in communication and relationship management											
OB1	Communication breakdown	7	7	16	38	59	127	0.812598	0.747401	Important obstacle	2
OB3	Lack of coordination between project stakeholders	9	3	22	41	52	127	0.795276			
OB6	Lack of information in drawings	9	10	22	40	46	127	0.763780			
OB33	Lack of understanding of clients' requirement	5	14	34	42	32	127	0.729134			
OB35	Misunderstanding terms	10	24	45	29	19	127	0.636220			
Deficient in quality and assessment management											
OB4	Delay reply queries	17	23	47	23	17	127	0.600000	0.701102	Of little important obstacle	5
OB12	Inadequate site inspection	9	9	12	31	66	127	0.814173			
OB17	Absence of clear uniform standard of work acceptance	8	18	45	39	17	127	0.661417			
OB19	Non-integrated project delivery	8	33	38	32	16	127	0.623622			
OB32	Unfamiliar building specification	8	5	20	36	58	127	0.806299			
Deficient in design management											
OB2	Slow decision	6	17	49	39	16	127	0.666142	0.734323	Slightly important obstacle	4
OB27	Insufficient design detail	3	7	20	52	45	127	0.8032			
OB34	Constant design changes	3	6	38	48	32	127	0.7606			
OB14	Design error	5	18	21	48	35	127	0.7465			
OB5	Unworkable detail	3	17	41	41	25	127	0.7102			

4.3.1 Rank 1: Deficient in Claims and Legal Matters Management

Table 4.15 summarizes the frequency and the computed relative importance index for each obstacle. The average index is based on the total frequency of theme for each obstacle, found in the final column. Deficient in claims and legal matters management ranked first with an importance index of 0.759. There are three types of obstacles that fall under the theme of deficient in claims and legal matters management, which are poor contract management, discrepancy in contract documentation, and unawareness of legal policy. The ranking of obstacles **from very important obstacle to little important obstacles** for graduate architects is as follows:-

1) OB 15 Unaware legal policy
2) OB 5 Poor contract management
3) OB 10 Discrepancy in contract documentation

The main obstacle - unaware legal policy (RII=0.7890) tends to occur during authority submission. The rules and policies of government change regularly. This result is aligned with previous findings from McKim et al (2000) that one of the factors contributing is the ever-changing regulatory requirements set by respective authorities. Unrelenting bureaucracies and vague processes caused difficulty for graduate architects to cope. Subsequently, drawings need to be submitted more than once to capture the amendment. Graduate architects spent unnecessary time and energy in authority submission.

The important index of poor contract management was also relatively high (RII=0.7795). This is reflected in the fact that the modifications of standard forms which are mostly utilized by private sectors to satisfy the project requirements given by owners had changed the balance in risk allocation and forced the contractor to shoulder the majority of the risks.

This result agrees with a study done by Weng & Ahmad (2015) that the modified documents had an impact on the clarity and readability which indirectly causes a misunderstanding of the contractual terms and behavior. Graduate architects are confused when the standard form of contract has been modified which indirectly caused poor contract administration and management.

The discrepancy in contract documents with an important index of 0.7087 implied a low obstacle to graduate architects within this component. This is because the scenario as such only occurred when the employer tends to recycle contracts from previous projects without proper modifications occurring in the industry, ill-defined contract procedure, non-practical conditions and changes to the standard conditions, adding non-standard conditions, unfair contract terms, biased contractual clauses, catch-all clause, and poorly written contract clauses. In addition, there is a quantity surveyor assist to prepare and counter-check the content of the modifications. Hence, the chances of discrepancy are minimal.

4.3.2 Rank 2: Deficient in Communication and relationship management

Deficient in Communication and relationship management ranked second with an importance index of 0.7474. This theme contained a combination of five correlated variables **from very important obstacle to little important obstacle** as follows:-:

1) OB1 communication breakdown (RII= 0.8123)
2) OB3 lacks coordination between project stakeholders (RII=0.7953)
3) OB6 lacks information in drawings (RII=0.7638)
4) OB33 lacks understanding clients' requirements (RII=0.7291)
5) OB35 misunderstanding terms (RII=0.6362)

According to the survey, communication and relationship management are deficient among the graduate architects which has affected schedules and costs, and ultimately delayed projects and burst existing budgets. This is because the curriculum of architecture schools serves the needs of the industry with more technical knowledge compared with communication and relationship management knowledge. This result is aligned with previous findings from Tzonis (2014) that architecture education sustains using the old traditional curriculum frameworks with minimal changes to address the new challenges for the industry that produce a lag between graduate architects' abilities and the construction industry's expectations.

Of all the variables within this factor, remarkable importance is given to communication breakdown (with an important index of 0.8126). Miscommunication occurred in the construction industry due to its complexity and dynamism. Information is frequently misinterpreted and late delivery is due to the involvement of multiple parties. Moreover, messages are frequently communicated via ambiguous communication channels resulting in misunderstandings. This finding is parallel with the finding by Hoezen (2016) who confirmed 9 common communication breakdowns during construction are distorted information, multiple stakeholders, usage of technical jargon, unclear communication channels, language barriers, late information dissemination, lack of necessary skills, multicultural work environment, and personality factor. Besides that, this result also aligned with findings from Yusof and Rahmat (2020) that the communication breakdown existing on the project was exacerbated by the presence of a language barrier when supervisors failed to convey messages from consultants to foreign workers who come in from various nationalities and speak a range of languages, slang, accents, and dialects.

This result also parallels with study done by Akunyumu et al. (2019) who identified 6 reasons for communication breakdown which include restriction to information, cultural issues, delays in sharing information, technical challenges, lack of feedback, and lack of cooperation. Graduate architects often encountered communication breakdowns when failed to convey information among project stakeholders and caused rework/redundancy work.

From the analysis, lack of coordination between project stakeholders (with an important index of 0.7952) is one of the main obstacles for graduate architects while supporting BCA. Lack of coordination occurs when the design intent/message is not conveyed properly during coordination. This result agrees with Krishna (2023) that lack of coordination includes unwillingness to cooperate, lack of attention to explore others' work, low repetitive nature of the working process, reluctance to learn new skills, reluctant to share information and technical knowledge, chain of command taking time to convey from top to bottom management, lack experience to detect information errors during exchange information. This incident often occurs when items are missed out during design/construction and cause unnecessary variation orders to the employer.

Lack of information in drawings (with an important index of 0.7638) is one of the obstacles faced by graduate architects during the construction process in the traditional contracting approach. Graduate architects are unsure types of information to be incorporated in construction drawings. The majority left the technical part under the contractor's proposal and design. This result agrees with Mendelsohn (1997) that 75% of the problems on the construction site are generated during the design phase as a contractor is not invited to provide technical knowledge and opinion complimenting the design and buildability issue which results in the building failure to build per designed.

Graduate architects find it difficult to understand clients' briefs because the brief is often inadequate and limit the creativity of the designer, client refuses to give additional information, are poorly read, lack proper structure, and generic norms and standard makes it difficult to pinpoint unique characteristics of a project, unclear about financial information, client unable to formulate all their requirements beforehand, unsure which requirements are 'fixed' or 'flexible'. This is reflected in a lack of understanding of clients' requirements (with an important index of 0.7291). Among all the variables in this theme, misunderstanding terms have a low important index (0.6162). Respondents thought that the chances of misunderstanding terms when engaging with general contractors, engineers, and builders are rare as they could always use sketching to convey messages rather than spelling out the accurate term.

4.3.3 Rank 3: Deficient in Project Management

Deficient in project management, ranked third with an importance index of 0.7409. This theme contained a combination of four correlated variables **from very important obstacle to little important obstacle** as follows:-:

1) OB25 Conventional management protocol (RII= 0.8929)
2) OB36 incomplete documentation (RII=0.8252)
3) OB28 ineffective management (RII=0.6252)
4) OB21 lacks the guidance of documentation (RII=0.6205)

Graduate architects faced deficient in project management when they encountered the following situations such as poorly defined goals, poor team skills, inadequate communication, lack of risk assessment, accepting impossible deadlines, resource deprivation, ambiguous contingency plans, lack of accountability, scope changes, lack of stakeholder engagement, and high expectations.

Conventional management protocol (RII=0.8929) is one of the main obstacles for graduate architects while supporting BCA. Incorrect information transmitted and hidden information had become an obstacle to graduate architects. This result agrees with Tilley and Barton (1997) that emphasis on a hierarchy where the process of conveying confirmation from top management to the final executor is not done properly easily causes errors in construction.

Incomplete documentation (RII=0.8252) is part of the obstacle to graduate architects' time constraint during tender preparation that caused designers unable to transmit sufficient information and ideas into drawings. The effectiveness and efficiency of the transformation depend largely on the quality and documentation provided. Unfortunately, contractors are often supplied with incomplete project documentation, and conflicting and require clarifications to resume construction. This is reflected in the request for information (RFI) forms submitted by the contractor where they highlighted the lack of details drawings and requested clarification. Graduate architects need to figure out design details after taking over the design work which is an obstacle for them.

Ineffective management (RII=0.6252) occurred when graduate architects spent longer time than necessary to obtain the necessary information to reply to queries (RFI). This inevitably becomes 'ineffective management' highlighted in the survey. This finding is parallel with findings by Yap (2021) who confirmed the reason for more time spent to source for information by graduate architects is to resolve the following types of RFI:-

1. Conflicting information – RFI issued when two or more contract documents provide conflicting information about the same item
2. Incorrect information – RFI issued when the contract documents provide information that is an error
3. Insufficient information – RFI issued when the information supplied in the contract documents is considered incomplete
4. Questionable information – RFI issued when the information supplied in the contract documents is considered inappropriate about its application in the project

Lack of guidance and proper documentation (RII=0.6205) is an obstacle to graduate architects due to lack of consistency, reuse of notes and details of similar projects, wrong assumptions of standard practice, inexperience, lack of clarity, and poor interface co-ordination, poor management practices, inadequate quality management, poor communication, absence of well-defined design leadership, unclear project leadership role and lack of design verification, low design fees, low-quality control, low design time allowances, low constructability, low quality of staff, unreliable and incompetent staff, acceptance of low design fee, time boxing, stress, repetitive tasks, limited attention, biases, modification of rules, unavailable data, memory loss, misperception of data, over-reliance on default values and failure to monitor data. These errors in contract documentation caused poor project performance, and plagued construction projects with disputes, wastes, variation, project abandonment, loss of confidence and reputation, and eventual discouragement of investment in construction projects among others.

4.3.4 Rank 4: Deficient in Design Management

Deficiency in design management ranked fourth with an importance index of 0.7373. This theme contained a combination of five correlated variables **from very important obstacle to little important obstacle** as follows:-:

1) OB27 Insufficient design detail (RII= 0.8032)
2) OB34 constant design changes (RII=0.7606)
3) OB14 design error (RII=0.7465)
4) OB5 unworkable detail (RII=0.7102)
5) OB2 slow decision (RII=0.6661)

Deficient in design management is an obstacle when graduate architects suffer from a lack of systematic planning and deficient specification of tasks and responsibilities. This result is aligned with previous findings from Barber et al. (2020) that the design process in construction is fragmented, poorly planned, and poorly managed. This scenario happens when the involved persons perceive uncertainty in what has to be done, who has to do it, and when it has to be ready. Graduate architects are unsure how to move on with the project.

Insufficient design detail (RII=0.8032) was the highest obstruction because graduate architects are found missing coordination between disciplines when lack of communication between designers and graduate architects. Deficient planning and resource allocation, deficient input information, and changes contribute to the incompleteness of design detail. Graduate architects ended up being bombarded with queries by contractors during construction.

Constant design change (RII=0.7606) occurs when graduate architects meet indecisive employers such as they need persuading to understand the importance of defining what they want, lack alternative proposals submitted, they are unsure whether all their requirements are transferred to the project, a project initiated in a rush of time and there is no time for thinking thoroughly, lack of methodical programming in the project, lack of experience and knowledge of design and the construction process, lack of funding allocated inadequate briefing, and poor communication with design consultants. Graduate architects failed to persuade employers to make design confirmations. This result agrees with Rounce (1998) that experience and knowledge are the key points to convince the client for confirmation.

Design error (RII=0.7465) and unworkable detail (RII=0.7102) occurred when there was poor integration among design team members that hindered the flow of information, e.g. engineers used CAD technologies while architects used REVIT to document their designs, and as a result, some drawings were issued with dimensional errors and missing information. These are obstacles to graduate architects due to incomplete design. Slow decision (RII=0.6661) accounts for the least obstacle among all the factors because the decision-making usually falls under the building contract administrator and not graduate architects.

4.3.5 Rank 5: Deficient in Quality and Assessment Management

Deficient in quality and assessment management ranked fifth with an important index of 0.7011. This theme contained a combination of five correlated variables **from very important obstacle to little important obstacle** as follows:-:

1) OB12 Inadequate site inspection (RII= 0.8142)
2) OB32 unfamiliar building specification (RII=0.8063)
3) OB17 absence of a clear uniform standard of work acceptance (RII=0.6614)
4) OB19 non-integrated project delivery (RII=0.6236)
5) OB4 delay reply queries (RII=0.6000)

Inadequate site inspection (RII= 0.8142) is the main obstacle for graduate architects because lack of awareness among graduate architects in project quality control and project implementation work procedure. This result is aligned with previous findings from Zulkifli (2020) that reasons for inadequate site inspection carried out by graduate architects are inspection data, entering/transferring data to a computer after a site inspection is tedious, poor communication during the inspection, delay in method statement approval, data inconsistency that leads to confusion during inspection, delay in material approval, and delay in reply RFI.

Unfamiliarity with building specifications (RII=0.8063) is an obstacle because the specification is created to complement the design drawings and to convey the architect's design intention. However, graduate architects tend to recycle specifications for different projects. The problem with existing specification practice is associated with the unclear delineation of responsibilities amongst stakeholders and the infrequent use of reliable templates. This problem has caused disputes and inconsistency of work quality in the construction process.

The absence of a clear uniform standard of work acceptance (RII=0.6614) is an obstacle when there is a lack of guidelines on the acceptance level of workmanship on site. Quality work involves higher costs. Employers who emphasize cost-saving refuse to determine the types of acceptable workmanship in contract documents. Hence, QS stated 'workmanship based on architect's satisfaction' which the opinion is subjective and difficult to justify. In Malaysia, QLASSIC was set up as the standard for the construction stakeholders. Developers and contractors that have adopted QLASSIC have been reported to deliver high-quality buildings. Therefore, adopting good quality procedures can serve to reduce defects.

Non-integrated project delivery (RII=0.6236) and delayed reply queries (RII=0.6000) account for fewer obstacles to graduate architects. Non-integrated project delivery is not a major obstacle as the design changes are restricted by sales and purchase agreements. Delayed reply queries are also less obstruct to graduate architects because they may reply to the contractor expeditiously, but they are not expected to provide the information immediately.

4.3.6 Summary of Analysis for Objective 1

Statistical analysis results in Figure 4.13 show that there are 5 main obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. The obstacles shown in Table 4.16 are categorised into a sequence from **very important obstacle to little important obstacle**:

1) deficient in claims and legal matters management,
2) deficient communication and relationship management,
3) deficient in project management,
4) deficient in design management and
5) deficient quality and assessment management.

Deficient in claims and legal matters management is a very important obstacle to graduate architects in BCA. The jargon language used in most of the contracts as pointed out by Sebastian & Davidson (2009) inhibits graduate architects from understanding the contract documents. This finding is parallel with the finding by Ajator (2017), who confirmed that unclear scope in contract documents hinders graduate architects' work performance.

Deficient in communication and relationship management is the second obstacle to graduate architects. Communication breakdowns often occurred on site that delayed the construction. This result is aligned with previous findings from Saram &Ahmed (2001) that lack of coordination is the main source of communication breakdown between graduate architects with project stakeholders. The design was not coordinated properly and ended with unnecessary variation orders for employers.

The moderately important obstacle is deficient in project management when graduate architects encounter the following situations such as poorly defined goals, poor team skills, inadequate communication, lack of risk assessment, accepting impossible deadlines, resource deprivation, ambiguous contingency plans, lack of accountability, scope changes frequent, lack of stakeholder engagement, and high expectations. This result is aligned with previous findings from Kertzner (2022) that inadequate communication and accepting impossible deadlines affect project management.

A slightly important obstacle faced by graduate architects is deficient in design management when graduate architects suffer from a lack of systematic planning and deficient specification of tasks and responsibilities. This result agrees with Barber et al. (2020) that the design process in construction is in bad conditions. This scenario happens when the involved persons perceive uncertainty in what has to be done, who has to do it, and when it has to be ready. Graduate architects are unsure how to move on with the project.

Of little important obstacle is deficient in quality and assessment management when a lack of awareness among graduate architects in project quality control and project implementation work procedure. This problem has caused disputes and inconsistency of work quality in the construction process. Therefore Bukola et al. (2018) suggested that the root cause of the work obstructions faced by graduate architects need to be identified. The next section analysed findings regarding the root cause of the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia.

Table 4.16: Summary result from the survey for types of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

Problem	Theme	Variable		Description
Obstacles faced by graduate architects while supporting BCA of housing projects	Deficient in claims and legal matters management	OB5 OB15 OB10	poor contract management Unaware of legal policy Discrepancy in contract documentation	a. Unaware of architect's legal responsibility and scope of duties b. difficult to understand contract document **c.** misinterpretation and misunderstanding of facts in contract obligations
	Deficient in communication and relationship management	OB1 OB3 OB6 OB33 OB35	Communication breakdown Lack of coordination between project stakeholders Lack of information in drawings Lack of understanding of client's requirements Misunderstanding terms	a. fear to communicate b. delay notification of change c. lack of sector experience d. individual barrier e. slow information flow among parties f. lack confidence
	Deficient project management	OB25 OB36 OB28 OB21	Conventional management protocol Incomplete documentation Ineffective management Lack of guidance and proper documentation	a. information deficiencies and poor coordination b. incomplete design c. deficient planning or resource allocation
	Deficient in design management	OB22 OB34 OB23 OB31 OB2	Insufficient design detail Constant design changes Design error Unworkable detail Slow decision	a. unbalanced resource allocation b. lack of coordination between disciplines c. deficient or missing input information d. erratic decision making e. failing to plan information flow
	Deficient quality assessment management	OB12 OB32 OB17 OB19 OB4	Inadequate site inspection Unfamiliar building specification Absence of clear uniform standard of work acceptance Non-integrated project delivery Delay reply queries	a. insufficient time for quality management b. insufficient information provided by consultants c. no proper guideline on workmanship quality d. unclear technical requirements of material, construction techniques during quality control e. unsure what item to inspect during the site walk f. unfamiliar design detail

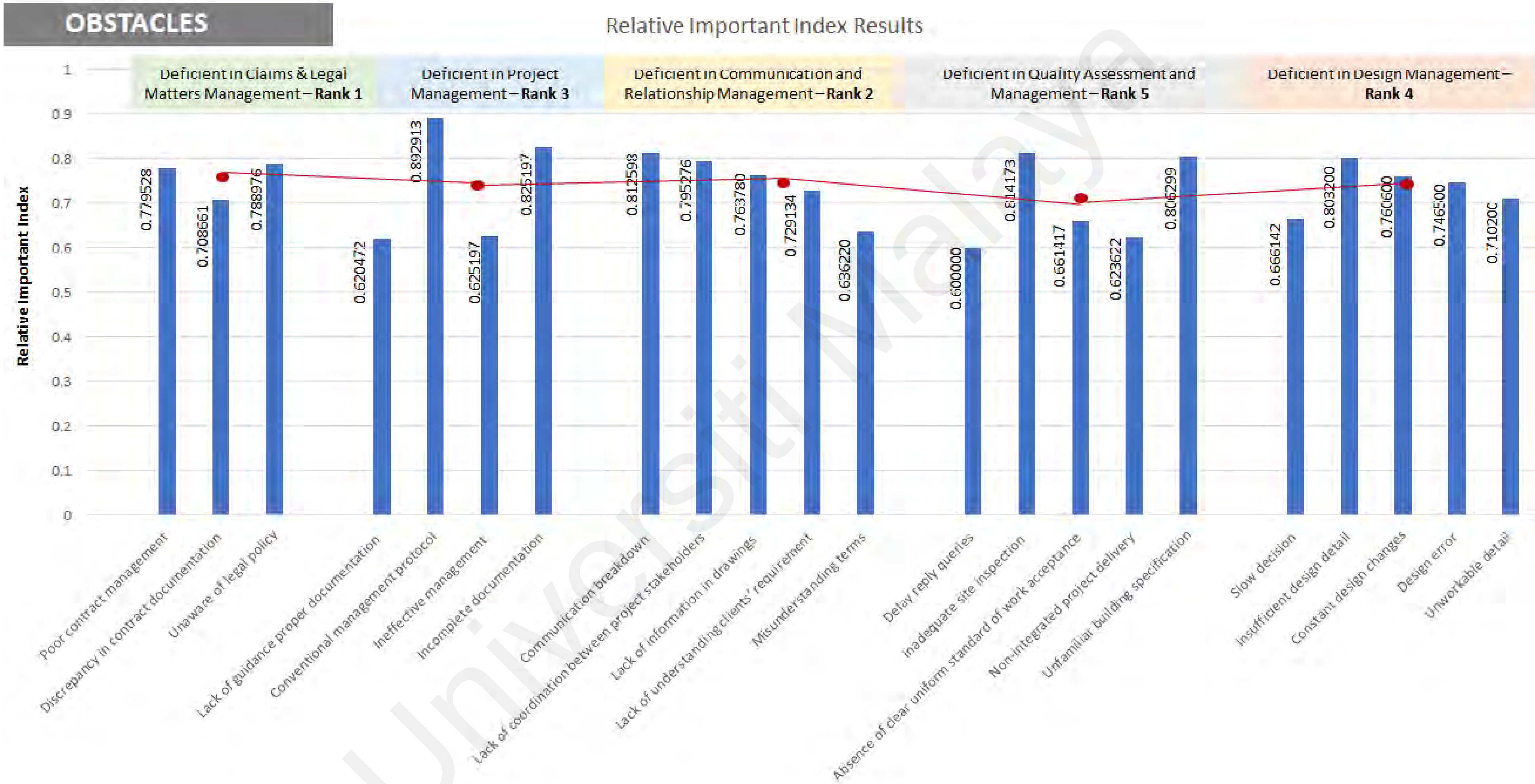


Figure 4.13: Summary ranking result for types of obstacles faced by graduate architects in BCA

4.4 Research Objective 2 – "To Investigate The Root Causes Of The Obstacles Faced By Graduate Architects While Supporting BCA of Housing Projects In Malaysia"

The Likert scale and ranking analysis were applied to rate the root causes of the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. In the literature review presented in the previous chapter, there are 5 root causes of the obstruction when supporting BCA of housing projects considered in this study. The root causes are:

1. Inadequate claim and legal matter management skill
2. Inadequate communication and relationship management skills
3. Inadequate project management skill
4. Inadequate design management skill
5. Inadequate quality assessment and management skill

The respondents were asked to rate the degree of importance of the skills lacking in graduate architects when supporting BCA housing projects. The Likert scale of 5, from which 1 indicates of little important skill to 5 very important skill was applied. The result of responses is calculated and ranked using the Relative Index method which represents the strength of response from 0.2 to 1.0 for each variable where 1.0 indicates 100% very important skill by all respondents and 0.2 is 100% of little important skill.

Table 4.17 explains in detail the results regarding inadequate skills in graduate architects such as inadequate claim and legal matters management skills, inadequate communication and relationship management skills, inadequate project management skills, inadequate design management skills, and inadequate quality assessment and management skills.

The overall result of the inadequate skills in graduate architects while supporting BCA of housing projects shows that the top three themes are 'inadequate quality and assessment management skill', followed by 'Inadequate design management skill', third 'inadequate communication and relationship management skill'. To determine the scale of research variables to achieve a certain level, an average index is to be provided. The average index is classified into the following:

0.86 – Of little important skill

0.87 – Slightly important skill

0.88 – Moderately important skill

0.89 – Important skill

0.90 and above – Very important skill

Table 4.17: RII result from respondents for root causes of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

Code	Theme	Frequency						Relative Important Index	Average Index	Level of importance	Rank
		1	2	3	4	5	Total				
Inadequate Claims and legal matters management skill											
S9	conflict management	0	1	17	45	64	127	0.870866	0.870866	Slightly important	4
Inadequate Communication and relationship management skills											
S4	Understand clients' aspiration	0	0	15	55	57	127	0.866142	0.889764	Moderately important	3
S7	Technical coordination	0	0	6	60	61	127	0.886614			
S11	Oral	0	2	9	45	71	127	0.891339			
S12	Ability to chair meetings	0	1	8	44	74	127	0.900787			
S3	Interpersonal	0	0	7	47	73	127	0.903937			
Inadequate Project management skill											
S10	Writing	0	2	11	43	71	127	0.888189	0.890551	Important	2
S1	Project management	0	0	9	50	68	127	0.892913			
Inadequate Design management skill											
S5	Skill to adapt to changes	0	2	10	55	60	127	0.872441	0.890551	Important	2
S13	Make a decision	0	0	7	44	76	127	0.908661			
Inadequate Quality assessment and management skill											
S2	Technical	0	0	7	42	78	127	0.911811	0.896062	Very important	1
S6	Quality management	0	0	16	52	59	127	0.867716			
S8	Resolve technical problem	0	0	8	42	77	127	0.908661			

4.4.1 Root causes rank 1: Inadequate Quality assessment and management skill

Inadequate quality assessment and management skills ranked first in root causes of obstacles with an important index of 0.8961. This theme contained a combination of three correlated variables **from very important to little important** root causes as follows:-:

1) S2 technical (RII= 0.9118)
2) S8 resolves technical problems (RII=0.9087)
3) S6 quality management (RII=0.8677)

Lack of technical skills (RII=0.9118) is a very important obstacle faced by graduate architects while supporting BCA of housing projects. The architectural profession has failed to create the range of skills required to meet the demands of the present construction industry. The range of skills consists of planning and scheduling, construction management activities, basic technical knowledge in own field, productivity and cost control, forecasting techniques, quality control, estimating and tendering, reading and understanding drawings, design activities, and background. This result is aligned with previous findings from Mari et al. (2019) that technical skills are often attained through training and experience within a field which absent among graduate architects.

Lack of resolving technical problems (RII=0.9087) and lack of quality management (RII=0.8677) are part of the root cause because graduate architects are unfamiliar with proper design, detailing, and choice of material during construction. Subsequently, longer time, skilled workers are required to complete the construction when applying conventional methods, materials, and design. This result agrees with Alawag et al.(2023) that discrepancies or errors in contract documents and drawings are often left for the contractor during construction who tends to find the easiest and fastest solutions where workmanship has been sacrificed.

4.4.2 Root causes rank 2: Inadequate Design management skill

Inadequate design management skills ranked second in root causes of obstacles with an important index of 0.8906. This theme contained a combination of two correlated variables **from very important to little important** root causes are as follows:-:

1) S13 makes a decision (RII= 0.9087)
2) S5 skill to adapt changes (RII=0.8724)

Inadequate design management skills (RII=0.8906) as the main root causes of obstacles among graduate architects due to a lack of communication and coordination between designers with graduate architects, weakness in the definition of the time required for each design phase, and missing coordination between disciplines among project stakeholders. This finding is parallel with the finding by Gamil and Rahman (2023) that if one party failed to convey his or her intentions would lead to misunderstanding and the associated problems.

Lack of skill to make a decision (RII=0.9087) is part of the root cause of the obstacles when graduate architects are unable to make decisions. They often experience decision-making as confusing and non-rational. Moreover, they are unsure of the process of decision-making from the moment of problem definition, negotiated and controlled by powerful actors, through communication, and argument between members to nodal judgments and resolution which forms the decision. Another reason for the lack of decision-making skills is due to inadequate briefing by the client. This result is aligned with previous findings from Barton (2002) that the problem of cost, quality, and concept design is attributable to inadequate briefs. Time pressure affects decision making and information suffers degradation when not delivered on time.

Lack of skill to adapt to changes (RII=0.8724) contributes to the root cause when graduate architects adopt traditional modes of project delivery based on their basic training and experience. In this mode, the graduate architect's energy is devoted to low-level management of contracts, focusing on time and cost without adequate attention to the method to attain the best overall results. This is parallel with studies done by Koskela et al. (2002) who found that the most frequent causes of severe deviations during design were deficient planning and resource allocation, deficient input information, and changes. Graduate architects are unable to adapt to changes due to:

1) Assumptions are made and checked later – which leads to redoing when assumptions have to be corrected after checking. Often checking is easily forgotten and discrepancies between different designs might emerge
2) Design input is actively sought in design meetings and by telephone – which tends to make the design of other designers fragmented, preventing concentration
3) Design iteration is eliminated through an alternative construction method – more costly
4) The interface between design tasks is prearranged – the solution is sub-optimal
5) The design solution is over-dimensioned to absorb all possible future decisions – the solution is sub-optimal
6) The design solution is selected based primarily on the consideration of the design process – the solution might be inferior in other respects, like functionality and cost

4.4.3 Root causes rank 2: Inadequate Project management skill

Inadequate project management skills ranked the same as inadequate design management skills which is the second root cause of obstacles with a similar important index of 0.8906. This theme contained a combination of two correlated variables **from very important to little important** causes of the obstacles are as follows: -

1) S1 project management (RII= 0.8929)
2) S10 writing(RII=0.8882)

Inadequate project management skill (RII=0.8906) is part of the root causes of the obstacles due to project failure and correcting the situation requires training in advance to get the job done.

This theme consists of 2 variables where a lack of project management skills can be easily detected from the rate of project success. Graduate architects are found to lack this skill when they fail to identify the client's objectives in terms of utility, function, quality, time and cost, and the establishment of relationships between resources. Consequently, graduate architects are unable to integrate, monitor, and control contributors to the project and their output, unable to evaluate and select alternatives in pursuit of the client's satisfaction with the project outcome. This result is aligned with previous findings from Ajator (2017) that effective project management requires integration of all parties e.g. ownership, use, design, estimation, construction, operation and management, etc, involved to ensure success.

Lack of writing skill (RII=0.8882) among graduate architects is part of the root causes because there are misunderstandings during construction, inadequately defined tasks and critical processes, and uncertainty regarding the responsibilities, scope, or objectives of the projects that caused projects to fail. This result agrees with Koc & Gurgun (2022) that writing skill is part of contract documenting and it is important for recording the constant selling and reselling of ideas, documenting the scope and methodologies of the project to diverse groups of people, recording the bargaining with service providers and suppliers, or recording negotiating to settle disputes or interpersonal conflict between project team members or other stakeholders.

4.4.4 Root causes rank 3: Inadequate Communication and relationship management skill

Inadequate communication and relationship management skills ranked third root causes of the obstacles with an important index of 0.8898. This theme contained a combination of five correlated variables **from very important to little important** causes of the obstacles are as follows: -

1) S3 interpersonal (RII= 0.9039)
2) S12 ability to chair meetings (RII=0.9008)
3) S11 oral (RII=0.8913)
4) S7 technical coordination (RII=0.8866)
5) S4 understands clients' aspirations (RII=0.8661)

Inadequate communication and relationship management skills consist RII value of 0.8898 when communicated messages fail to flow from the sender and fail to encode through the transmission channel/medium by verbal method to the receiver that decodes the messages. This result agrees with Mari et al. (2019) that each stakeholder has different expectations on the project delivery and the graduate architect needs to exercise his or her skill to manage stakeholder's expectations. Poor communication skills caused the graduate architects unable to convey the right thing at the right time to project members. Consequently, it affects the schedule, the cost, the safety of workers, and the project quality.

Lack of interpersonal skill (RII=0.9030) is part of the root causes when problems occur such as difficulty in motivating project stakeholders due to lack of formal authority and influence, internal conflicts between graduate architects and project teams when facing different stakeholder expectations, ineffective communication whereby graduate architects received an insufficient flow of information within the project team, misunderstanding, excessive amount of information, unavailability of necessary information and late arrival of information, and lack of teamwork and cooperation when each individual develops personal career goals and has competitive thinking. This result agrees with Jena & Satpathy (2017) that interpersonal skill is a nontechnical ability to facilitate mastered performance in particular contexts to ensure project success.

Lack of ability to chair meetings (RII=0.9008) occurred when graduate architects are expected to know, understand, and able to demonstrate the capability to control a meeting after the completion of a process of learning but they failed because meetings are conducted without an agenda, there was no interaction where participants get bored and unable to share feedback, meeting stray too far from the topic of discussion, allowing conflict to get out of control and not summarizing actions required to be taken. This result agrees with Krishna (2023) that the ability to chair meetings will cause meetings of mind to become gossip which is a waste of time and money.

Lack of oral skill (RII=0.8913), lack of technical coordination (RII=0.8866), and lack of understanding of clients' aspirations (RII=0.8661) are the root causes for obstacles faced by graduate architects as the practice of supporting BCA involves many different stages such as planning, project organization, designing and modeling of building design and construction, documentation, contract administration, and others.

Graduate architects need to deal and work with many parties including employers, project managers, surveyors, engineers, graphic designers, interior designers, contractors, and suppliers to accomplish these diverse tasks. This result is aligned with previous findings from Mari et al. (2019) that a lack of understanding of clients' aspirations will prevent graduate architects from guiding a team of professionals, discussing and negotiating with contractors/employers, and resolving issues and problems related to a project. Consequently, this caused them unable to adapt to the high expectations of the job nature, as mistakes and incompetency lead to damaging impacts on firms' performance, productivity, and competitiveness.

4.4.5 Root causes rank 4: Inadequate Claims and legal matters management skill

Inadequate claims and legal matters management skills ranked fourth with an important index of 0.8709. This theme contained only one correlated variable that formed the root cause of the obstacle which is: -

S9 conflict management (RII=0.8709)

Inadequate claims and legal matters management skill is the least important variable contributing to the root causes of obstacles for graduate architects because conflict only occurs when failure to develop and manage expectations such as poor briefing and coordination, lack of experience in situations, difficulty in arriving at a consensus, failure to take on board opinions, design errors, and omission, design failing to meet specification, construction failing to meet design requirements, difficulty in obtaining formal approval of decisions, difficulty in clients interpreting drawings, quality of work less than expected, exceeding project duration and budget, building function problems, internal politics, conflict in loyalty, different levels of change control, bypassing single point of contact, different emphasis on the project, difficulty in managing professional group interfaces and the use and misuse of standard documents and contracts. This result agrees with Fenn et al. (1997) that the four conflicting elements are function (all the technical and physical requirements), aesthetic (the satisfaction of all the human and subjective aspects that had been enshrined in the result), cost (both capital and running costs), and time (the logistic requirements for commercial completion and occupation).

Lack of conflict management skills (RII=0.8709) is part of the root causes of the obstacles faced by graduate architects. Conflict occurs when gaps in the requirements, overlap, and conflict between drawings, specifications, and schedules, occur due to inadequate understanding, coordination, and checking between the disciplines and people working in parallel on developing the design. This result agrees with Loosemore et al.(2000) that change in the construction process leads to conflict; however, contradict with study done by Gardiner and Simmons (1992) that conflict leads to change. Most conflicts were managed by exploring alternative solutions, and different perspectives, and encouraging all participants to engage in discussions and cooperate to result in win-win solutions which normally require a certain amount of experience to deal with. Unfortunately, this is what graduate architects lack and they are found unable to let dispute parties talk openly and honestly regarding the root causes of the conflict. However, the lack of this skill is considered minor when considering employers may engage a third party to resolve the dispute rather than depend on graduate architects.

4.4.6 Second Summary of Analysis for Objective 2

Statistical analysis results in Table 4.18 show the main root cause of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia is inadequate skills. The types of skills required in Figure 4.14 but lacking among graduate architects based on the importance level from **very important to little important root causes** are: -

1) inadequate quality assessment and management skills,
2) inadequate design management skills,
3) inadequate project management skills,
4) inadequate communication and relationship management skills, and
5) inadequate claims and legal matters management skills.

The skills that are very important but lacking among graduate architects are quality assessment and management skills. This result is consistent with Celadyn (2020) that quality assessment and management skills are needed to enhance the working capacity of graduate architects and to have better control of workmanship quality.

The important skills but lacking among graduate architects are design management skills and project management skills which carry the same weight while supporting BCA. This result is parallel with studies done by Mari et al. (2019) and Tilley et al. (2005a) confirmed that design management skills and project management skills rely on making a decision based on experience and knowledge. Lacking these skills caused rework and projects delayed.

Zerjav & Ceric (2002) pointed out that communication and relationship management skill is needed by graduate architects when they are involved in BCA. This is parallel with the result of the survey where inadequate communication and relationship management skill falls under moderately important. Graduate architects who lack this skill are unable to communicate and convey a message consequently causing the end product not to tally with the initial design.

Lastly, the result showed that inadequate claims and legal matters management skill has the least votes which contradict the study done by Verma (1998) which emphasizes little importance for graduate architects to master claim and legal matter management skills for smooth project delivery due to the disputing party's tendency to source for 3rd party to resolve the dispute i.e. mediation, adjudication, and arbitration.

Table 4.18 shows the summary of the results of the survey findings. The development of this summary can assist graduate architects in establishing mitigation measures to resolve obstacles faced by them while supporting BCA of housing projects.

Table 4.18: Summary result from the survey for root causes of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

Issue	Root causes	Variable		Descriptions
Root causes of obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Inadequate quality assessment and management skill	RC2 RC6 RC8	Technical Quality management Technical Problem	-architecture profession -failed to create the skill -lack of good design -improper plans & specifications
	Inadequate Design management skill	RC13 RC5	Make a decision Adapt changes	-Missing coordination between stakeholders -Time pressure affects decision making -Unsure process of decision making -Making incorrect assumptions
	Inadequate Project management skill	RC1 RC10	project management writing	-Poor project planning & scheduling -unable to identify the client's objective -Unable to control contributors to the project & output
	Inadequate communication and relationship management skills	RC3 RC4 RC7 RC12 RC11	Interpersonal Understand clients' aspirations Technical coordination Ability to chair meeting Oral	-internal conflicts -ineffective communication -insufficient flow of information -lack of teamwork
	Inadequate claim and legal matters management skill	RC9	Conflict management	-poor briefing -lack experience -failure to take board's opinions

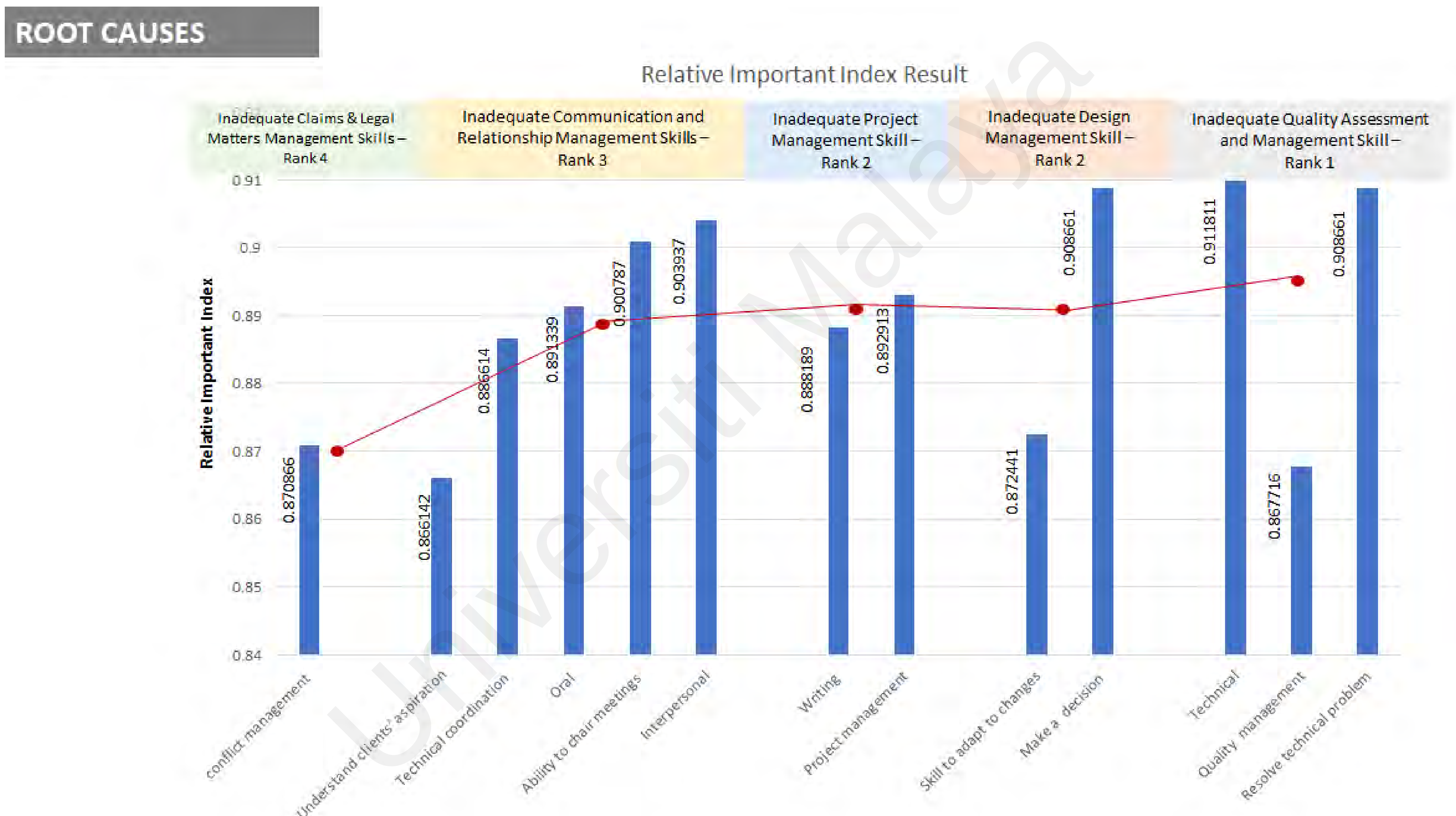


Figure 4.14: Summary ranking result for root causes of obstacles faced by graduate architects in BCA

4.5 Research Objective 3 – "To Establish Mitigation Measures For Obstacles Faced By Graduate Architects while Supporting BCA Of Housing Projects In Malaysia"

The Likert scale and ranking analysis were applied to rate the mitigation measures for obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia. In the literature review presented in the previous chapter, there are 5 types of mitigation measures for the obstacles faced by graduate architects when supporting BCA of housing projects in Malaysia considered in this research. The mitigation measures are:

1) Instil claims and legal matters management knowledge
2) Instil communication and relationship management knowledge
3) Instil project management knowledge
4) Instil Design management knowledge
5) Instil quality assessment and management knowledge

The respondents were asked to rate the degree of importance of the type of mitigation measures for the obstacles faced by graduate architects when supporting the building contract administrator for housing projects in Malaysia. The Likert scale of 5, from which 1 indicates of little important mitigation measure to 5 very important mitigation measure was applied. The result of responses is calculated and ranked using the Relative Index method which represents the strength of response from 0.2 to 1.0 for each factor where 1.0 indicates 100% very important mitigation measure by all respondents and 0.2 is 100% of little important mitigation measure. Table 4.19 explains in detail the result regarding mitigation measures for obstacles faced by graduate architects such as instilling claims and legal matters management knowledge, instilling communication and relationship management knowledge, instilling project management knowledge, instilling design management knowledge, and instilling quality assessment and management knowledge.

The overall result of the type of mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects shows that the top three types are ‘instill claims and legal matters management knowledge’, followed by ‘instill building quality assessment and management knowledge’ and ‘instill design management knowledge’. To determine the scale of research variables to achieve a certain level, an average index is to be provided. The average index is classified into the following:

< 0.80 – Of little important mitigation measure

<0.87 – Slightly important mitigation measure

0.87 – Moderately important mitigation measure

0.88 –Important mitigation measure

0.89 – Very important mitigation measure

Table 4.19: RII result from respondents for mitigation measures on obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

Code	Mitigation measures	Frequency 1	2	3	4	5	Total	Relative Important Inde	Average Index	Level of importance
Instil claims and Legal matters management Knowledge										
MM18	Authority approving process	0	0	7	42	78	127	0.911811	0.888977	Very important
MM10	Construction contract law	0	1	18	46	62	127	0.866142		
Instil communication and relationship management knowledge										
MM7	Structural engineering	1	4	21	53	48	127	0.825197	0.766929	Of little important
MM3	Town planning	0	7	23	47	50	127	0.820472		
MM6	Electrical engineering	1	6	24	53	43	127	0.806299		
MM5	Mechanical engineering	1	5	29	51	41	127	0.798425		
MM9	Quantity Surveying	3	4	31	45	44	127	0.793700		
MM14	Interior design	2	9	34	50	32	127	0.759055		
MM13	Landscape	2	12	29	54	30	127	0.754331		
MM8	Geotechnical engineering	4	15	41	38	29	127	0.714960		
MM4	Civil engineering	10	24	45	29	19	127	0.636220		
MM20	IT Construction	1	8	41	42	35	127	0.760630		
Instil project management knowledge										
MM1	Project management	0	1	8	44	74	127	0.900787	0.798819	Slightly important
MM16	Valuation study	1	9	29	57	31	127	0.770079		
MM15	Financial planning	3	11	31	44	38	127	0.762205		
MM17	Environmental studies	1	10	34	49	33	127	0.762205		
Instil Design management knowledge										
MM3	Architecture	0	7	23	47	50	127	0.900787	0.877165	Moderately important
MM19	Feasibility studies	2	0	12	61	52	127	0.853543		
Instil Quality assessment and management knowledge										
MM11	Construction methods	0	1	9	56	61	127	0.878740	0.877953	Important
MM12	Building materials	0	1	12	51	63	127	0.877165		

4.5.1 Mitigation Rank 1: Instill claim and legal matters management knowledge

Instil claim and legal matters management knowledge ranked first with an important index of 0.8890. This theme contained a combination of two correlated variables **from very important to little important** mitigation measures are as follows: -

1) MM18 authority approving process (RII= 0.9118)
2) MM10 construction contract law (RII=0.8661)

To instill claims and legal matters management knowledge (RII=0.8890) is crucial for a graduate architect to understand the contents of the documents and the spirit of the contractual relationships. This result is aligned with previous findings from Koc & Gurgun (2022) that a detailed understanding of the claims and legal matters is essential to minimize the construction risks that may lead to unnecessary problems such as disputes, claims, litigation, shoddy works, and reworks even loss of future business relations. The effects of construction disputes are detrimental as they may cause project delays, undermine team spirit, increase project costs, and above all damage continuing business relationships.

To instill this type of knowledge is through a better understanding of contract documents such as sincerity in contracting, the drawing must be clear and checked by all parties, clarified in the contract document for better understanding, the employer's requirement is stipulated, contract document was written in simple language, contract document is precise, objective and practical, qualified personnel to prepare the contract document, regulatory requirement stipulated, minimize the use of complicated legal phrases, familiar general condition of the contract, and simplify construction work specification.

Instilling authority submission process knowledge (RII=0.9118) is part of the mitigation measures because the complexity of the submission process has a huge impact on the project outcome. This result is aligned with previous findings from Zahimi et al. (2024) that the authority submission process is lengthy and proper planning is required to ensure project success.

Instilling construction contract law knowledge (RII=0.8661) is another mitigation measure for graduate architects because could prevent payment disputes such as underpayment, late payment, or non-payment issues that lead to delay or abandonment in the construction projects.

4.5.2 Mitigation Rank 2: Instill quality assessment and management knowledge

Instill quality assessment and management knowledge ranked second with an important index of 0.8780. This theme contained a combination of two correlated variables **from very important to little important** mitigation measures are as follows:

1) MM11 construction methods (RII= 0.8787)
2) MM12 building materials (RII=0.8772)

Instilling quality assessment and management knowledge (RII=0.8780) as mitigation measures for the obstacles faced by graduate architects as quality control reduces the possibility of changes, mistakes, and omissions, which in turn result in fewer conflicts and disputes. Quality assessment and management knowledge involves establishing project-related policies, procedures, standards, training, guidelines, and systems necessary to produce quality.

Quality in the construction industry can be defined as meeting the requirements of the designer (well-defined scope, qualified staff, adequate information before design, provisions for decision and contracting to perform work), regulatory agencies (public safety and health, environmental considerations, protection of public property and laws and regulations) and the employer (functional adequacy, completion time, budget and lifecycle costs). This type of knowledge could be instilled through quantified assessment of designs through finished design, constructability review on design documents at an early stage by checking on discrepancies or errors, and ensuring coordination between drawings and specifications to ensure smooth project delivery by implementing constructability programs at different project stages.

Instilling construction methods knowledge (RII=0.8787) is part of the mitigation measures as the construction industry has experienced revolution and huge changes with the rapid growth of technology and the introduction of new building materials and modern construction methods. This result aligned with previous findings from Alawag et al. (2023) that different construction methods influence project performance in various ways and impact the productivity of construction projects. The choice of construction method significantly affected the cost, time, and quality of buildings, and adopting inappropriate methods increased the cost and duration of projects.

Moreover, fluctuations in the construction market and the seasonal nature of the industry have forced many contractors towards diversity. As a result, they do not focus on conventional construction methods but try to adopt advanced methods and techniques. Hence, graduate architects need to understand the latest construction techniques for ease of supervising and monitoring the contractor's work.

Even though the construction methods are selected and confirmed by contractors, graduate architects also need to know about the criteria for selecting the appropriate construction methods for cost-saving, time-saving, and quality improvement. This result agrees with Bukola et al. (2018) that the criteria for building method selection include the following:

a. Economical – initial system construction cost, design cost, cost of life cycle, maintenance cost, structure value, return on investment speed, cost of materials, labor costs, impact on the cost of interface system, impact on the cost of related items, construction time, delivery time, uncertainty of time
b. Qualitative – compliance with construction regulations, building control, defects, flexibility, structural resistance, resistance against fire, seismic resistance, possibility of retrofitting in the future, performance of building lifecycle, durability
c. Social – safety and health concerns for workers, residents' health, impact on the labor market, physical space, beauty options
d. Environmental – energy consumption in design and construction, consumption of materials, waste production, production of pollution, energy efficiency when using the building, recyclability, adaptation to climatic and environmental conditions
e. Executive and technical – design repeatability and standardization, buildability, ease of implementation, design flexibility, use in future projects, height limitation, structural weight, production capacity

f. Procurement/logistics – supply chain, ease of site coordination, building service integration, availability of local companies, qualified workers, availability of equipment for installation, system market availability, manufacturer competence and capability, contractual risk, space requirement for building structures, execution expertise

Instilling building materials knowledge (RII=0.8772) is also part of the mitigation measures for graduate architects because this knowledge is crucial to protect the employer's interest against substandard materials and for the estimation of the provision of funds for the project. This type of knowledge could be instilled through attending the latest product launching by suppliers, technical seminars conducted by PAM, building material exhibitions (Archidex), etc.

4.5.3 Mitigation Rank 3: Instill Design management knowledge

Instill design management knowledge ranked third with an important index of 0.8772. This theme contained a combination of two correlated variables **from very important to little important** mitigation measures are as follows: -

1) MM3 architecture (RII= 0.9008)
2) MM19 feasibility studies (RII=0.8535)

To instill design management knowledge (RII=0.8772) as a mitigation measure for obstacles faced by graduate architects. This result is aligned with Gunduz & Mekkawy (2022) that the need to manage design activity has been recognized for some time, whether in industrial product design, architecture, or more recently construction. Management of architectural design is essential to deliver design intent and optimize value to project stakeholders.

This is to prevent conflicts between designers and contractors which can be attributed to poor planning of design, inaccuracy of design documents, high built cost of design options, delay of drawing supply, and unreasonable design fees.

This type of knowledge could be instilled through establishing links with various stakeholders to facilitate open communication to assist necessary information to be effectively integrated into the design process, team building, effective communication, timely responsiveness, partnering with employer to fully understand employer's expectations and requirements, partnering with designers to solve complex technical problems, especially for handling design changes, adopting optimization design initiatives and improving constructability.

To instill architecture (RII=0.9008) knowledge is another measure to assist graduate architects in smoothening their work progress. Architecture knowledge is a solid conceptual foundation for design management because the most frequent causes for severe deviations during design were deficient planning and resource allocation, deficient or missing input information, and changes. This result agrees with Coles & Barritt (2014) that the most significant causes of design problems are poor briefing and communication, inadequacies in the technical knowledge of designers, and a lack of confidence in preplanning for design work.

This issue occurred due to a lack of clear guidance on the role of the architectural manager, the insufficient effort being made by educational institutions to include architectural design management within the curriculum, and inadequate promotion of architectural management done by professional bodies to members of the profession.

Hence, an important source of how buildings perform has been derived from feedback studies in which buildings are in use and evaluated according to certain pre-established criteria.

This result also aligned with previous findings from Tilley (2005a) that the link between knowledge about how buildings are designed and used and the practical world of design and construction decisions exists in programming and post-occupancy evaluation (POE). Graduate architects must transfer information from the end-users to designers when they carry out design work. Designers will understand better about the suitability of certain designs when they receive feedback from end users and the best person to convey these messages is the graduate architects. This is due to graduate architects being the ones who are still involved in the projects after vacant possession. The end user will highlight information on building operations and management, user functionality and comfort, and the building delivery process adhering to initial design objectives and intentions.

Instill feasibility studies knowledge (RII=0.8535) is another mitigation measure for graduate architects. This result agrees with Best (2010) that a feasibility study is a requirement by an employer to determine the feasibility of different investment alternatives by calculating costs and benefits to extract measurements for every alternative. Based on these measurements, the employer will compare different alternatives and make the investment decision. There are many classifications for feasibility studies. Based on a study done by Gunduz & Mekkawy (2022), they can be classified according to profit and the function of the study.

a. Profit – this is known as the social profitability of the investment project that expresses the self-benefits of the project and any side effect of this project

b. Function – can be classified into legal feasibility study, marketing feasibility study, technical and engineering feasibility study, financial and economical feasibility study, and social feasibility study.

The procedures of the feasibility study involve the following:

a. Pre-feasibility study – discussion of investment idea including simple legal, marketing, technical and engineering, financial and economic or social criteria that lead to primary approval or refusal of the idea

b. Detailed feasibility study – a legal study that includes the legal aspects of the project, any legal issues forbidding the project, and any legal modifications required to proceed with this project. A market study that includes the supply, and demand analysis, technical and engineering studies that define the project capacity, type, complete design, construction process, and method, site location and planning schedules, financial and economic studies that define the investment costs including the fixed costs, financial schedule, resources, and budgets and revenues, social study measures the social profitability of the project.

c. Project appraisal – expected economic and social revenues of the project are evaluated and analysed using a variety of techniques to decide the project feasibility

d. Implementation – decided by the client after a feasibility study

4.5.4 Mitigation Rank 4: Instill project management knowledge

Instill project management knowledge ranked fourth with an important index of 0.7988. This theme contained a combination of four correlated variables **from very important to little important** mitigation measures are as follows: -

1) MM1 project management (RII= 0.9008)
2) MM16 valuation studies (RII=0.7701)
3) MM15 financial planning (RII=0.7622)
4) MM17 environmental studies (RII=0.7622)

To instill project management knowledge (RII=0.7988) to mitigate obstacles faced by graduate architects as project management in construction ranges from operational activities of architectural and engineering construction companies to the development of infrastructure in every country. This result aligned with the previous study by Guo & Zhang (2022) that project management is an exercise in control over quality, schedule, and costs includes the following aspects of management: integration, scope, time, cost, quality, human resources, risk, communication, and procurement. This knowledge is important for graduate architects to deliver the owner's physical development within the constraints of cost, schedule, quality, and safety requirements.

Project management knowledge in academic programs covers a significant proportion of the outlined knowledge areas such as finance and accounting, sales and marketing, strategic planning, tactical planning, operational planning, organizational behavior, organizational behavior, personnel administration, conflict management, personal time management, stress management, economic analysis, social trends, political developments, IT advancements, legal framework, statistics, probability theory and risk.

A little knowledge of accounting procedures, legal matters, and authority regulations is crucial for graduate architects to effectively deal with the many forces that bear on the construction process. Table 4.20 shows the skills that are generated through project management knowledge.

Table 4.20: Project management competencies

Competency	Description	Source
Conceptual thinking	Ability to see the big picture of the project	(Pinto, 2002)
Information seeking	Ability to seek information about people, issues, or the project situation	(White & Fortune, 2002)
Analytical thinking	Ability to understand a situation by deconstruction it	(Levitt, 2011)
Client orientation	Meeting clients' needs	(Yap & Skitmore, 2018)
Organizational awareness	Understanding the power relationships within the organization	(White & Fortune, 2002)
Vision and imagination	Knowing the strengths and weaknesses of a project	(Gido & Clements, 2014)
Results Orientation	Focusing the project team on key objectives to obtain optimum outcome	(Alias et al., 2012)
Organizing	Ability to organize project staff and integrate and allocate project resources effectively	(Alias et al., 2012)
Communication	Ability to communicate with all types and levels of people effectively	(Walker, 2015)
Impact and influence	Ability to obtain support for a course of action or to influence the views of other stakeholders	(Oberlender & Oberlender, 1993)
Flexibility	Ability to adapt and work flexibly within a variety of situations	(White & Fortune, 2002)
Self-management	Ability to remain composed, restrain negative actions, and cope well	(Gido & Clements, 2014)
Building relationships	Ability to build and maintain good relationships with clients, contractors, and local authorities	(Alias et al., 2012)
Negotiating	This skill is necessary for changes in projects' scope, cost, scheduling objectives, contract terms and conditions	(Gido & Clements, 2014)
Teamwork	Desire to work cooperatively as part of a team	(Oberlender & Oberlender, 1993)
Empowering	Giving people the opportunity for team members to participate in decision-making	(Walker, 2015)

Financial and commercial knowledge	Familiarity with construction costs and budgets	(White & Fortune, 2002)
Knowledge of risk management	Knowledge of risk management measures for construction projects	(Lock, 2017)

Instill valuation study (RII=0.7701) knowledge is another mitigation measure for obstacles faced by graduate architects because it is a useful method in addressing challenges such as budget constraints and project complexity in the construction industry. This result agrees with Salleh et al. (2016) that a successful valuation study should clarify the client's objectives, improve communication with stakeholders, and stimulate creativity through the interaction of participants of the valuation study. This type of knowledge could be instilled through innovative ideas and solutions, conducting orientation meetings for team members, cost estimate verification during the exercise, excellent communication skills, arranged site visits for team members, willingness to accept changes and innovations, clear definition and scope of different professionals, suitable feedback from the original design team, etc.

Instill financial planning knowledge (RII=0.7622) is another method to mitigate the obstacles. This result is aligned with previous findings from Guo & Zhang (2022) that this knowledge will give a total picture of the future financial activities of the project and ensure adequate funds, maintain a reasonable balance between outflow and inflow of funds, making growth and expansion programmers, reduce uncertainties with regards to changing market trends, etc. Financial planning in construction includes pre-tender estimate, tender pricing document, contract sum, revised contract sum, and final account. This knowledge could be instilled through templates for different cost planning and control functions at different stages in the delivery process of the project.

Financial planning is generally prepared by a quantity surveyor. However, graduate architects should know the principle of this knowledge for advising the employer when necessary.

Instilling environmental studies knowledge (RII=0.7622) to graduate architects is effective because they will be more precautionary when designing and selecting building methods and materials which has less impact on the environment. This result agrees with Gray & Larson (2006) that industrialized building methods are based on the widespread use of high-energy materials such as aluminum, cement, concrete, and steel and these materials are responsible for high levels of pollution as a result of the energy consumed during extraction, processing, and transportation of raw materials. Therefore, there is a need to reduce carbon dioxide emissions, reduction in the authorization of new quarries, have obligations to rehabilitate quarry workings, and prohibit material extraction from river beds.

Sustainable building construction could be formed through the usage of sustainable methods and materials to minimize the construction impact on the environment, such as the adoption of the IBS system by using prefabricating materials, applying green solutions, applying waste management where enforce site to recycle material, lean manufacturing to reduce energy and selection of materials from recycled products and from local sources, etc. This type of knowledge could be instilled through academic, workshops, and seminars conducted to increase environmental awareness among graduate architects.

4.5.5 Mitigation Rank 5: Instill communication and relationship management knowledge

Instill communication and relationship knowledge ranked fifth with an important index of 0.7669. This theme contained a combination of ten correlated variables **from very important to little important** mitigation measures are as follows: -

1) MM7 structural engineering (RII= 0.8252)
2) MM3 town planning (RII=0.8205)
3) MM6 electrical engineering (RII=0.8063)
4) MM5 mechanical engineering (RII=0.7984)
5) MM9 quantity surveying (RII=0.7937)
6) MM20 IT construction (RII=0.7606)
7) MM14 interior design (RII=0.7591)
8) MM 13 landscape (RII=0.7543)
9) MM8 geotechnical engineering (RII=0.7150)
10) MM4 civil engineering (RII=0.6362)

To instill communication and relationship knowledge (RII=0.7669) is the least effective mitigation measure as there were always several problems arose during every project no matter how thorough the briefing process, how clear the drawings were, and how good the site management was. This result agrees with Wahyuni et al. (2018) that communication breakdown occurs when one party fails to convey his or her intentions to another which leads to misunderstanding and associated problems that such a state may bring about.

How the project participants communicate with one another, through formal and informal communication channels is key to a successful project. The faster graduate architects communicate effectively the faster they will establish good working relationships and hence the stronger the likelihood of a successful project. Communication channels between parties are dependent upon how the building team is comprised and the procurement route selected, in particular between client and design team members, design team members, design team and construction team, and construction team members.

Graduate architects who manage the project must be aware of group dynamics and responsibilities throughout the project's diverse stages. This result also aligned with previous findings from Wahyuni et al. (2018) that seven measures of ideal communication include-

a. Careful assembly of a multi-skilled team with managerial, technological, and analytical abilities
b. Removal of artificial barriers, designers become part of the site management team
c. Considered use of management tools to ensure programming and progress data is continually revised and available to all parties
d. Abolition of conflicting interests, through incentives to minimize defensive action
e. Adequate resources for obtaining information held off-site
f. Limit disruption brought about by other projects
g. Record all events and actions for later analysis and feedback into future projects.

To instill knowledge such as structural engineering knowledge (RII=0.8252), town planning knowledge (RII=0.8205), electrical engineering knowledge (RII=0.8063), mechanical engineering knowledge (RII=0.7984), quantity surveying knowledge (RII=0.7937), IT construction knowledge (RII=0.7606), interior design knowledge (RII=0.7591), landscape knowledge (RII=0.7543), geotechnical engineering knowledge (RII=0.7150) and lastly civil engineering knowledge (RII=0.6362) is to assists graduate architect to communicate more effectively with co-workers, supervisors, consultants and clients which inevitable enhance relationships at work and advance their construction career.

This is because each discipline has its unique terms which are only known by insiders. This is aligned with previous findings from Krishna (2023) that every project stakeholder will arrive at the same understanding when the correct term is used. Hence, graduate architects need to learn these terms to gain rapport and speak the same language with other project stakeholders.

4.5.6 Summary of Analysis Objective 3

Statistical analysis results show that there are 5 types of mitigation measures for obstacles faced by graduate architects while supporting BCA housing projects in Malaysia. The types of mitigation measures for obstacles faced by graduate architects are tabulated in Table 4.21 and have been arranged in sequence based on popularity which is to instill claim and legal matters management knowledge, instill quality and assessment management knowledge, instill design management knowledge, instill project management knowledge and instill communication and relationship management knowledge.

Results in Figure 4.15 showed that instilling claims and legal matters knowledge is **very important** mitigation measure for obstacles faced by graduate architects. Under the claims and legal matters knowledge, the authority approving process is a must-know for graduate architects. This result is consistent with Rahim (2004), that the authority approving process is crucial for overall master program planning. Their finding is parallel with findings by Zahimi et al. (2024), who confirmed that authority submission is a lengthy process and various forms and permits need to be submitted and obtained before construction. Besides that, graduate architects need to be familiar with construction law to advise dispute parties when they seek alternate solutions to resolve the problem. Graduate architects may instill this type of knowledge through attending the latest authority submission road show, seminars organized to understand the latest authority's requirement, alternative dispute resolution courses organized by PAM, etc.

Statistic results show that instilling quality assessment and management knowledge is an **important** mitigation measure for graduate architects. Emmit (2006) confirmed that supervision and monitoring work will be improved if graduate architects understand the construction methods applied on site and can select proper building materials on site that will affect the outcome of the end product. Graduate architects may instill this type of knowledge through attending product launches by suppliers, technical seminars organized by PAM, Archidex exhibitions, etc.

Best (2010), pointed out that instilling design management knowledge is a **moderately important** mitigation measure as design management is the ability to translate design intent to building end product. Cooper & Lockwood (2009) further added that design management knowledge is crucial for graduate architects to convey end users' feedback correctly to designers for improvement in the future.

Graduate architects may instill this type of knowledge through post-occupancy evaluation (POE) by understanding the building operations and management, user functionality, comfort, and building delivery process from the end user's perspectives and transferring those comments into future design.

Results show that instilling project management knowledge is **slightly important** than communication and relationship management knowledge. This result parallels with findings from Heagney (2016), that graduate architects' master's in project management knowledge will have a deep impact on project performance as project management covers time, cost, and quality management. Graduate architects may instill this knowledge through education, conducting orientation meetings for team members, cost-saving templates, etc.

Communication and relationship knowledge is **of little important** in mitigating the problems as according to Zerjav & Ceric (2009), this is categorised as tacit knowledge that can only be gained through experience. However, graduate architects may instill this knowledge through communicating more with project stakeholders, conducting more technical coordination, etc.

Table 4.21: The Summary result of a survey on mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

Issue	Mitigation measures	Variable		Descriptions
Mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia	Instill Claims and legal matters knowledge	MM18 MM10	Authority approving process Construction contract law	a. pre-consultation with authority b. obtain submission checklist c. alternative dispute resolution method
	Instill Quality assessment and management knowledge	MM11 MM12	Construction methods Building materials	selection of construction methods and materials that comply with economic, quality, social, environmental, technical, and procurement
	Instill Design management knowledge	MM3 MM19	Architecture Feasibility studies	conduct a post-occupancy evaluation to understand end users' space requirement
	Instill Project management knowledge	MM1 MM16 MM15 MM17	Project management Valuation study Financial planning Environmental studies	a. emphasize time, cost, and quality b. decide on conducting a valuation study c. propose solutions that are considered environmentally friendly
	Instill Communication and relationship management knowledge	MM7 MM3 MM6 MM5 MM9 MM14 MM13 MM8 MM4 MM20	Structural engineering Town planning Electrical engineering Mechanical engineering Quantity Surveying Interior design Landscape Geotechnical engineering Civil engineering IT Construction	a. better understanding b. prevent misinterpretation

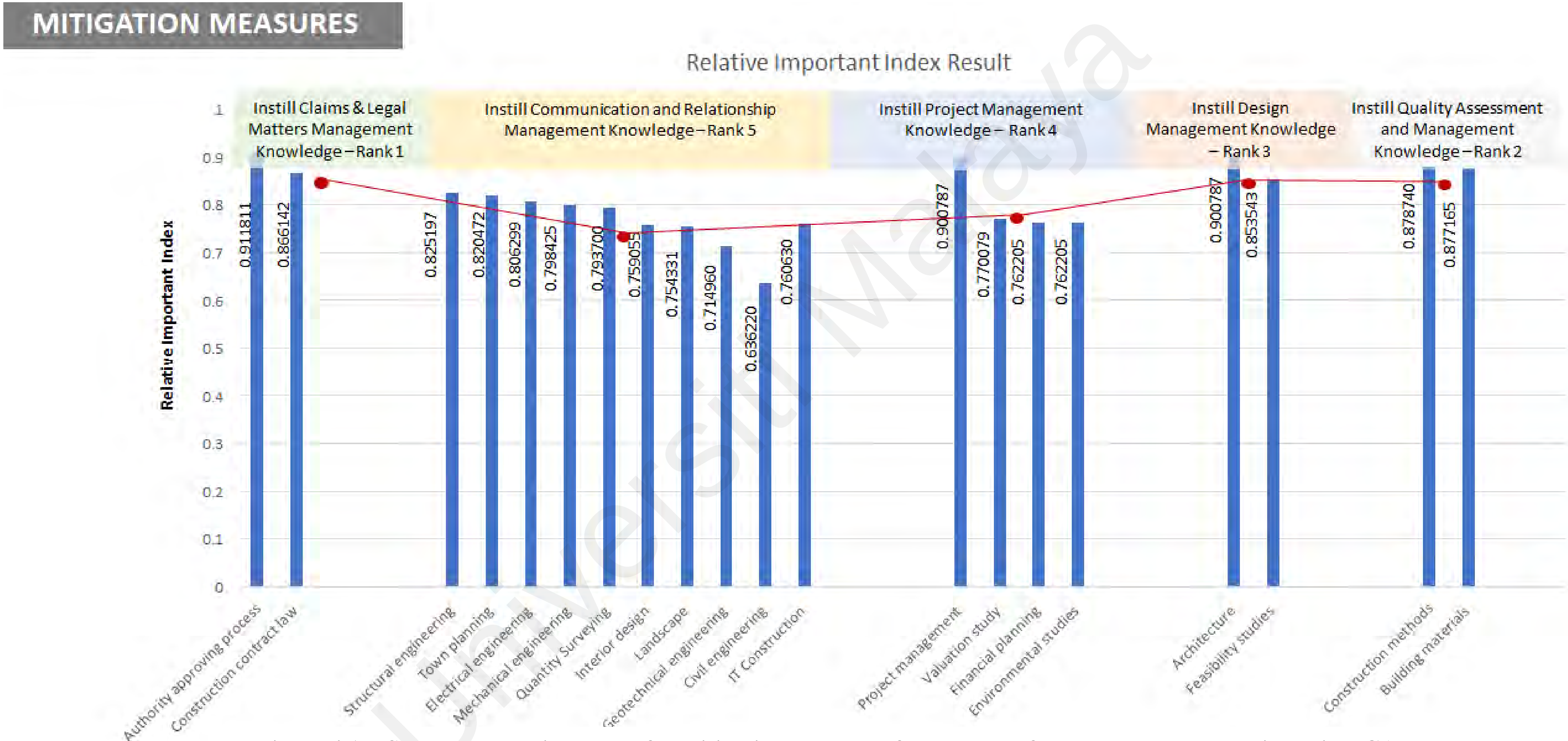


Figure 4.15: Summary ranking result for mitigation measures for obstacles faced by graduate architects in BCA

The result of the survey for types of obstacles, root causes, and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia had been ranked accordingly as summarized in Table 4.22**. The sequence arrangement of the sub-theme was based on the ranking from the survey.** The variables had set the parameters of the framework. An analysis of the relationship between the variables was conducted to determine which variables (under types of obstacles OR root causes OR mitigation measures) to be inserted in the content of the framework.

Table 4.22: The summary result of the survey for types of obstacles, root causes, and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia based on RANKING

Rank	Types of obstacles	Root causes	Mitigation measures
1	**Deficient in Claims & Legal matters management** 1. Unaware legal policy 2. Poor contract management knowledge, 3. Discrepancy in contract documentation	**Inadequate Quality assessment & management skills** 1. Technical 2. Resolve technical problem 3. Quality management	**Instill Claims & Legal matters management knowledge** 1. Authority approving process 2. Construction contract law
2	**Deficient in Communication & relationship management** 1. Communication breakdown 2. Lack of coordination between project stakeholders 3. Lack of information in drawings 4. Lack of understanding of client's requirements 5. misunderstanding terms	**Inadequate Project management skill** 1. Project management 2. Writing **Inadequate Design management skills** 1. Make a decision 2. Adapt changes	**Instill Quality assessment & management knowledge** 1. Construction methods 2. Building materials

Rank	Types of obstacles	Root causes	Mitigation measures
3	**Deficient in Project management** 1. Conventional management protocol 2. Incomplete documentation 3. Ineffective management 4. Lack of guidance and proper documentation	**Inadequate Communication & relationship management skills** 1. Interpersonal 2. Ability to chair meetings 3. Oral 4. Technical coordination 5. Understand clients' aspiration	**Instill Design management knowledge** 1. Architecture 2. Feasibility study
4	**Deficient in Design management** 1. Insufficient design detail 2. Constant design changes 3. Design error 4. Unworkable detail **5.** Slow decision	**Inadequate Claims & Legal matters management skill** 1. Conflict management	**Instill Project management knowledge** 1. Project management 2. Valuation studies 3. Environmental studies 4. Financial planning
5	**Deficient in Quality assessment & management** 1. Inadequate site inspection 2. Unfamiliar with building specification 3. Absence of clear uniform standard of work acceptance 4. Non-integrated project delivery 5. Delay reply queries	**N/A**	**Instill Communication & relationship management knowledge** 1. Structural engineering 2. Town planning 3. Electrical engineering 4. Mechanical engineering 5. Quantity Surveying 6. IT for construction 7. Interior design 8. Landscape 9. Geotechnical engineering 10. Civil engineering

4.6 Research Objective 4 – "To Analyze Relation between Obstacles, Root Causes and Mitigation Measures For Graduate Architects While Supporting BCA of Housing Projects In Malaysia"

The next step was to analyze the relationships between **types of obstacles (simplified as performance barriers)** and **mitigation measures for obstacles (simplified as competence development**), and the mediating roles of **root causes of obstacles (simplified as BCA skills)** to clarify the mechanism of interactions between them as shown in Figure 4.16.

This analysis applied multiple linear regression and process Hayes macro analysis to determine the causal linkages in an independent variable (IV) lead to variation in a dependent variable (DV). Various regression models were created and the first model focused on performance barriers' impact on BCA skills – path A. The second model covered the BCA skills' effect on competence development – path B. The third model concentrated on performance barriers' influence on competence development – path C. Before performing regression analysis, outlier detection, collinearity assessment, and assumption testing were performed.

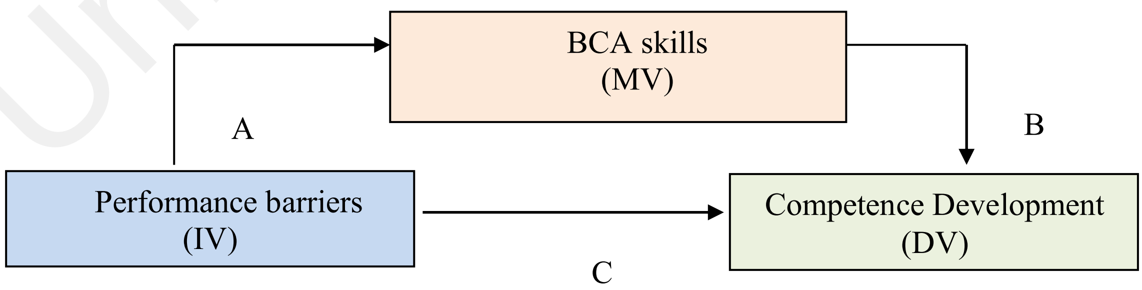


Figure 4.16: Mediation model

The multiple regression analysis is conducted to test the relationships between competence development (DV) and performance barriers (IV). Regression consists of several hierarchical procedures in which the potentially effective elements are added sequentially to an already existing model. Before performing regression analysis, outlier detection, collinearity assessment, and assumption testing were performed.

4.6.1 Assumption Testing for Regression Analysis

Table 4.23: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.586[a]	.482	.474	.53283	1.533

a. (Constant). Performance barriers (types of obstacles)

b. Dependent Variable: competence development (mitigation measures for obstacles)

The model summary in Table 4.23 presented the regression model to predict competence development based on performance barriers. The regression model accounts for a significant amount of variance in competence development (R^2=0.482). This means that approximately 48.2% of the variability in performance barriers can be explained in the model and 52.8% of the variability means that there are likely other variables that contribute to competence development but are not included in the current model. According to Richard F. Gunst et al. (1975), the R^2 more than 0.8 to 0.9 is termed as multicollinearity. In this research, the result shows 0.482 means the independent variables do not correlate with one another which is the norm and should not pose any serious problem. The Durbin-Watson is valued at 1.533 which is below 2.0, therefore there is no outlier.

Table 4.24: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.155	1	3.155	11.112	.001[b]
Residual	35.488	125	.284		
Total	38.643	126			

a. Dependent Variable: competence development (mitigation measures for obstacles)

b. (Constant). Performance barriers (types of obstacles)

The ANOVA table in Table 4.24 indicates that the performance barriers in a regression model are statistically significant in predicting competence development where an F-value of 11.112, with a p-value<0.05. p-value less than 0.05 is considered statistically significant (St and Wold, 1989). This signifies that the model is robust and reliable.

Table 4.25: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	2.968	.270		10.988	.000		
Performance barriers	.242	.073	.286	3.334	.001	1.000	1.000

Note: a. Dependent Variable: Performance barriers

Based on Table 4.25 result, the tolerance value is above 0.10 and the VIF values are less than 10. Therefore, it does not violate the multicollinearity assumptions. The p-values indicate the statistical significance of the coefficient where a p-value less than 0.05 is considered statistically significant. The results above indicated that performance barriers (β=0.242, p-value=0.001) have a significantly strong positive relationship with competence development.

Table 4.26: Residual Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted value	3.2534	4.1768	3.8539	.15824	127
Residual	-1.75907	1.29662	.00000	0.53071	127
Std. Predicted value	-3.795	2.040	.000	1.000	127
Std. Residual	-3.301	2.433	.000	.996	127

Dependent Variable: competence development (mitigation measures for obstacles)

Table 4.26 provides the differences between the observed and predicted values of the residual. In this model, the average distance of the observed values from the predicted values is 0.53071 and the range of residuals to show the spread of errors around the predicted values is -1.75907 to 1.29662. The mean of the residual is close to zero (0.00000), indicating that the model predicts the dependent variable accurately. The residual analysis shows that the model provides a good fit to the observed data, as the mean of the residual is close to zero.

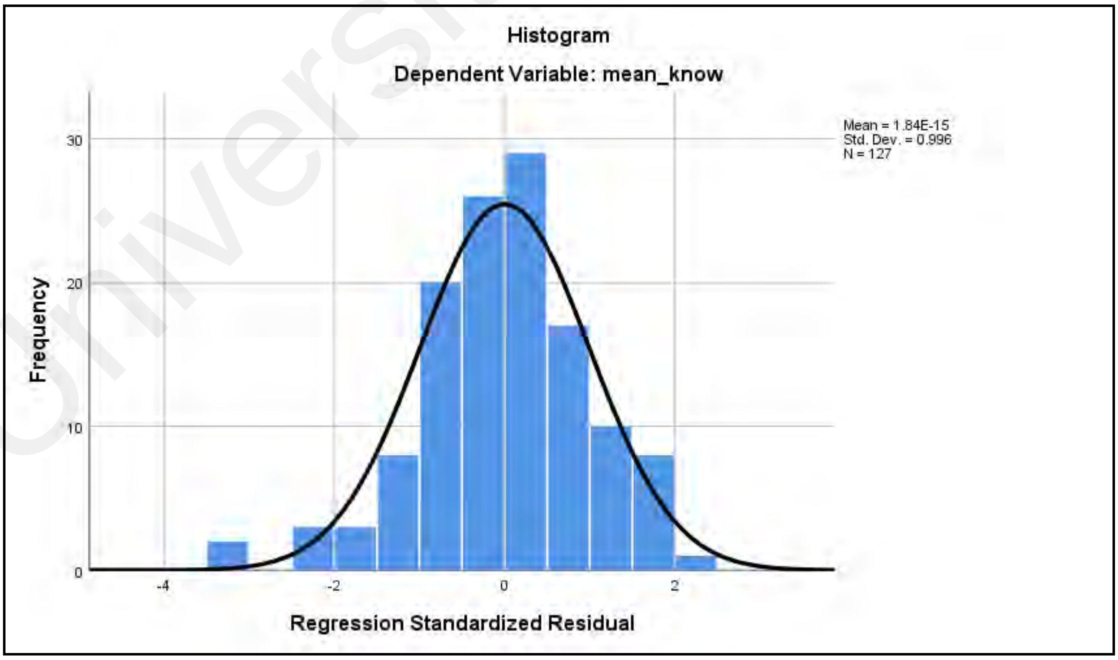


Figure 4.17: Histogram (Regression Standardized Residual)

Figure 4.17 shows a histogram graph of standardized residuals to analyze the distribution shape of residuals and assess the normality of the data. The normal distribution is characterized by a mean value of 0 and a standard deviation of 1. Based on the histogram, the mean value obtained is 1.84 x 1015, which indicates that the data follows a relatively normal distribution.

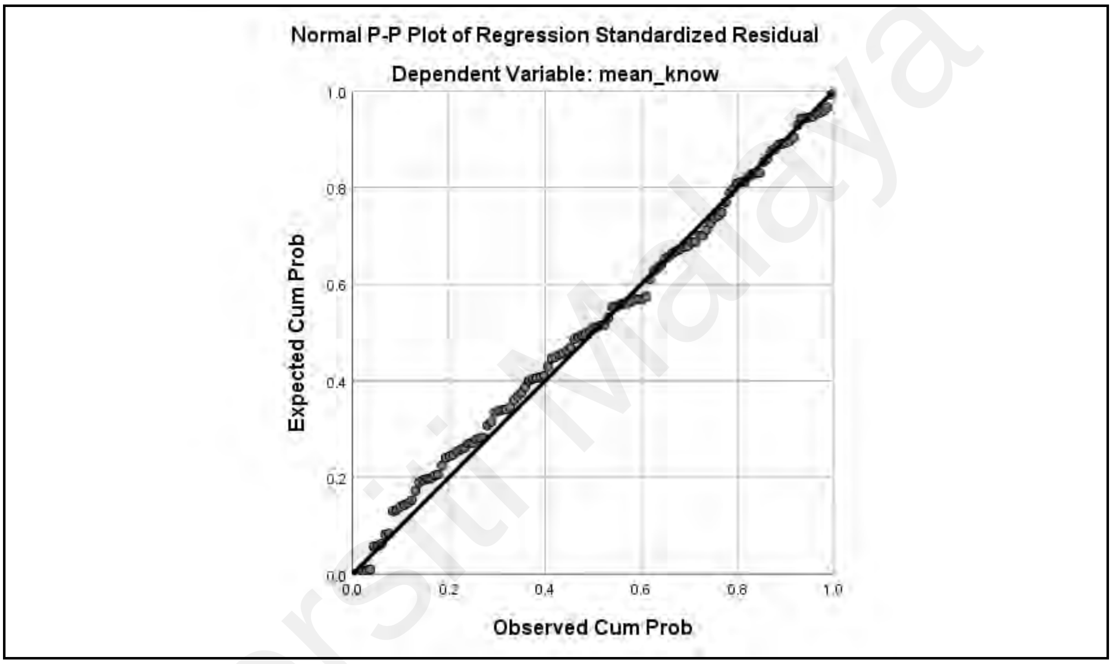


Figure 4.18: Normal P-Plot of Regression Standardized Residual

Figure 4.18 above shows that the points in the P-Plot closely adhere to the diagonal line with not much deviations from the normality in the data. This shows that the residuals are normally distributed based on the standardized regression which supports the assumptions of normality from the standardized regression earlier.

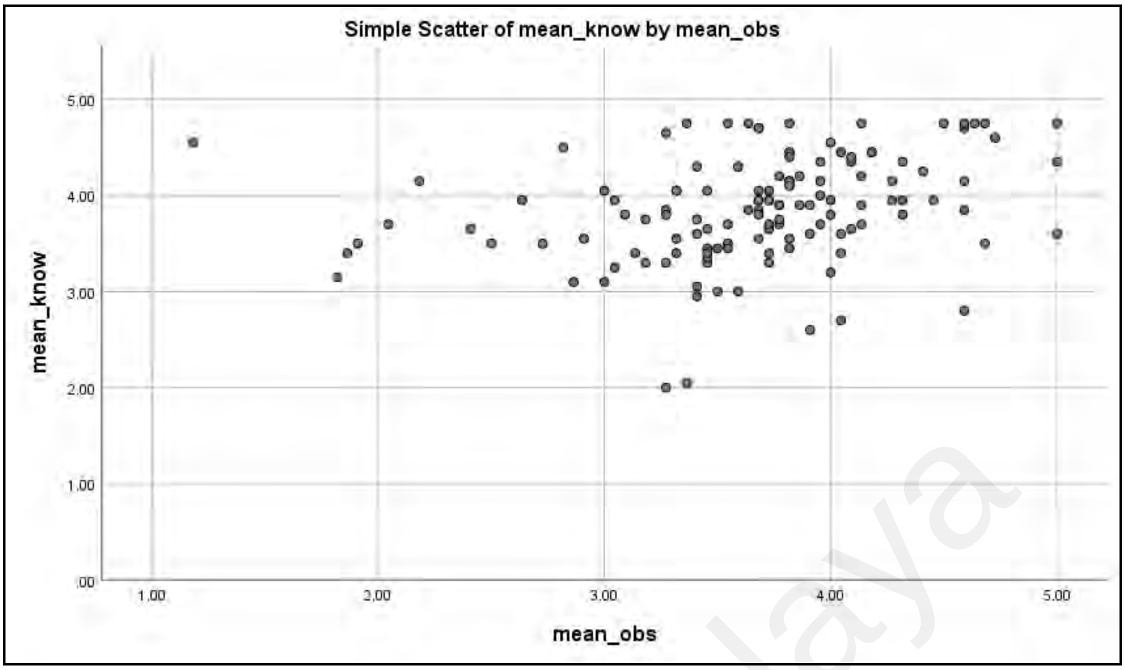


Figure 4.19: Scatterplot for competence development

The scatterplot analysis in Figure 4.19 revealed that the majority of data points fell within the expected range, providing support for the assumption under investigation. There are two outliers identified in the scatter plot which align with the results obtained from the Casewise Diagnostics procedure as shown in Table 4.27. This strengthens the overall conclusion of the assumption being examined where Case 3 and Case 11 exhibit lower competence development than predicted. The outliers' presence does not affect the obtained outcomes and hence the outliers could be retained without removing and rerunning the analysis.

Table 4.27: Casewise Diagnostics

Case Number	Std Residual	Mean competence development	Predicted Value	Residual
3	-3.249	2.05	3.7811	-1.73105
11	-3.301	2.00	3.7591	-1.75907

Dependent Variable: competence development (mitigation measures for obstacles)

4.6.2 Mediation Analysis

Table 4.28 shows shows the results for regression analyses of performance barriers' impact on BCA skills – Path A. This model consists of five variables: (1) deficient in claims and legal matters management; (2) deficient in project management; (3) deficient in communication and relationship management; (4) deficient in quality assessment and management; and (5) deficient in design management.

Performance barriers (IV) was the independent variable, BCA skills (MV) was the mediator variable and competence development (DV) was the dependent variable. From the regression result, the standardized coefficient for performance barriers impact on BCA skills is 0.174, with a significance of 0.004 which summarizes that the performance barriers have a significant positive impact on BCA skills.

Table 4.28: Coefficient for Path A

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.805	.220		17.314	.000
Performance barriers (IV)	.174	.059	.255	2.947	.004

Note: a. Dependent Variable: BCA skills (MV)

Table 4.29 presents the regression analysis results for the model of BCA skills' effect on competence development – Path B. This model consists of five variables: (1) claims and legal matters management skills; (2) project management skills; (3) communication and relationship management skills; (4) quality assessment and management skills; and (5) design management skills. BCA skills were the independent variable, and competence development was the dependent variable.

From the regression result in Table 4.29, the standardized coefficient of BCA skills' effect on competence development is 0.707, with a significance of 0.000 which summarizes that BCA skills play a very significant mediating role between performance barriers and competence development.

Table 4.29: Coefficient for Path B

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.516	.394		1.310	.193
BCA skills (MV)	.707	.090	.606	8.515	.000

Note: a. Dependent Variable: competence development (DV)

Table 4.30 presents the results for regression analysis of performance barriers' influence on competence development – Path C. This model consists of five variables: (1) To instill claims and legal matters management knowledge; (2) To instill project management knowledge; (3) To instill communication and relationship management knowledge; (4) To instill quality assessment and management knowledge; and (5) To instill design management knowledge. Performance barriers were the independent variable, and competence development was the dependent variable. From the regression result, the standardized coefficient for performance barriers influence on competence development is 0.119, with a significance of 0.001 which summarizes that performance barriers have a significant positive influence on competence development.

Table 4.30: Coefficient for Path C

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.968	.270		10.988	.000
Performance barriers (IV)	.119	.062	.286	3.334	.001

Note: a. Dependent Variable: competence development (DV)

Refer to Figure 4.20 shows the outcome for variables in PROCESS macro results consists IV, DV, and MV variables, the model used, and the sample size. The result indicated that there is the significant direct effect between the IV variables (performance barriers) on MV variables (BCA skills) where the p-value=0.038 (p-value<0.05).

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.2 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : DV
    X  : IV
    M  : MV

Sample
Size:  127

**************************************************************************
OUTCOME VARIABLE:
 MV

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2548      .0649      .1880     8.6821     1.0000   125.0000      .0038

Model
              coeff         se          t          p       LLCI       ULCI
constant     3.8052      .2198    17.3143      .0000     3.3702     4.2402
IV            .1740      .0590     2.9465      .0038      .0571      .2908

Standardized coefficients
         coeff
IV       .2548

**************************************************************************
OUTCOME VARIABLE:
 DV

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .6209      .3856      .1915    38.9051     2.0000   124.0000      .0000
```

Figure 4.20: Outcome for variable IV in PROCESS macro results

Figure 4.21 shows that the effect of IV (performance barriers where p-value=0.05) through MV (BCA skills where p-value=0.00) on DV (competence development where p-value≤0.05) is significant.

```
Model
              coeff        se          t          p       LLCI       ULCI
constant      .2775     .4089      .6788      .4985     -.5317     1.0868
IV            .1189     .0616     1.9292      .0460     -.0031      .2408
MV            .7069     .0903     7.8316      .0000      .5283      .8856

Standardized coefficients
          coeff
IV        .1404
MV        .5701

************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 DV

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2857      .0816      .2839    11.1125     1.0000   125.0000      .0011

Model
              coeff        se          t          p       LLCI       ULCI
constant     2.9676     .2701    10.9881      .0000     2.4331     3.5021
IV            .2419     .0726     3.3335      .0011      .0983      .3854

Standardized coefficients
          coeff
IV        .2857


************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_cs
      .2419      .0726     3.3335      .0011      .0983      .3854      .2857

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_cs
      .1189      .0616     1.9292      .0560     -.0031      .2408      .1404

Indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
MV      .1230      .0534      .0347      .2433

Completely standardized indirect effect(s) of X on Y:
       Effect     BootSE   BootLLCI   BootULCI
MV      .1453      .0551      .0434      .2598

*********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

------ END MATRIX -----
```

Figure 4.21: Outcome for variables IV(performance barriers) and MV(BCA skills) on DV(competence development) in PROCESS macro.

A Sobel test, based on the work from Michael E. Sobel, was also performed to investigate the mediating effect of BCA skills in the relationship between performance barriers and competence development. According to Preacher and Leonardelli (2001), the Sobel Test is used to determine whether a variable mediates the influence of IV on the DV. It also determines the significance of the indirect effect of a mediator variable in mediation analysis (Sobel, 1986).

Input:			Test statistic:	Std. Error:	*p*-value:
a	0.174	Sobel test:	2.76099384	0.0445557	0.00576258
b	0.707	Aroian test:	2.74159295	0.04487099	0.00611421
s_a	0.059	Goodman test:	2.78081252	0.04423815	0.0054223
s_b	0.090	Reset all	Calculate		

Figure 4.22: Sobel Test

The indirect effect analysis results for IV to MV to DV using Sobel Test are as follows:

Test Statistic = **2.76099384**

Std. Error = **0.0445557**

p-value = **0.00576258**

Figure 4.22 displays the Sobel test results, where the p-value is <0.05, indicating a statistically significant mediating effect. Therefore, the result concludes that the indirect effect between performance barriers and competence development is statistically significant (p-value<0.05).

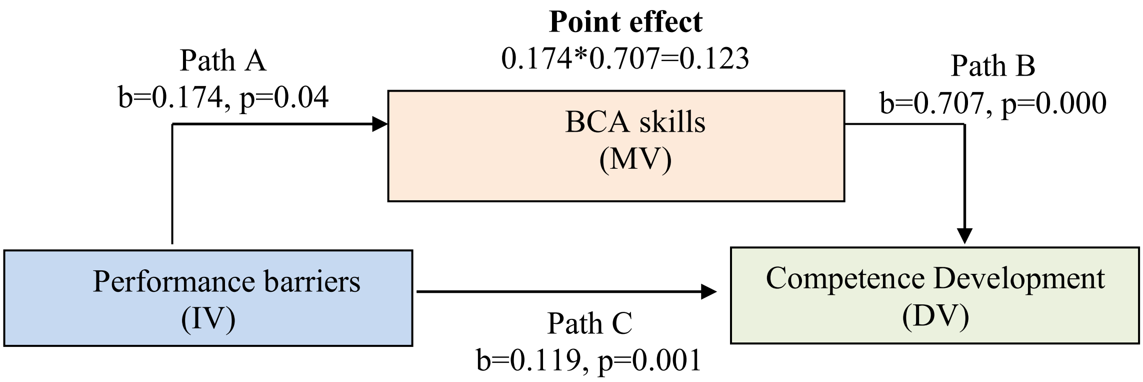


Figure 4.23: Summary of the Mediation model
(Source: Author)

4.6.3 Summary of Analysis Objective 4

The results presented the mediation role of BCA skills on the relationship between performance barriers and competence development. The results revealed a significant indirect effect of performance barriers on competence development (b=0.1230, t=1.9292). Furthermore, the direct effect of performance barriers on competence development in the presence of the mediator was also found significant (b=0.1189, p<0.05). Hence, BCA skills partially mediated the relationship between performance barriers and competence development. The mediation analysis summary is presented in Figure 4.23 and Table 4.31.

Table 4.31: Summary of Mediation Analysis

Relationship	Total effect	Direct effect	Indirect effect	Confidence Interval		t-statistic	Conclusion
				Lower bound	Upper bound		
Performance barriers > BCA skills > Competence development	0.2419 (0.000)	0.1189 (0.000)	0.1230	0.347	0.2433	1.9292	Partial Mediation

In a nutshell, types of obstacles (or performance barriers) influenced the root causes of obstacles (or BCA skills) and mitigation measures for the obstacles (or competence development) faced by graduate architects while supporting BCA housing projects in Malaysia. **Hence, the sub-theme of the framework is based on variables under types of obstacles (or performance barriers) as summarized in Table 4.32.**

Table 4.32: Summary of performance barriers variables and Relevancy Documents from the Literature review

Rank	Types of obstacles
1	**Deficient in Claims & Legal matters management** (Kasi, 1998; Gunduz and Elsherbeny, 2020; Abotaleb & El-Adaway, 2017; Weng&Ahmad, 2015; Mari et al., 2019, etc) 1. Unaware legal policy – relevant to authority submission 2. Poor contract management knowledge – relevant to building certification 3. The discrepancy in contract documentation – relevant to the contract
2	**Deficient in Communication & relationship management** (Zerjav and Ceric, 2009; Krishna, 2023; Hoezen et al., 2006; Gamil & Rahman, 2017, etc) 1. Communication breakdown – relevant to meeting 2. Lack of coordination between project stakeholders – relevant to coordination 3. Lack of information in drawings – relevant to coordination 4. Lack of understanding of client's requirements – relevant to coordination 5. misunderstanding terms – relevant to meeting
3	**Deficient in Project management** (Pinto, 2002; Lock, 2017; Madon, 2005; Ajator, 2017; Love and Edwards, 2004; Kerzner, 2022, etc) 1. Conventional management protocol – relevant to contract documentation 2. Incomplete documentation – relevant to contract documentation 3. Ineffective management – relevant to letter writing 4. Lack of guidance and proper documentation – relevant to contract documentation
4	**Deficient in Design management** (Pooworakulchai et al., 2017; Mohammed, 2021; Cooper and Press, 1995; Gunduz et al., 2022, etc) 1. Insufficient design detail – relevant to the design brief 2. Constant design changes – relevant to building material 3. Design error – relevant to the design brief 4. Unworkable detail – relevant to the design brief **5.** Slow decision – relevant to the design brief
5	**Deficient in Quality assessment & management** (Salleh et al., 2016; Pressman, 2006; Alawag et al., 2023; Mari et al., 2019, etc) 1. Inadequate site inspection – relevant to building details 2. Unfamiliar with building specifications – relevant to building details 3. Absence of clear uniform standard of work acceptance – relevant to the quality standard 4. Non-integrated project delivery – relevant to building details 5. Delay reply queries – relevant to contractors' submission

4.7 Summary

In this chapter, the types of obstacles, root causes of obstacles, and mitigation measures for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia were explored and discussed in detail. Data collected had been analysed using mean and standard deviation, data normality test, reliability test, factor analysis, relative important index, assumption tests, and mediation analysis. The sequence arrangement of content for the BCA framework is based on the ranking obtained from the survey. Sub-themes of the framework are based on the result of an analysis relationship between performance barriers and competence development through BCA skills. Four objectives of the research were achieved and highlighted through the process of data collection, massive analysis, and interpretation.

The next chapter presented the data collection and analysis of the final objective through the method of case studies through documentation review and semi-structured interviews.

CHAPTER 5: QUALITATIVE DATA COLLECTION & DISCUSSION

This chapter provides a detailed description of the research findings from the case study. The findings are presented according to the research objective RO5 which is to determine the content of the building contract administration framework. Seven housing projects at Klang Valley were selected for the experimentation as described in the previous chapters. Elevan types of documents were reviewed followed by semi-structured interviews with twenty respondents to increase coverage of information that might be overlooked. Data collected were analysed using thematic analysis and content analysis.

5.1 Case Study

A case study is used to investigate a contemporary phenomenon within its real-life context. To establish a draft contract administration framework for graduate architects, a case study is used as an illustration and assessment to explore how it met the aims of creating purposeful solutions, suited local context, and met the demands of the profession in a supportive environment that fostered development.

5.1.1 Documentation Review

Seven housing projects at Klang Valley that fall under the category of residential, strata development, high-rise buildings, and buildings under construction, utilized PAM contracts where the building contract administrator is the architect were selected as case studies and renamed as Project A, Project B, Project C, Project D, Project E, Project F, and Project G. Eleven types of documents related to claims and legal matters management, project management, communication & relationship management, quality assessment and management, and design management were reviewed.

5.1.1.1 Project A: Medium & low-cost mixed apartments

Project A consists of 3 blocks of 33-story, 211,878 sqft, a 2000-unit residential building located next to Duke Highway at Mukim Setapak. It is a multi-unit residential building in Kuala Lumpur. There are 12 unit types ranging from 80-meter square to 110-meter square. This project was designed within the context of combination of affordable and medium-cost housing project. Project A commenced since 15 August 2017 and still under construction. The contract sum for Project A was RM 310,191,993.00. These buildings were built in a well-established downtown neighborhood. The location is within walking distance of parks, stores, and education facilities. The building 'L' shape and orientation create a wind-sheltered, sun-filled, courtyard that provides a warm microclimate for site vegetation, playground, and flower garden plots. Additional common area on the 8th floor consists of a *surau*, multi-purpose room, management office, swimming pool, shop, café, laundry, games room, and toilet.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims & legal matters management: Project A is under the district of Wilayah Persekutuan Kuala Lumpur. Hence the authority submission procedure was based on the Dewan Bandaraya Kuala Lumpur (DBKL) checklist from submission of Borang B (notice of construction commencement) till construction completion (submission of certificate of compliance and completion). All certificates are issued based on the PAM form of contract ranging from payment certificates such as interim certificates to penultimate certificates.

Event certificates such as certificates of non-completion (CNC) to certificates of practical completion (CPC) for mock-up units were issued. Project A is currently under construction.

2) Project management: The contract documentation requirement of Project A was stated in the letter of award issued to the main contractor. All documents mandatory to submit within 2 weeks of receiving a letter of award are done except the project safety plan and project environmental plan which are unable to be retrieved from the documentation record.

   Progress report circulated at every site meeting consists of information such as a summary of NSC, organization chart, the status of payment, list of shop drawing/sample/catalog submissions, list of general submissions, list of AI, EI, LAI, RFI status, list of VO, the status of NCR, site memo, list of drawings registered (Archi, C&S, M&E, landscape), list of shop drawing submission, work program, the progress of section work done, 2 weeks work program, site record (manpower, plant & machinery, weather, cube test), site layout plan with site photographs (previous & current). Architect's instructions (AI) records show that less than 50 nos had been issued including additional work, stop work order, omission work, rectification defects, etc. These results provide a clear indication of not many changes requested by employers during the construction process.

3) Communication & relationship management: Various meetings were conducted during construction till the completion of Project A ranging from client consultant meetings to site meetings to discuss matters related to work progress and wrap up the entire project within quality, time, and cost frame.

Various letters were issued during and after construction for Project A ranging from a letter of appointment of nominated sub-contractor to a letter inviting authority for CCC inspection. There are 70 nos letters issued to contractors such as replied to EOT applications, safety issues, requests for temporary wet risers, revised masterwork program, material defects, delayed progress on site, a site visit from authority, partial handover, workmanship quality, defects rectification, etc.

From the record, more than 100 nos of RFI submitted by contractors highlighted clashing issues among structure, Archi, M&E services, and discrepancy of information between contract drawings and contract documents. These results indicate that coordination between consultants is insufficient.

4) Quality assessment and management: The preferable workmanship quality is not stated in contract documents. This posed difficulty to graduate architects who support BCA when carrying out site inspections. The workmanship level is determined by instincts and own subjective preference. There were 265 nos of non-compliance records (NCR) issued to the contractor, e.g. NCR related to poor workmanship on tiling, wall finishes, door installed, slow work progress, safety and cleanliness issues on site, insufficient manpower, work done not in accordance to drawings, etc. This indicates that the contractor is unsure about the contract specification. Graduate architects who support the building contract administrator need to closely monitor the work progress and pinpoint the common mistakes made by the contractor during the site walk.

5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors.

Project A consists of an RFI of more than 100 nos where the contractor queried from floor termination detail to request section drawings for staircases. These results indicate major deficiencies in the architectural design process.

5.1.1.2 Project B: Apartments in mixed development

Project B consists of 2 blocks 22 and 23 stories respectively with a GFA of 485,199 sqft, 429 units of residential buildings located at Jalan Bukit Kiara, Mukim Kuala Lumpur. It is a multi-unit mixed-development building in Kuala Lumpur. There are 12 unit types ranging from 650 square feet to >800 square feet. This project was designed within the context of a medium-cost housing project on a mixed development that includes a shopping mall at the podium and an office block. Project B commenced since 15 August 2016 and still under construction. The construction cost of Project B was not recorded. These buildings were built in a well-established downtown neighborhood. The location is within walking distance of parks, stores, and education facilities. The buildings are arranged in cluster form and orientation creating a wind-sheltered, sun-filled, courtyard that provides a warm microclimate for site vegetation, playground, and flower garden plots. Additional common areas on the 8th floor consist of a surau, gym, multi-purpose hall, reading room, playground, and swimming pool.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims & legal matters management: Project B is under the district of Wilayah Persekutuan. Hence the authority submission procedure was based on the Dewan Bandaraya Kuala Lumpur (DBKL) checklist from submission of Borang B (notice of construction commencement) till construction completion (submission of certificate of compliance and completion).

The residential tower was completed and handed over earlier than the commercial areas. Hence, a Partial Completion and Compliance Certificate for the tower block was required. All certificates are issued based on PAM form of contract ranging from payment certificates such as interim certificates to penultimate certificates. Event certificates such as certificates of non-completion (CNC) to certificates of partial completion (CPC). Project B is still under construction.

2) Project management: No specific requirements on documents to be submitted upon receiving the letter of award. Progress reports are circulated during every site meeting conducted on a fortnightly basis which covers information such as detailed work progress, RFI submission, and contractor submission (shop drawing, material, method statement). Architect's instructions (AI) issued less than 50 nos include additional work, variation work, omission of work, formalized engineer's instructions, etc. These results indicate not many changes requested by employers during the construction process.

3) Communication and relationship management: Various meetings were conducted during construction and completion of Project B ranging from client consultant meetings to site meetings to discuss matters related to work progress and wrap up the entire project within quality, time, and cost frame. Various letters were issued during and after construction for Project B ranging from a letter appointment of a nominated sub-contractor to a letter inviting authority for CCC inspection. There are approximately 44 nos of letters issued to the contractor such as letters about temporary building, lack of site personnel, request work program, delay in work progress, request renewal of work permit, material selection, stop work order, compound received from authority, etc.

More than 100 nos of RFI were issued about the discrepancy of drawings/documents even though REVIT had been adopted to check on CLASH before construction. This indicates that the coordination between consultants is poor.

4) Quality assessment management: Project B aimed for QLASSIC standards. The graduate architect conducted a site walk and commented on the workmanship based on QLASSIC requirements. No NCR record was found in Project B. This result indicates that the contractor is well aware of contract specifications.
5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors. Project B consists of an RFI of more than 100 nos where the contractor queried on riser size, wall termination detail, fire hydrant location, door detail, pedestrian ramp design, etc. These results indicate major deficiencies in the architectural design process.

5.1.1.3 Project C: Apartments surrounded by landed properties

Project C consists of 1 block 31 stories, 35,100 sqm, 228 units of residential buildings located at Jalan SS 24/9, Mukim Sg Buloh. It is a multi-unit mixed-development building in Selangor. There are 13 unit types ranging from 77 meters square to 300 meters square. This project was designed within the context of a mixed development including a shopping mall at the podium and a medium-cost housing project. Project C commenced on 8 December 2017 and is still under construction. The construction cost of Project C was RM 211,580,000.00. The building is built in a well-established downtown neighborhood.

The location is within walking distance of parks, stores, and education facilities. Additional common areas on the 8^{th} floor consist of a multi-purpose hall, playroom, sauna, management office, gym, daycare center, plaza, playground, swimming pool, and community hall.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims & legal matters management: Project C is under the district of Petaling Jaya. Hence the authority submission procedure was based on the Majlis Bandaraya Petaling Jaya (MBPJ) checklist from submission of Borang B (notice of construction commencement) till construction completion (submission of certificate of compliance and completion). The submission checklist of MBPJ is slightly different from DBKL as they emphasize on Universal design (UD) requirement. All certificates are issued based on the PAM form of contract ranging from payment certificates to interim certificates to penultimate certificates. Event certificates from certificates of non-completion (CNC) to certificates of practical completion (CPC) for mock-up units. Project C is still under construction.
2) Project management: No specific requirements on documents to be submitted upon receiving the letter of award. Progress reports are circulated during every site meeting conducted on a fortnightly basis which consists of information such as project participants, site organization chart, masterwork program, progress summary, physical progress report, physical S-curve, manpower record, plant& machinery record, weather record, list of AI, EI, landscape architect’s instruction (LAI), sample submission and approval list, construction drawing list,

RFI, 2 weeks progress forecast, cube test summary, claim and payment record, progress photograph and appendix. Architect's instructions (AI) issued not more than 50 nos include health and safety issues, permitted working hours reminders, the appointment of NSC, variation work, additional work, etc.

These results indicate that not many changes are required by employers during the construction process.

3) Communication and relationship management: Various meetings were conducted during construction and completion of Project C ranging from client consultant meetings to site meetings to discuss matters related to work progress and wrap up the entire project within quality, time, and cost frame. Various letters were issued during and after construction for Project C ranging from letters of appointment of nominated sub-contractor to letters inviting authority for CCC inspection. There are only 8 nos of letters issued to contractors about logistic plans, safety reports, workmanship quality, requests for temporary building fees, etc. More than 300 nos of RFIs were issued about discrepancies in drawings/documents due to poor communication between local architects and foreign designers. This result indicates insufficient coordination among consultants.

4) Quality assessment and management: The preferable workmanship quality is not stated in contract documents. This had posed difficulty to graduate architects who support the building contract administrator when carrying out site inspections. The workmanship level is determined by instincts and own subjective preference. There were over 100 nos. of non-compliance records (NCR) related to floor finishes defects, staircase finishes, signage installation, ponding test, parapet wall height, railing footing, public corridor, ms railing,

balcony railing, aluminum window inner frame, wall verticality, wall thickness, RWDP gradient, kitchen wall tiles grouting, ceiling alignment, etc issued to contractor requested for rectification.

This indicates that the contractor is unsure about the contract specification. Graduate architects who support the building contract administrator need to closely monitor the work progress and highlight the common mistakes made by the contractor during the site walk.

5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors. Project C consists of an RFI of more than 300 nos where the contractor queried on clearance height required for a car park, lift motor room, etc. This result indicates that major deficiencies in the architectural design process.

5.1.1.4 Project D: Affordable apartment

Project D consists of a single block 35-story, 41,833 sqft, 515-unit residential building located at Jalan Persiaran Pertahanan, Kampung Wirajaya, Mukim Setapak. It is a multi-unit mixed-development building in Kuala Lumpur. There is only one unit type with 79 square meters. This project was designed within the context of a low-cost housing project. Project D commenced on 8 June 2018 and is still under construction. The construction cost of Project D was RM 81,212,000.00. The building is in linear form. The location is within walking distance of parks, stores, and education facilities. Additional common areas on the 8th floor consist of a surau, mortuary rooms, taska, shop, café, laundry, multi-purpose hall, and management office.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims and legal matters management: Project D is under the district of Wilayah Persekutuan Kuala Lumpur. Hence the authority submission procedure was based on the Dewan Bandaraya Kuala Lumpur (DBKL) checklist from submission of Borang B (notice of construction commencement) till construction completion (submission of certificate of compliance and completion).

   All certificates are issued based on the PAM form of contract ranging from payment certificates to interim certificates to penultimate certificates. Event certificates from certificates of non-completion (CNC) to certificates of practical completion (CPC) for mock-up units. Project D is still under construction.

2) Project management: The contract documentation requirement of Project D was stated in the letter of award issued to the main contractor. All documents mandatory to submit within 2 weeks of receiving a letter of award are done. Progress reports are circulated during every site meeting conducted on a fortnightly basis which consist of information such as payment status, a summary of NSC, organization chart, the balance of work schedule, overall work progress, schedule handover, list of shop drawing, sample and catalog submission, list of AI, EI, LAI, the status of NCR, RFI status, list of VO, list of architecture drawing, list of C&S drawing, list of M&E drawing, list of landscape drawing, site memo, work program (catch up program, overall work progress), site record (workforce, plant & machinery, weather), site photographs. Types of architect's instructions (AI) issued less than 50 include nomination of NSC, omission of work, variation work, etc. This result indicates not many changes requested by employers during the construction process.

The low selling price is another factor that discourages the employers from making further investments in this project.

3) Communication and relationship management: Various meetings were conducted during the construction and completion of Project D ranging from client consultant meetings to site meetings to discuss matters related to work progress and wrap up the entire project within quality, time, and cost frame.

   Various letters were issued during and after construction for Project D ranging from a letter appointment of a nominated sub-contractor to a letter inviting authority for CCC inspection. There are approximately 35 nos of letters issued to contractors related to floor height proposals, masterwork programs, logistic plans, project quality plans, replied EOT applications, demobilization passenger hoist, validity of insurance, make good defects, quality of material, etc. There are less than 10 nos of RFI requests for information about discrepancies between drawings with contract documents. This result indicates that coordination between consultants is in order.

4) Quality assessment and management: The preferable workmanship quality is not stated in contract documents. This posed difficulty to graduate architects supporting BCA when carrying out site inspections. The workmanship level is determined by instincts and own subjective preference. However, no record of NCR was found. This indicates that the contractor is well aware of the contract specifications.

5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors. Project D consists of an RFI of less than 40nos where the contractor queried from floor termination detail to request section drawings for certain staircases. This result indicates that the drawings issued were sufficient to carry out the scope of work.

5.1.1.5 Project E: Apartments in the vibrant surrounding

Project E consists of 2 blocks of 34 stories, 64,308 square meters, and 584 units of residential buildings located at Jalan Kiara, Mukim Batu. It is a multi-unit mixed-development building in Kuala Lumpur. There are 5 unit types ranging from 75-meter square to 94-meter square. This project was designed within the context of a mixed development including a shopping mall at the podium, a SOVO block, and a medium-cost housing project. Project E commenced on 1 November 2014 and is still under construction. The contract sum of Project E was RM 638,000,000.00. These buildings were built in a well-established downtown neighborhood. The location is within walking distance of parks, stores, and education facilities. The buildings are in linear form and orientation creating a wind-sheltered, sun-filled, courtyard that provides a warm microclimate for site vegetation, playground, and flower garden plots. Additional common areas on the 8th floor consist of a surau, changing room, taska, multi-purpose hall, management office, laundry, swimming pool, gym, and playground.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims and legal matters management: Project E is under the district of Wilayah Persekutuan. Hence the authority submission procedure was based on the Dewan Bandaraya Kuala Lumpur (DBKL) checklist from submission of Borang B (notice of construction commencement) till construction completion (submission of certificate of compliance and completion). Project E was completed with partial CCC where residential units had been handed over before completion of the commercial areas. All certificates are issued based on the PAM form of contract ranging from payment certificates to interim certificates to penultimate certificates. Project E is still under construction.
2) Project management: No specific requirements on documents to be submitted upon receiving a letter of award. Progress reports are circulated during every site meeting that is conducted on a fortnightly basis which consists of information such as work progress for every trade. Less record on the progress report submitted by the contractor. Types of architect's instructions (AI) issued less than 50 nos include nomination of NSC, variation of work, instruction to stop work (Movement Control Order), instruction to resume work, etc. This result indicates not many changes requested by the employer during the construction process.
3) Communication and relationship management: Various meetings were conducted during construction and completion of Project E ranging from client consultant meetings to site meetings to discuss matters related to work progress and wrap up the entire project within quality, time, and cost frame.

   Various letters were issued during and after construction for Project E ranging from a letter appointment of a nominated sub-contractor to a letter inviting authority for CCC inspection.

There are approximately 29 nos letters issued to the main contractor such as requesting a revised construction period, permitted working hours, letters highlighting public health issues, schedule of defects, letter replied on the application of certificate sectional completion, etc.

There are more than 100 nos of RFI requests for information about discrepancies in drawings with contract documents. This indicates that the coordination between consultants is insufficient.

4) Quality assessment and management: The preferable workmanship quality is not stated in contract documents. This posed difficulty to graduate architects supporting BCA when carrying out site inspections. The workmanship level is determined by instincts and own subjective preference. No record of NCR was found. This indicates that the contractor is well aware of the contract specifications.
5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors. Project E consists of an RFI of more than 100nos about floor, wall, staircase, ramp, and sundries detail drawings. This result indicates major deficiencies in the architectural design process.

5.1.1.6 Project F: Apartment next to institution

Project F consists of 2 blocks of different-height apartments, 32 stories, and 45 stories respectively with 830,090 sqft, and 705 units of residential buildings located at Jalan Sentul, Mukim Batu. It is a multi-unit building in Kuala Lumpur. There are 7 unit types ranging from 600 sqft to 900 sqft. This project was designed within the context of a medium-cost housing project. Project F commenced on 3 August 2020 and is still under construction.

The contract sum of project F was RM 160,930,000.00 and located in a well-established downtown neighborhood. The location is within walking distance of parks, stores, and education facilities. The buildings are arranged in linear form. Additional common areas on the 8th floor consist of a surau, laundry, changing room, function room, multi-purpose hall, gym, café, meeting room, AV room, children’s playroom, etc.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims and legal matter management: Project F is under the district of Wilayah Persekutuan Kuala Lumpur. Hence the authority submission procedure was based on the Dewan Bandaraya Kuala Lumpur (DBKL) checklist from the submission of Borang B (notice of construction commencement) till the submission of amendment plans for approval. All certificates are issued based on the PAM form of contract ranging from payment certificates to interim certificates to certificates of extension of time. Project F is under construction.
2) Project management: The contract documentation requirement of Project F was stated in a letter of award issued to the main contractor. All documents mandatory to submit within 2 weeks of receiving a letter of award are done. Progress report circulated on every site meeting consists information such as project particular (contract summary, project consultant, site plan/logistic, project organization chart, list of domestic subcon& NSC), program & progress (summary of work progress, next 2 weeks planning, masterwork program, S-curve financial and physical work, status progress claim, summary of VO claim), list of drawings and resources (drawing registered, site personnel & manpower, plant & machinery, list of RFI, construction,

material submission status, list of shop drawings, list of method statements, list of NCR, site memo, summary and status of AI/EI), weather record, NSC submission record (NSC work progress record, M&E submission status, M&E list of method statement, M&E shop drawing list), progress photos, summary of report (test cube result, safety report), list of correspondences, minutes of meetings & TNB checklist. Types of architect's instructions (AI) issued more than 50 nos include additional work, variation work, omission of work, site clearing, defects rectification, permitted working hours, nomination of NSC, etc. This result indicates many changes requested by employers during the construction process.

3) Communication and relationship management: Various meetings were conducted during construction. Project F ranging from client consultant meetings to technical coordination meetings to discuss matters related to work progress.

   Various letters were issued during construction for Project F ranging from a letter appointment of a nominated sub-contractor to a letter inviting authority for CCC inspection. There are approximately 46 no letters issued to the main contractor related to EOT application, workmanship quality, material quality, failure to complete mock-up units, lack of supervisor on site, design variance with contract specification, change of material, work progress on site, etc. From the record, 110 nos of RFI submitted by contractors highlighted clashing issues among structure, Archi, M&E services, and discrepancy of information between contract drawings and contract documents. This indicates that coordination between consultants is insufficient.

4) Quality assessment and management: Project F aimed for QLASSIC standard. The graduate architect conducted a site walk and commented on the workmanship based on QLASSIC requirements.

   There were less than 20 nos of non-compliance records (NCR) related to window& glazing installation, painting, plastering, sliding door, waterproofing, etc issued to the contractor requested for rectification. This indicates that the contractor is well aware of the contract specifications.

5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors.

   Project F consists RFI of 20nos where the contractor queried from the floor, wall termination, types of finishes, etc. This result indicates that the drawings issued are sufficient to carry out the scope of work.

5.1.1.7 Project G: Apartment next to the river

Project G consists of 2 blocks of 42 stories, 649,861 sqft, 681-unit residential buildings located at Jalan Kasipillay, Mukim Batu. It is a multi-unit building in Kuala Lumpur. There are 4 unit types ranging from 600 sqft to 900 sqft. This project was designed within the context of a medium-cost housing project. Project G commenced on 8 March 2018 and is still under construction. The contract sum of Project G was RM 140,000,000.00. These buildings were built in a well-established downtown neighborhood. The location is within walking distance of parks, stores, and education facilities. The buildings are arranged in linear form. Additional common areas on the 8th floor consist of taska, surau, laundry, changing room, function room, multi-purpose hall, gym, refuse chamber, guard house, management office, and shop.

The following information was obtained from the progress report, correspondence between project stakeholders, and submission from contractors.

1) Claims & legal matters management: Project G is under the district of Wilayah Persekutuan Kuala Lumpur. Hence the authority submission procedure was based on the Dewan Bandaraya Kuala Lumpur (DBKL) checklist from submission of Borang B (notice of construction commencement) till construction completion (submission of certificate of compliance and completion). All certificates are issued based on the PAM form of contract ranging from payment certificates to interim certificates. Project G is still under construction.
2) Project management: The contract documentation requirement of Project G was stated in the letter of award issued to the main contractor. All documents mandatory to submit within 2 weeks of receiving a letter of award are done. Progress report circulated on every site meeting consists of information such as project particular, logistic plan, site organization chart, NSC particular, work progress, work program, physical S-curve, financial S-curve, status of progress claim, list of VO, list of drawing register, manpower record, machinery record, list of RFI, list of material/shop drawing/ method statement, list of shop drawing submission, site direction/site memo, list of AI, EI, LAI, material submission NSC, method statement NSC, shop drawings NSC, weather chart, progress photos, cube test report, NSC meeting minutes and settlement monitoring record. Types of architect's instructions (AI) issued more than 50 nos include variation works, omission of work, additional work, compliance of authority requirement, appointment of NSC, permitted working hours, etc. This result indicates not many changes requested by employers during the construction process.

3) Communication and relationship management: Various meetings were conducted during construction till completion of Project G ranging from client consultant meetings to CCC meetings to discuss matters related to work progress and wrap up the entire project within quality, time, and cost frame. Various letters were issued during and after construction for Project G ranging from letters of appointment of nominated sub-contractor to letters inviting authority for CCC inspection.

   There are approximately 40nos of letters issued to the main contractor related to the EOT application, request for mitigation program, comments on poor housekeeping, comments on slow progress on site, highlighted material issues, etc.

   From the record, only 30 nos of RFI submitted by contractors highlighted clashing issues among structure, Archi, M&E services, and discrepancy of information between contract drawings and contract documents. This result indicates that coordination between consultants is sufficient.

4) Quality assessment and management: Project G aimed for QLASSIC standard. The graduate architect conducted a site walk and commented on the workmanship based on QLASSIC requirements. There were less than 10 nos of non-compliance records (NCR) related to substandard material, poor workmanship, etc issued to the contractor requested for rectification. This result indicates that the contractor is well aware of the contract specification.

5) Design management: The completeness of detailed drawings relied on the number of RFI (requests for information) submitted by the contractors. Project G consists of an RFI of not more than 30 nos related to termination detail for wall, floor, skirting, and staircase detail. This result indicates that the drawings issued are sufficient to carry out the scope of work.

In summary, the quality of the design and documentation being provided, along with its effect on construction process efficiency, is of major concern to many parties within the Malaysian construction industry. Due to this concern, documentation records, authority submission process, certification process, contract documentation, record of coordination, compliance of contract specification, and the sufficiency of drawings issued from the seven selected projects were investigated and summarized under Table 5.1. The breakdown details of the findings are summarized in Table 5.2.

Table 5.1: Summary of documentation review from seven case studies

Description	Project A	Project B	Project C	Project D	Project E	Project F	Project G
1) Claims and legal matters management- authority submission status & certificates issued	Pending CCC Pending CPC	Pending CCC Pending CPC	Pending CCC Pending CPC	Pending CCC Pending CPC	Pending CCC Pending CPC	Pending CCC Pending CPC	Pending CCC Pending CPC
2) Project management – No. of AI issued	<100	<100	>100	<100	<100	<100	>100
Contract documents requirement	✓	X	X	✓	X	✓	✓
3) Communication and relationship management No. of Letters issued to the main contractor	>50	<50	<50	<50	<50	<50	<50
No. of RFI issued due to discrepancy in documents	>100	>100	>100	<100	>100	>100	<100
4) Quality assessment and management – No. of NCR issued	>50	n/a	n/a	n/a	n/a	<50	<50
5) Design management- No. of RFI received	>100	>100	>100	<100	>100	>100	<100

Note:

1) ✓- List of documents to be submitted by contractor to consultants upon receiving the Letter of Award
2) No. of letters / RFI issued - < 50 means minimal as stated in the provision of contract document
3) No. of RFI - <100 means minimal as stated in the provision of contract document

Table 5.2: Summary of information obtained from seven case studies

	Project A	Project B	Project C	Project D	Project E	Project F	Project G
Claims and legal matters management							
Types of Authority Submission							
1. Development Order	*	*	*	*	*	*	*
2. Building plan submission	*	*	*	*	*	*	*
3. Amendment Development order	*	*	*	*	*	*	*
4. Amendment Building plan	*	*	*	*	*	*	*
5. Earthwork submission	*	*	*	*	*	*	*
6. Road & drain submission	*	*	*	*	*	*	*
7. BOMBA passive submission	*	*	*	*	*	*	*
8. BOMBA active submission	*	*	*	*	*	*	*
9. Building name submission	*	*	*	*	*	*	*
10. Postal address submission	*	*	*	*	*	*	*
11. SWCorp submission	*	*	*	*	*	*	*
12. Temporary building permit	*	*	*	*	*	*	*
13. SKMM submission	*	*	*	*	*	*	*
14. TNB submission	*	*	*	*	*	*	*
15. Street lighting submission	*	*	*	*	*	*	*
16. Telephone layout tapping submission	*	*	*	*	*	*	*
17. Landscape submission	*	*	*	*	*	*	*
18. POS submission	*	*	*	*	*	*	*
19. SIFUS submission	*	*	*	*	*	*	*
20. COB submission	*	*	*	*	*	*	*
21. KMB submission	*	*	*	*	*	*	*
22. BOrang B submission	*	*	*	*	*	*	*
23. Hoarding & signboard submission	-	-	*	-	-	-	-
24. Certificate of completion and compliance	-	-	-	-	-	-	-
Types of certification							
1. Certificate of practical completion	-	-	-	-	-	-	-
2. Certificate of non-completion	*	*	*	*	*	-	-
3. Certificate of partial completion	-	-	-	*	-	-	-
4. Certificate of sectional completion	*	*	*	-	-	-	-
5. Certificate of extension of time	*	*	*	*	*	*	*
6. Certificate of making good defects	-	-	-	-	-	-	-
7. Interim certificate	*	*	*	*	*	*	*
8. Penultimate certificate	-	-	-	-	-	-	*
9. Final certificate	-	-	-	-	-	-	-
10. Stage billing certificate	*	*	*	*	*	*	*

Project management							
1. Project quality plan	*	-	-	*	-	*	*
2. Project safety plan	-	-	-	*	-	*	*
3. Project environmental plan	-	-	-	*	-	*	*
4. Logistic plan	*	*	*	*	-	*	*
5. Schedule of shop drawing	*	*	*	*	*	*	*
6. Schedule of material submission	*	*	*	*	*	*	*
7. Schedule of the method statement	*	*	*	*	*	*	*
8. Schedule of proposed manpower, machinery, and equipment	*	*	*	*	*	*	*
9. Masterwork program	*	-	-	*	-	*	*
10. Site organization chart	*	*	*	*	-	*	*
11. Progress report format	*	-	-	*	-	*	*
12. Certificate registration CIDB	*	*	*	*	-	*	*
13. Certificate JKKP	*	*	*	*	-	*	*
14. Project cash flow planning	*	*	*	*	-	*	*
15. List of subcontractors	*	*	*	*	-	*	*
Communication and relationship management							
Types of letter writing							
1. Letter of award/nomination	*	*	*	*	*	*	*
2. Letter submission of CCC	*	*	*	*	*	-	*
3. Letter request for CCC inspection	*	*	*	*	*	-	*
4. Letter of compliance authority comments	*	*	*	*	*	*	*
5. Letter invitation for tender	*	-	-	*	-	*	--
6. Letter reply contractor submission	*	*	*	*	*	*	*
7. Letter report work progress on site	*	*	*	*	*	*	*
8. Letter request for cost estimation	-	-	-	-	-	*	*
9. Letter request for processing fee	*	*	*	*	*	*	*
10. Letter submission of processing fee	*	*	*	*	*	*	*
11. Letter request for contractor insurance cover and performance bond	-	-	-	-	-	-	*
12. Letter distribute contract documents	-	-	-	-	-	-	*
13. Letter distribution of construction drawings	*	*	*	*	*	*	*
Types of meetings							
1. Client consultants meeting	*	*	*	*	*	*	*
2. Site meeting	*	*	*	*	*	*	*
3. Technical coordination meeting	*	*	*	*	*	*	*
4. CCC meeting	*	*	*	*	-	*	*
5. Defects meeting	*	-	*	*	-	-	-
6. NSC meeting	*	-	*	*	*	*	*
7. Safety committee meeting	*	*	*	-	-	*	*
8. Variation order meeting	-	-	*	-	-	-	*

9. Valuation engineering meeting	-	-	*	-	-	-	-
10. Tender interview meeting	*	*	*	*	*	*	*
11. kick-off meeting	*	*	*	*	*	*	*
Coordination checklist							
1. Architecture design	-	*	*	-	*	-	-
2. Civil & structural design	-	*	*	-	*	-	-
3. Mechanical, electrical, and plumbing	-	*	*	-	*	-	-
Quality assessment and management							
Submission of MOS Internal finishes							
1. Floor	*	-	-	*	-	*	*
2. Internal wall	*	-	-	*	-	*	*
3. Ceiling	*	-	-	*	-	*	*
4. Door	*	-	-	*	-	*	*
5. Window	*	-	-	*	-	*	*
6. Internal fixture	-	-	-	-	-	-	-
7. External finishes	-	-	-	-	-	-	-
8. Roof	*	-	-	*	-	*	*
9. External wall	*	-	-	*	-	*	*
10. Apron & perimeter	-	-	-	-	-	-	-
11. Material & functional test	*	-	-	*	-	*	*
Design management							
Material specification & buildability							
1. Staircase & ramp	*	*	*	*	*	*	*
2. Frame	*	*	*	*	*	*	*
3. Upper floor construction	*	*	*	*	*	*	*
4. External wall	*	*	*	*	*	*	*
5. Internal wall	*	*	*	*	*	*	*
6. Windows	*	*	*	*	*	*	*
7. Doors	*	*	*	*	*	*	*
8. Ironmongery	*	*	*	*	*	*	*
9. External wall finishes	*	*	*	*	*	*	*
10. Internal wall finishes	*	*	*	*	*	*	*
11. Floor finishes	*	*	*	*	*	*	*
12. Ceiling finishes	*	*	*	*	*	*	*
13. Painting	*	*	*	*	*	*	*
14. Sanitary wares and fittings	*	*	*	*	*	*	*
15. Roof	*	*	*	*	*	*	*
16. Sundries	*	*	*	*	*	*	*

5.2 Semi-structured interview

Semi-structured interviews were conducted with respondents in charge of the housing projects selected as case studies since there is information lacking from documentation review. A total of twenty interviews were conducted. The profiles of all the 20 interview respondents in each case study project and their demographic information are summarized in Table 5.3.

Table 5.4 indicates the responses from the respondent's interviews on Research Objective No. 5 'To develop a building contract administration framework to resolve the obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia'. Answers given by the respondents are based on questions about solutions to resolve obstacles faced by graduate architects while supporting BCA of housing projects based on their experience through the projects selected as case studies. The solutions can be categorised into 5 categories, which are:

1) S1 – Claims and legal matters management
2) S2 – Project management
3) S3 – Communication and relationship management
4) S4 – Quality assessment and management
5) S5 – Design management

Table 5.3: Summary of Respondent's demographic information

Project	Respondent code	Age Range	Gender	Education background	Years working experience	No. of years working in the current workplace
A	G1	50-60	Male	Local grad	>10	>10
	G2	20-30	Female	Local grad	5-10	<5
	G3	30-40	Female	Local grad	>10	>10
B	G4	50-60	Male	Overseas grad	>10	>10
	G5	30-40	Female	Local grad	>10	>10
C	G6	30-40	Female	Local grad	>10	>10
	G7	30-40	Male	Local grad	>10	5-10
	G8	20-30	Male	Local grad	1-5	<5
D	G9	40-50	Female	Local grad	>10	>10
	G10	30-40	Male	Overseas grad	>10	5-10
	G11	30-40	Female	Overseas grad	>10	<5
	G12	40-50	Female	Overseas	>10	>10
E	G13	30-40	Female	Overseas grad	>10	5-10
	G14	30-40	Male	Local grad	>10	>10
	G15	30-40	Female	Local grad	>10	5-10
	G16	20-30	Male	Overseas	1-5	<5
F & G	G17	30-40	Female	Local grad	>10	<5
	G18	40-50	Male	Overseas grad	>10	<5
	G19	30-40	Female	Local grad	>10	<5
	G20	20-30	Male	Overseas grad	5-10	<5

Demographics of the interviewee are provided in Table 5.3. The majority of the respondents are male and local graduates, and the mean age of the respondents was in the range of 30-40 years. They have an average working experience of more than 10 years in the building contract administration industry and the majority of them serve in the current architectural consultant practice for more than 10 years.

Table 5.4: Content analysis of the respondent interviews for RO5

RO5: To develop a building contract administration framework to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia			
Respon dents	Interview Text	Keywords	Code
G1	Problem: Confused with the authority submission procedure as they tend to change the requirement very often, e.g. the requirement for workers' quarters changed from temporary building permit to centralized labor quarter and back to worker's cabin permit. *Solution: GA to pre-consult and obtain the latest checklists from the authority*	Authority	S1
	Problem: Unable to resolve floor and wall finishes termination details which are often highlighted by contractors during site walk *Solution: GA familiarization with building details is important*	Building detail	S4
	Problem: Designers tend to work isolated and a lot of discrepancies, e.g. beam clashed with M&E risers, columns clashed with car park, etc are found in the drawings when superimposed with other consultants' designs. *Solution: To have face-to-face discussions with all the consultants in the presence of clients to resolve discrepancies.*	Discrepancies	S3
	Problem: Unsure what type of workmanship standard, e.g. tolerance for floor/wall tiles joint, tolerance for wall alignment, etc is acceptable during the site walk. *Solution: To understand the workmanship standard available in the industry*	Workmanship	S4
	Problem: Indecisive in building color selection which caused the end product to be different from the sales brochure *Solution: To ensure the end product adhered to the design brief*	Design Brief	S5

G2	Problem: Variation order (addition) incurred when a client requested to have additional screens to shield public corridors from weather, scupper drain to discharge incidental rainwater into public space, etc. which initially should be captured in the design. *Solution: To formalize additional items required by the client with the architect's instruction*	Architect's instruction	S2
	Problem: Engineers late furnish input, e.g. size of the TNB substation, and size of M&E rooms caused major changes to the design *Solution: To conduct a coordination meeting*	Coordination	S3
	Problem: Project stakeholders are unsure about the next course of action after meetings as the discussion was not recorded *Solution: To record items to follow up/action by who in meeting minutes*	Meeting	S3
	Problem: The contractor highlighted some of the details, e.g. roof installation, wall construction, etc not workable in the local context *Solution: A list of common details for housing projects is required*	Detail design	S5
G3	Problem: Unsure about the submission drawing scale, drawing types, and which authority to submit *Solution: To pre-consult with authority*	Authority	S1
	Problem: Uncertain design detail, e.g. wall designed to be constructed in a particular method to get a certain effect *Solution: A list of common details for housing projects is required*	Design detail	S5
	Problem: Unsure the adequacy of drawings to minimize variation order (VO) during construction *Solution: To obtain a complete list of drawings from previous projects with minimal VO*	Drawing	S2

G4	Problem: The client requested to waive certain requirements stated in the authority submission checklist, e.g. waive processing fee, waive certain terms required by the authority *Solution: pre-consultation with authority*	Authority	S1
	Problem: Failure to issue architect's instruction for additional work that affected the contractor's cash flow *Solution: To understand about contract documentation*	Documentation	S2
	Problem: Often received a request for information (RFI) from the contractor regarding discrepancies of drawings between consultants, e.g. location of M&E rooms is different, location of columns differ, etc. *Solution: To conduct a coordination meeting*	Meeting	S3
	Problem: Missing details in the drawing, e.g. special fixing method for railing, special wall design, etc that cause contractors to find easy ways to work it out *Solution: To familiarize yourself with building details*	Building details	S4
	Problem: Design discrepancy, e.g. staircase design/railing design during conceptual and reality are different due to practicality *Solution: Understanding the design brief is important*	Design Brief	S5
G5	Problem: Lack of proper referencing number caused GA unsure which detail drawings are the latest as too many versions of drawings issued *Solution: To understand contract documentation*	Documentation	S2
	Problem: Uncertain about drawing scale for special types of projects, e.g. for large-scale projects, it is impossible to have a whole elevation cover in a 1:200 scale drawing *Solution: To pre-consult with authority*	Authority	S1

	Problem: Different authority has different requirements during submission, e.g. MPPD requested road & drainage approval and earthwork approval before building plan submission *Solution: To pre-consult with authority*	Authority	S1
G6	Problem: Submission has been rejected due to incorrect project title, e.g. project title for the site worker's quarter submission is different from the building plan submission title *Solution: To pre-consult with authority*	Authority	S1
	Problem: Discrepancy found between the contract drawing and the contract document (BQ), e.g. drawings specified floor finishes to be tiled but BQ stated cement render *Solution: To conduct a coordination meeting*	Coordination	S3
	Problem: Encountered design problem during construction, e.g. method installation of mirror, wall tiles edge termination detail, etc *Solution: To familiarize yourself with building detail*	Building detail	S4
	Problem: Delay reply to contractor's queries / RFI due to unsure which detail is workable/which option is viable, e.g. roof shop drawing *Solution: To familiarize yourself with building detail*	Building detail	S4
G7	Problem: Unsure which department to pre-consult for special authority submissions, e.g. requirement of food stalls for a mixed development housing project to pre-consult with the planning department, hawker's licensing department, or finance department, etc *Solution: To pre-consult with authority*	Authority	S1
	Problem: Indecisive in building design that affected the overall façade, e.g. units with or without balconies will affect the building facade *Solution: To understand the design brief*	Design	S5

	Problem: The amount of the submission fee calculated based on guidelines had been commented on by authority *Solution: To pre-consult with authority*	Authority	S1
G8	Problem: Unsure calculation of processing fee as the authority often changes formula calculation *Solution: To pre-consult with authority*	Submission	S4
G9	Problem: The authority often updates the submission checklist and requires additional documents that we are unable to compile within a short period, e.g. consent letters from purchasers during the submission of amendment building plans *Solution: To pre-consult with authority*	Authority	S1
	Problem: There are lots of 'grey areas' in the contract and the contractor found loopholes to get what they want, e.g. using the reason of renewing insurance to obtain an extension of time *Solution: To understand more about contract documentation*	Contract	S2
	Problem: The contractor preferred verbal confirmation instead of in writing *Solution: Queries should be put in writing. Documentation is important*	Documentation	S4
	Problem: Unsure what to inspect during the site walk where actually the door swing direction is incorrect, paint finishes are incorrect, tiles joints are inconsistent, etc *Solution: To understand workmanship standards for ease of checking during the site walk*	Quality	S4
G10	Problem: Unfamiliar with local government building requirements, e.g. the fire lobby requirement, which area needs compartmentation, etc *Solution: To pre-consult with authority*	Authority	S1

	Problem: Some engineers refuse to revise their design to suit architectural requirements, e.g. refuse to reduce the depth of the beam to obtain the clearance height design *Solution: To conduct a coordination meeting*	Meeting	S3
	Problem: The developer is not willing to explore new types of material/system due to budget constraints, e.g. siphonic RWDP system *Solution: To explore different material specification*	Design	S5
G11	Problem: Difficult to get the right authority department as they tend to push around when dealing with special cases, e.g. unsure how to demarcate additional accessway for existing underground AIS water pipes in amendment planning submission *Solution: To pre-consult with authority*	Authority	S1
	Problem: Unsure how to assess the masterwork program submitted, e.g. are we checking on the duration proposed? Or scope of work? *Solution: To check with contract documentation*	Contractor's submission	S4
	Problem: Unsure what is the acceptable workmanship standard during the site walk, e.g. tolerance for wall alignment *Solution: To understand the workmanship standard*	Workmanship	S4
	Problem: Unsure how to comment on the draft BOMBA submission/BP submission etc *Solution: To understand about authority requirement*	Authority	S1
G12	Problem: Confused about the requirement of drawing scale, and paper size during authority submission. Sometimes, paper A0 was not allowed during KM submission and we needed to reset the drawing scale and reprint everything. *Solution: To pre-consult with authority before submission*	Authority	S1

G13	Problem: Unsure about the document requirement for certain submissions, e.g. PKLM (permit kerja lebih masa) *Solution: To pre-consult with authority*	Authority	S1
	Problem: Unsure about EOT assessment especially for concurrent delay items *Solution: To understand contract documentation*	Documentation	S2
	Problem: Unable to track some of the emails sent from consultants as unsure how to do proper filing system *Solution: To understand contract documentation*	Record	S2
	Problem: A CLASH problem occurred during the construction, e.g. column obstructed the car park *Solution: To conduct a coordination meeting*	Meeting	S3
	Problem: unworkable design detail highlighted by contractor, e.g. insufficient clearance height of staircase for transfer floor *Solution: To familiarize yourself with building details*	Design	S4
G14	Problem: Unsure about authority requirement for submission drawings, e.g. the requirement of submitting refuse drawings during building plan submission *Solution: To pre-consult with authority*	Authority	S1
	Problem: Unsure about what to write in the letter issued to the main contractor, e.g. when the work progress is slow, we are to request the contractor to 'expedite' work but not 'accelerate' work *Solution: Refer to contract documentation*	Documentation	S2
	Problem: Meeting minutes remain the same every time after the meeting, e.g. contractor/consultant unsure what or when to action *Solution: To record items to follow up/action by who in meeting minutes*	Meeting	S3

	Problem: Materials utilized on site are not the same as approved version *Solution: To understand contract documentation*	Site walk	S4
G15	Problem: Building plans prepared in certain method due to special cases and unsure about the acceptance of authority, e.g. land surrendered for accessway *Solution: To pre-consult before submission*	Authority	S1
	Problem: Seldom formalize changes as they are done verbally, e.g. to replacing top hung window with down hung window for safety purposes for all units that may incur additional cost *Solution: To understand contract documentation*	Documentation	S2
	Problem: The client requested for value engineering exercise, e.g. material specified for façade design – glass railing replaced by mild steel railing *Solution: To understand material specification before propose*	Material	S5
	Problem: The building was constructed differently with design intention, e.g. the allocation of covered walkways in certain area *Solution: To conduct a coordination meeting*	Coordinate	S3
G16	Problem: Unclear which statement of declaration from the principal submitting person needs to incorporate in submission drawings *Solution: To pre-consult with authority*	Authority	S1
	Problem: Missing details, e.g. material specification for covered walkway, type of floor finishes for a particular room, etc that caused additional VO during construction *Solution: To familiarize yourself with building details*	Building details	S4

	Problem: Frequent errors e.g. floor drop missing, missing lines, etc in construction drawings *Solution: To familiarize yourself with building details*	Building details	S4
G17	Problem: The authority submission procedure is confusing as they often update the checklist, e.g. new requirement submission to JPS during planning submission *Solution: To pre-consult with authority*	Authority	S1
	Problem: The contractor is unsure about the documents that need to be submitted upon issuance letter of award, e.g. list of schedule of material submission, list of shop drawing submission, and list of method statement submission. They didn't understand the importance of planning for document submission before construction. Hence, some of them even asked: 'Is it necessary to submit so early?' *Solution: To understand contract documentation*	Documentation	S2
	Problem: Unsure how to file contractor's submission, e.g. keywords missing, complicated reference number *Solution: To understand contract documentation*	Documentation	S2
	Problem: A lot of rework occurred at the site due to poor communication between consultants and contractors, e.g. contractor using obsolete drawings for construction *Solution: To conduct coordination*	Coordination	S3
	Problem: Frequent design changes that do not affect sales and purchase agreements by developers at later construction stages delayed the overall work progress, e.g. change of façade design *Solution: To have a design brief*	Design Brief	S5

	Problem: An indecisive client obstructed work progress, e.g. failed to confirm the variation order requested by the consultant *Solution: To have a design brief*	Design Brief	S5
G18	Problem: The initial design changed after complying with the authority's requirement, e.g. incorporation of a fire lobby for the staircase will affect the façade design *Solution: To pre-consult with authority*	Authority	S1
	Problem: The design had been filtered several times after value engineering, e.g. façade design had been simplified, a downgrade of material specification. *Solution: To understand the material specification*	Material	S4
	Problem: Unsure about the room size required by M&E and C&S consultants *Solution: To conduct a coordination meeting*	Coordination	S3
	Problem: No specific requirement from the developer but what we provided was not as per their expectation, e.g. proposal of façade design, unit layout, etc *Solution: To have a design brief*	Design Brief	S5
G19	Problem: Frequent changes in the authority submission checklist, e.g. different requirements for documentation submission complicated the submission process *Solution: To pre-consult with authority*	Authority	S1
	Problem: Unsure how to assess the project quality plan (PQP) and environmental safety plan as they seemed like standard documents from a contractor that fit any project *Solution: To understand contract documentation*	Documentation	S2

	Problem: Unsure how to file for all correspondence received from project stakeholders, e.g. types of keywords, referencing number required, etc *Solution: To understand contract documentation*	Documentation	S2
	Problem: Project stakeholders are not active in coordination meetings, e.g. ensuring the meeting agenda *Solution: To understand which items to be recorded in meeting minutes*	Meeting	S3
	Problem: Contractor reluctant to submit site diary and safety report as majority of them did not practice writing in the first place. *Solution: To understand contract documentation*	Documentation	S2
G20	Problem: Uncertain types of certificates to prepare after certain events occurred *Solution: To refer PAM 2006 handbook*	Certification	S1
	Problem: Contractor unsure which is the latest version of construction drawings for action due to lack of revision number *Solution: To understand contract documentation*	Documentation	S2
	Problem: The designer is unable to furnish design details, e.g. feature wall design, which we ended up copying from another source *Solution: To familiarize yourself with building details*	building detail	S4

To map the research framework, the following table has summarized the Descriptive Codes from Respondent Interviews. Table 5.5 indicates the display for the summarization of Descriptive Codes for Research Objective 5 (RO5). The data collected shows that the frequency of solutions highlighted for each theme is as follows:

1. S1 (Claims & legal matters management),
2. S2 (Project management), S3 (Communication and relationship management), S4 (Quality assessment and management)
3. S5 (Design management)

Eighteen out of twenty interviewees provided solutions to improve graduate architects' obstacles in claims and legal matters management. Eleven out of twenty interviewees provided solutions to improve graduate architects' obstacles in project management, communication and relationship management, and quality assessment and management. Nine out of twenty interviewees provided solutions to improve graduate architects' obstacles in design management.

Table 5.5: Summary descriptive codes for solutions to obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia

Respondent Identifier	S1 Solutions for claims & legal matters management	S2 Solutions for project management	S3 Solutions for communication and relationship management	S4 Solutions for Quality assessment and management	S5 Solutions for design management
G1	*	-	*	*	*
G2	-	*	*	-	*
G3	*	*	-	-	*
G4	*	*	*	*	*
G5	*	*	-	-	-
G6	*	-	*	*	-
G7	*	-	-	-	*
G8	-	-	-	*	-
G9	*	*	-	*	-
G10	*	-	*	-	*
G11	*	-	-	*	-
G12	*	-	-	-	-
G13	*	*	*	*	-
G14	*	*	*	*	-
G15	*	*	*	-	*
G16	*	-	-	*	-
G17	*	*	*	-	*
G18	*	-	*	*	*
G19	*	*	*	-	-
G20	*	*	-	*	-
TOTAL	18	11	11	11	9

5.3 Analysis and discussion

For better performance in building contract administration, graduate architects need to resolve obstacles caused by deficient in claims and legal matters management, deficient in project management, deficient in communication and relationship management, deficient in quality assessment and management, and deficient in design management. From the result of case studies that include documentation review and semi-structured interviews, few solutions have been proposed for better work performance.

5.3.1 Solutions for sub-themes of deficient in claims & legal matters management

Understanding the sequence of submission is important, from land application, planning submission, and building plan submission to CCC submission. Types of documentation and drawings required to submit are captured in the submission checklist. Respondent G4 stated: "It is important to pre-consult and obtain the latest submission checklist to prevent double handling work" **[G4].** Submission forms could be obtained from a one-stop center (OSC) in each local district. The OSC was initiated by the Ministry of Housing and Local Government in April 2007 to improve the planning system delivery and procedures at all local planning authorities by coordinating and shortening the approval process.

A construction project can only be commenced when approval for the requirements has been obtained from the respective department. For a planning application, a development layout shall be proposed by the architect and formalized & signed by the Registered Planner.

The next step is building plan approval where the application shall be submitted to the local authority concerned and shall comply with the Uniform Building By-laws applicable to the locality, e.g. lighting and ventilation requirement, room size requirement, air well requirement, set-back requirement, carpark requirement, facilities in the multi-story residential requirement, open space requirement, calculation of plinth, calculation of plot ratio, control of hillside development, guard house requirement, etc. The authority shall be notified before construction work commences on site.

Respondent G10 stated: "Authority often changed the requirement in Borang B submission, it is better to pre-consult before submit" **[G10]**. Referring to the Uniform Building by-laws, Form B (Notice of Commencement or resumption of building operation) should be submitted by the architect and engineer before construction.

Comprehensive documentation submitted to authority includes drawings (location plan, layout plans, setting out details, sections, and other details), design report/planning report (project brief, site feasibility study, design concepts, detail, and design specifications), construction record (detail records of the contractor, activities carried out, photographs during construction period), etc.

Besides authority submission, the sequence of building certification to be issued is important during construction to record different stages of construction progress. The content of certificates had been standardized to minimize disputes. Refer to respondent G17 stated: "It is advisable to refer to the certification template in the PAM handbook to prevent dispute by the contractor" **[G17]**. Building certificate templates available in PAM contracts such as architect's instruction, confirmation of architect's instruction, certificate of practical completion, schedule of defects, certificate of making good defects, certificate of partial completion for occupied part (with contractor's consent), certificate of partial completion for occupied part (without contractor's consent), certificate of non-completion, certificate of sectional completion, a notice of deduct liquidated damages, certificate of extension of time, a notice of default, notification of payment to nominated sub-contractor, certificate of direct payment to the nominated sub-contractor due to failure of payment by contractor, notification of payment to nominated supplier, interim certificate, penultimate certificate, and final certificate template should be referred and used by graduate architects when supporting in administering building contracts.

A PAM contract is a type of standard form of contract where the forms set out the terms or conditions on which the contract between the parties is to be carried out. The purposes of the standard form contract are:

1) Provide a basic legal framework to legalize the relationship between the parties
2) Furnish a mechanism for regulating the conduct of the commercial relationship between parties
3) Ensure the administrative procedures are in place to effect the legal and commercial relationship between parties
4) Establish the ambit of powers and duties of the contract administrators under the contract
5) To facilitate the contractual arrangements between all players in a project

The standard form of contract governs legalities and administrative issues to ensure both parties can discharge and perform.

5.3.2 Solutions for sub-themes of deficient in project management

Letter writing is an important aspect of project management. Unable to write properly will cause misunderstanding and misinterpretation between project stakeholders which is not preferable. Respondent G1 stated: “We are unsure how to write properly sometimes and we spent a lot of time searching similar letters as references which is time-consuming” [G1].

It is crucial to understand and compile the types of letters needed to be issued for housing projects for ease of reference in the future. This includes letter regarding the distribution of contract documents, issuance of certificates, request for insurance cover note submission, request for performance bond submission, request for site organization chart, request for key personnel curriculum vitae, request for masterwork program, request for a list of contractors’ submission, reply for EOT application, reply on noting divergence between statutory requirements and other documents, notification change in statutory requirements after base date, reply on direction issued on site by the clerk of works, reply on confirming an instruction, reply on receipt of 7-day notice requiring compliance with instructions, reply on removal or unfixed materials, reply on materials not procurable, request removal defective work, notification of antiquities found, reply on payment of loss and expense claim, reply on default notice served by contractor, letter of intent to NSC, etc.

In addition, this also includes reports such as development planning reports, design reports, site visit reports, progress reports, etc. Keywords and important phrases for each letter writing could be extracted to assist graduate architects with organization and developing the kinds of sentence, paragraph, and paper structure for strong display. Somerset (2008) indicates, that extracting the keywords and phrases, will help overcome the initial frustration caused by a lack of advanced competence in writing skills. It could be used as writing materials to improve graduate architects' writing skills for creative expression while giving a beginner graduate architect in BCA the tool to write.

In addition, contract documentation is also part of project management. Contract documentation as stipulated in the PAM contract includes Letter of Award, articles of agreement, conditions of contract, contract drawings, contract bills (instructions to tenderers, conditions of tendering, form of tender, preliminaries, preambles and specification, bills of quantities and others) and other documents incorporated in the contract documents. It is important to understand contract documentation for efficient construction progress.

Respondent G13 stated: "Contract documentation serves as a guideline to manage the project and we need it throughout the construction process" **[G13].** Letter of Award is a type of letter acceptance of the contractor's tender issued by or on behalf of the Employer. There are terms and conditions stated in the Letter of Award including document submission that consists of a project quality plan, health and safety plan, logistic plan, schedule of shop drawing submission, schedule of material submission, schedule of proposed manpower, machinery & equipment, schedule of method statement submission, masterwork program, site organization chart, progress report format, certificate registration with CIDB, JKKP registration, project cash flow, list of subcontractor, etc. Some of the documents need to be submitted by contractors two weeks after the letter of award is issued and failure to submit will constitute to breach of contract.

Respondent G16 stated: “Standard list of drawings/drawing register is important as a reference for the preparation of the drawings to be issued to contractor” [**G16].** The drawing register is a list of drawings that consist of base drawings, waterproofing key plan& details, bathroom details, part plan details, M&E rooms details, staircase details, architectural details, and schedules. This drawing register keeps a record of all the drawings in existence and is a central authority on the details of each drawing. The list includes the drawing number, title, revision, recipient, and date.

It is controlled to maintain its integrity and to avoid duplication, errors, and inconsistencies. Respondent G20 stated: “Is important to have a good drawing register system to make graduate architects more efficient” [**G20]**

5.3.3 Solutions for sub-themes of deficient in communication and relationship management

Meetings are an important part of the successful management of construction projects to enable project stakeholders to witness the progress and to look at problem areas, discuss quality issues, assess mock-ups, etc. The meeting could be categorised into status update meetings, decision-making meetings, problem-solving meetings, team building meetings, idea-sharing meetings, and innovation meetings. Items that must captured and recorded in kick-off meetings, site meetings, client consultants meetings, and NSC meetings should be provided.

Components of the meeting minutes are the name of the project, meeting date, time, location, list of attendees and the company/organization they represent, author of the meeting minutes, record of meetings such as scope, schedule, budget, time, and date of next meeting.

Respondent G19 highlighted the importance of items to record in meeting minutes by stating: “An efficient minutes meeting record will enhance the efficiency of a meeting” **[G19].** Meetings held for construction projects should be recorded with great fidelity for keeping proofs and records of the progress project.

Coordination is important among project stakeholders. The most effective design coordination is the technical type which helps the design team to ensure the design solutions can be integrated with mechanical, electrical, and plumbing designs that permeate through the entire building.

These technical coordination meetings could be used to check on a design from architecture, structural engineering, fire protection and hydraulics engineering, mechanical service coordination, electrical service coordination, lifts and escalator coordination, civil engineering coordination, landscaping, and specifications. Respondent G14 stated: “We need to know what items to take note of during coordination as a reference to counter-check all services with building design to prevent CLASH” **[G14].** Technical coordination meetings are thereby crucial to be utilized among consultants for counter-checking their design to reduce costs, delays, and disruptions that can be caused by problems on site and the need for remedial or abortive works and redesigns.

RIBA has several checklists that cater for coordination purposes covering architect preparation and brief checklist, architect concept design checklist, architect spatial coordination checklist, architect technical design checklist, architect construction checklist, architect handover checklist, and architect procurement checklist. Each checklist will include the design coordination reviewer’s name and title and list of items to be checked, review response, and remarks.

5.3.4 Solutions for sub-themes of deficient in quality assessment and management

Understanding workmanship standards is important during the site walk. Few workmanship standards exist in the industry such as CONQUAS, QLASSIC, etc to check on the quality of workmanship. Respondent G5 stated: "Graduate architects unsure what to check during the site walk. They just wander around aimlessly. It will be good to know what type of standard we are expecting during inspection**" [G5].**

Respondent felt that understanding workmanship standards will guide graduate architects for inspection and ensure the finished construction work meets the quality standards set in place. During the inspection, GA is expected to check whether work is done in compliance with the plan and specifications, meet the standard work quality and specifications, check on the types of paints and layers of coatings, witness field testing and material sampling, review and check on variation order, inspection of materials delivered and used, performing semi-final and final inspections upon building completion, preparation of punch list and monitoring completion works and handover inspection for smooth project completion.

The contractors' submission is a process to confirm that the project requirements have been relayed to and understood by the trades and fabricators to ensure the correct product is provided. Understanding the types of contractors' submissions and requesting them to submit accordingly is a process to collaborate and note any misinterpretations with the contract documents when the issues can be easily addressed.

It is a critical checkpoint to ensure the components submitted meet the design intent of the construction documents and address any site conditions that vary from those conditions shown in the construction documents.

Respondent G7 stated: "We need a list of contractors' submissions for ease of checking. Sometimes we just unsure what to expect from contractor" **[G7].** Types of contractors' submissions include method statements, material submissions, shop drawings submissions, performance test report submissions, alternative design submissions, variation order claims, an extension of time claims, loss and expense claims, mock-up sample submissions, site diary records, progress report format, masterwork program, mitigation program, etc.

5.3.5 Solutions for sub-themes of deficient in design management

The design brief describes the requirement for which the design provides the solution. Design briefs evolve over the life of a project and require input from consultants progressively.

Respondent G3 highlighted: "We faced a situation where the client was unsure what they wanted caused constant changes in design. We should have approached the client in the early stages of design to seek more information for each component of the buildings**" [G3].**

A design brief is a set of design recommendations to aid graduate architects with design concepts thereby promoting quality design with consideration of productivity, safety, and labor efficiency during construction. The design brief places emphasis on good architectural planning and design details and the use of appropriate materials and technology during construction. The framework of the design brief could be structured according to the main components of the building. The main building components identified are:

1) Main building areas consist of facades and external walls, roof areas, common areas, lift lobbies and corridors, parking areas, and other building areas such as washrooms, facilities
2) Mechanical and electrical facilities consist of plant, machinery and fixed equipment, security, piping and exposed services
3) Landscape and outdoor areas consist of planting and turf, water features, hardscapes

Design factors should be considered about

1) Access for maintenance – ability and ease to access, inspect, and maintain various parts of the building to enable efficient routine servicing and maintenance works. A building should be designed to remove the need for temporary access such as scaffolding and ladders where possible. Key considerations include the adequate provision of access for execution of maintenance tasks including cleaning, inspections, repair, and replacement of materials, components, or equipment; the design layout gives sufficient circulation and working space (headroom), minimizes the need for maintenance at height or in confined spaces; where it is impossible to eliminate the need for maintenance at height or in confined spaces, measures would be allowed to reduce the risks associated with working at height or confined spaces.
2) Materials and finishes – The suitability of materials in terms of durability, and perform the intended functions throughout the design life. Key considerations include striking a balance between aesthetics, costs, safety, and maintenance needs; selecting materials that are durable and suitable for the local climate, select materials that are available in the local market, consider innovative, high-performance materials that require minimum maintenance.

3) Design and detailing – proper design and detailing will minimize the occurrence of defects and reduce the need for maintenance interventions. Concerns include having careful detailing to prevent staining, water penetration, and premature deterioration, simple maintenance methods, and replacement of elements. Key considerations include proper and effective detailing to reduce the weather impact; design enables simple maintenance methods, standardization, and modular layout of components and prefabricated materials/components.

Respondent G20 stated: "We preferred to have a material specification list for ease of checking on contractor's counter proposed material" [**G20].** The advantage of understanding material specification is to apply material at the right location with the right tools and equipment for durable, functional, and affordable construction.

Overall, a draft contract administration framework has been developed based on results collected from RO1 to RO5 in Table 5.6. The draft building contract administration framework consists of types of obstacles, root causes of obstacles, mitigation measures for the obstacles, knowledge requirements, skill requirements, and action plans. This draft building contract administration framework was then validated through a focus group study.

Table 5.6: Draft Building Contract Administration Framework

Types of obstacles	Root causes of obstacles	Mitigation measures for the obstacles	Knowledge requirement	Skill requirement	Action plan
Deficient in Claims and Legal Matters management 1. Unaware of legal policy 2. Poor contract management 3. Discrepancy in contract documentation	Inadequate quality assessment and management skill 1. Inadequate Technical skill 2. Unable to Resolve Technical problems 3. Inadequate Quality management	Instill Claims and Legal Matters management knowledge 1. Authority approving process 2. Construction contract law	a. Town, Country Planning Act b. Street, Drainage, Building Act c. National Land Code d. Building By-Law e. PAM Contract f. Housing Development Act g. Strata Management Act h. Strata Title Act i. Changes in density, building usage, land use j. Building material technical specification k. Construction methods l. legal study knowledge m. material management knowledge n. knowledge of construction plants/equipment and their utilization o. knowledge of sub-contractor	a. Conflict management b. Writing skill c. Project management skill d. Understand clients' aspiration e. Oral skill f. Ability to chair the meeting g. Interpersonal skill h. Skill to adapt to changes i. Skill to make decision j. Quality management skill k. Resolve technical problem skill l. Technical skill (i.e. planning and scheduling, forecasting techniques, quality control, estimating and tendering, reading and understanding drawings, design activities and background, site	**Types of Authority Submission** a. Development order (DO) b. Building plan submission (BP) c. Amendment development order (ADO) d. Amendment building plan (ABP) e. earthwork submission f. road& drainage submission g. BOMBA passive and active h. car park JPIF i. IWK submission j. AIS submission k. building name submission l. postal address submission m. SWCorp submission n. temporary building permit o. SKMM submission p. internal plumbing q. TNB submission r. street lighting submission s. telephone layout tapping t. landscape submission u. POS submission v. SIFUS submission w. COB submission x. KMB submission y. Borang B submission z. hoarding and signboard submission **Certification Template** a. Certificate of Practical Completion b. certificate of making good defects c. certificate of non-completion
Deficient in Communication and Relationship management 1. Communication breakdown 2. Lack of coordination between project stakeholders 3. Lack of information in drawings 4. Lack of understanding of clients' requirement 5. Misunderstanding terms	Inadequate project management skill 1. Poor Project management 2. Poor Writing skill	Instill quality assessment and management knowledge 1. Construction methods 2. Building materials			

			management (i.e. variations, insurance) p. knowledge of sub-contractor tendering & bidding q. knowledge of health & safety management (i.e. compliance, regulation) r. knowledge of risk management (i.e. assessment and analysis) s. knowledge of financial and cost management (i.e. claims and payments) t. knowledge of construction specifications, TQM, building codes, and standard u. knowledge of quality management (i.e. quality control) v. knowledge of time management (i.e. understanding project schedule) w. knowledge of environment management (i.e.	layout and mobilization, technical writing) m. communication skills (i.e. public speaking, correspondence, report writing) n. general skills (i.e. public relations, chairing meetings, understanding of organization) o. legal skills (i.e. drafting contracts, health and safety issues, preparation of claims and litigation) p. financial skills (i.e. reporting system) q. IT skills (i.e. spreadsheet, CAD, BIM) r. managerial skill (i.e. leadership, time management, decision making, negotiation, delegation, strategic planning, human behavior, motivation, team working, top	d. certification of partial completion e. certificate of sectional completion f. penultimate certificate g. final certificate h. certificate of extension of time i. interim certificate **Types of contractor's submission** a. project quality plan b. health and safety plan c. logistic plan d. schedule of shop drawing submission e. schedule of material sample submission f. schedule of method statement submission g. schedule of proposed manpower, machine, and equipment h. masterwork program i. site organization chart j. progress report format k. certificate registration with CIDB l. JKKP registration m. project cash flow n. list of subcontractors **letter writing template** a. development planning report b. design report c. site visit report d. progress report e. letter distribution of contract documents f. letter issuance of certificates g. letter request for insurance cover note submission h. letter request for performance bond submission
Deficient in project management 1. Conventional management protocol 2. Incomplete documentation 3. Ineffective management 4. Lack of guidance and proper documentation	Inadequate design management skill 1. Unable to Make a decision 2. Unable to adapt to changes	Instill design management knowledge 1. Architecture 2. Feasibility studies			
Deficient in design management 1. Insufficient design detail 2. Constant design changes 3. Design error 4. Unworkable detail 5. Slow decision	Inadequate communication and relationship management skills 1. Inadequate Interpersonal skill 2. Inability to chair the meeting 3. Poor Oral skill 4. Inadequate Technical coordination 5. Difficult to Understand clients' aspirations	Instill Project management knowledge 1. Project management 2. Valuation study 3. Financial Planning 4. Environmental studies			

Deficient in quality assessment and management 1. Inadequate site inspection 2. Unfamiliar building specification 3. Absence of a clear uniform standard of work acceptance 4. Non-integrated project delivery 5. Delay reply queries	Inadequate Claims and Legal Matters management skill 1. Inadequate Conflict management skill	Instill Communication and Relationship management knowledge 1. Structural engineering 2. Town planning 3. Electrical engineering 4. Mechanical engineering 5. Quantity Surveying 6. Interior Design 7. Landscape 8. Geotechnical engineering 9. IT Construction 10. Civil engineering	EMS) x. knowledge of green and sustainable construction (i.e. GBI) y. knowledge of construction administration (i.e. documentation & record, submission, plans/ drawings)	management relations)	i. letter request for site organization chart j. letter request for key personnel CV k. letter request for a masterwork program l. letter request for a list of contracts' submission m. letter reply for the EOT application n. letter reply on noting the divergence between statutory requirements and other documents o. letter notifying change in statutory requirements p. letter reply on direction issued on-site q. letter reply confirming an instruction r. letter reply on receipt of a 7-day notice requiring compliance with instructions s. letter reply on the removal of unfixed material t. letter reply on materials not procurable u. letter requesting the removal of defective work v. letter notify antiquities found w. letter reply on payment of loss and expense claim x. letter reply on the default notice y. letter of intent to NSC **meeting minutes template** a. status update meeting b. decision-making meeting c. problem-solving meeting d. team building meeting e. idea sharing meeting – supplier's presentation f. innovation meeting g. client consultant meeting h. site meeting

					i. NSC meeting j. technical meeting k. tender meeting l. Valuation order meeting m. dispute mitigation meeting n. defects meeting o. ccc meeting **Design brief checklist** a. occupants b. spaces requirement c. aim of project d. surrounding context e. preferable materials f. preferable design goals g. preferable technologies h. infrastructure requirement i. budget **Building construction method** a. floor detail b. wall detail c. ceiling detail d. flat roof detail e. metal deck roof detail f. railing detail g. window detail h. door detail i. car park marking detail j. balcony detail k. ac ledge detail l. façade detail m. entrance statement detail n. guardhouse detail o. planter box detail p. ramp detail

					q. staircase detail r. M&E room detail s. lift core detail t. bathroom detail u. waterproofing detail v. unit layout detail **Material list** a. floor – adhesive, screed, bonding agent, tiles, solid wood, bamboo, waterproofing, EPDM, b. wall – plaster, render, paint, aluminum composite panel, corten cladding, face brick c. ceiling – aluminum, plasterboard, d. door – fire-rated door, plywood door, flush door, metal door, aluminum door, sliding door, pivot door, folding door, pocket door e. window- casement window, sliding window, top/bottom hung window, fixed glass window, louver window f. roof – metal deck roof, pitch roof, flat roof g. glazing – tempered, float, laminated, h. sundries – RWDP, railing **Coordination checklist** a. Architecture b. Structural engineering c. Fire protection d. Hydraulic engineering e. Mechanical service coordination f. Electrical service coordination g. Lifts and escalator coordination h. Civil engineering coordination

					i. Landscaping j. specifications **Contract documentation checklist** a. Letter of Award b. Articles of agreement c. Conditions of contract d. Contract drawings e. Contract bills

5.4 Difference between verification & validation of the draft framework

Verification represents an internal check of both model integrity and logic based on the projects studied. This involved checking on each of the components of the draft framework extracted from the case study projects. Validation involves an external check of the correlation between the model and reality. This activity involved applying the framework to real-time building contract administration activity as a means of confirming its applicability to graduate architects. This would allow both the ratification and critical feedback for the existing draft framework components.

5.5 Validation of draft framework

The building contract administration framework was transformed from the early detailed hierarchy landscape format tabulation to a simplified, comprehensive hierarchy portrait tabulation at a later stage. This finalized version was based on the initial hierarchy, with subtle modifications such as removing unnecessary detail information to smooth and reduce the overly structured appearance of the framework. The final framework is shown in Table 5.9.

5.5.1 Focus Group Study

The purpose of the focus group study is to validate and localize the draft building contract administration framework for graduate architects in Malaysia. The focus groups were conducted in March and December 2023 respectively and each session took approximately 60 minutes. This focus group was formed by five practicing architects who registered with LAM, were active in building contract administration for more than 10 years in strata housing projects, and supervised graduate architects selected for semi-structured interviews. The demography of the participants is shown in Table 5.7.

Table 5.7: Descriptive statistics of the participants in the focus group

Item	Focus group
Level of education	
Bachelor	1 (20%)
Masters	4 (80%)
PhD	0 (0%)
Role	
Academic	1 (20%)
Administrative	0 (0%)
Directors	4 (80%)
Salaried architects	0 (0%)
Working experience	
10 to 15 years	1 (20%)
16 to 20 years	0 (0%)
21 to 25 years	1 (20%)
More than 25 years	3 (60%)
Age	
30 – 40 years	1 (20%)
41 – 50 years	1 (20%)
51 – 60 years	1 (20%)
Above 60 years	2 (40%)

Of the 5 practicing architects, 1 female and 4 males agreed to participate in the focus group. The majority of the participants (n=4) hold postgraduate degrees, and only one participant holds double degrees. About 80% (n=4) of participants established their architectural consultancy practice and have more than 20 years of experience in practice. The age of participants varied range from 30 years to above 60 years old.

5.5.1.1 Findings from the Focus group

Consensus was obtained from all the participants for each recommendation to be eligible for inclusion in the final list of the building contract administration framework. This led to validating all the components consisting of types of obstacles, root causes of obstacles, mitigation measures for the obstacles, knowledge requirement, skills requirement, and action plans in the draft building contract administration framework.

The focus group consensus resulted in several amendments to the draft framework. For example, the composition of the framework was refined, information was arranged based on sequence importance, to emphasize on themes and sub-themes, to elaborate on skills requirements, and action plans, etc. Table 5.8 presents the amendments made to the draft framework. Amendments were made to the draft framework information. These amendments were: keep it, re-include, omit, merge with other action plans, shift to another place, paraphrase, and add a new one.

Table 5.8: Selected examples of amendments made in the draft Building Contract Administration Framework

Level of change		
Before amendments	After amendments	Reason
The composition of the overall framework is unorganized	The composition of the overall framework has been reconfigured	For ease of reading and understand
The sequence arrangement of information is unclear	Information has been arranged from very important to little important	For ease of reading
RO4 and RO5 missing	Captured RO4 and RO5 in the final framework	To capture all research objectives in the BCA framework
Lack of explanation of the framework	A brief explanation of the framework is inserted in one column	For ease of understanding
Should have explained the reason for introducing those solutions for sub-themes	The new column 'values of sub-themes' introduced	To understand the importance of each sub-theme

5.6 Building Contract Administration Framework

The outcome discussion of the focus group was summarized and represented in the diagram shown in Figure 5.1. The inner ring of the diagram consists of the research aim, followed by 5 themes of the framework, 11 types of sub-themes and the outer ring is the value of sub-themes on graduate architects. To make this diagram more comprehensive, structured, and organized, the final framework then be developed.

Table 5.9 shows the final building contract administration framework consisting of an introduction, research objectives, results from a quantitative study, and results from a qualitative study. Results from the quantitative study where the variables were arranged based on sequence importance. Results from the qualitative study where variables were categorised into themes, sub-themes, values of sub-themes, and core tasks which also arranged based on sequence importance.

Example usage of the final framework: GA intends to enhance work performance in BCA of housing projects. From the final BCA framework, they will tackle and pay attention to the obstacles, root causes, and mitigation measures identified from this study starting from very important to little important. Meanwhile, if graduate architects face difficulties in understanding the tasks assigned to them while supporting the BCA work, they may search through core tasks in the framework and find further clarification of each task in the supplementary checklist.

When the core tasks in the final framework were explored further, a supplementary checklist was established as shown in Table 5.10. This checklist consists of a list, description, concerned party, period, strategies, additional info, and remarks.

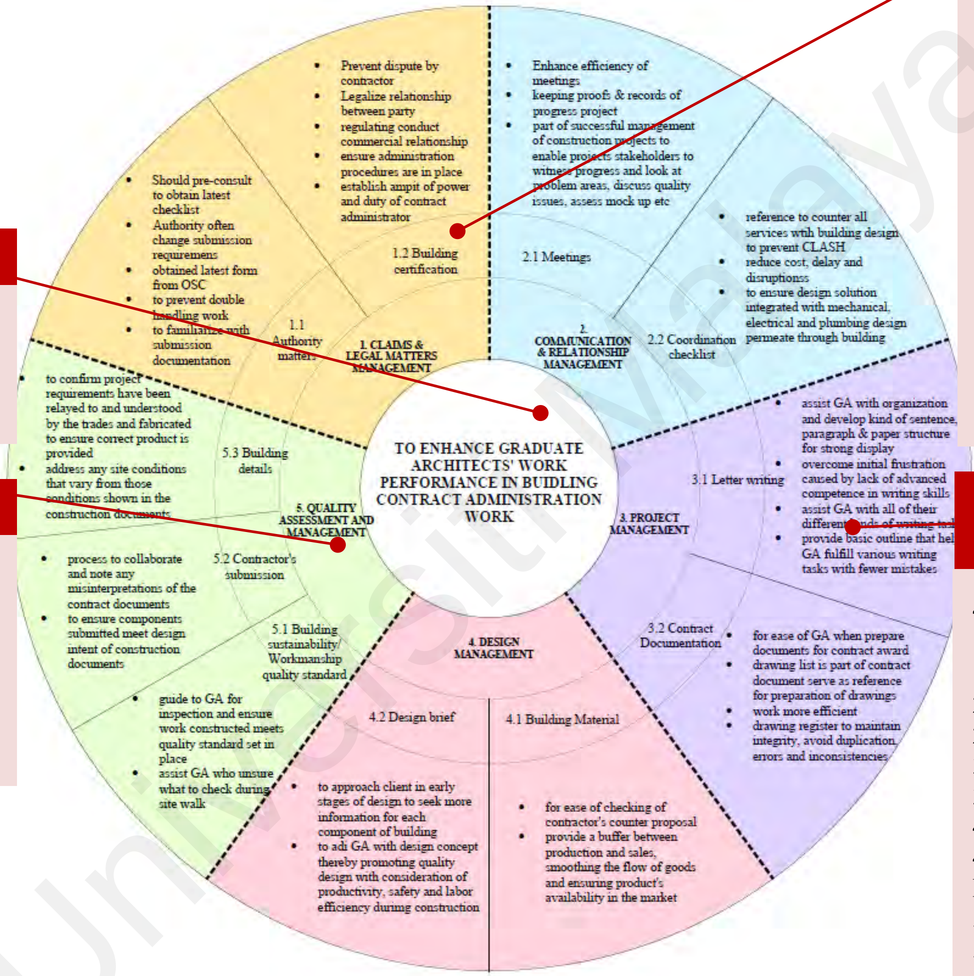
Example usage of checklist: In authority submission, there is planning submission which is renamed as *development order*. This checklist will describe what is *development order*, who is involved in the *development order*, when to submit the *development order*, what to take note when preparing and submitting the *development order*, where to find additional information regarding the *development order*, etc. The graduate architect is to insert remarks if a *development order* for that particular project has been conducted.

Aim of The Research

1[st] Inner circle
To enhance Graduate architect’s work performance in Building Contract Administration work

Themes For Framework

2[nd] Inner circle
1. Claims & Legal Matters Management
2. Communication & Relationship Management
3. Project Management
4. Design Management
5. Quality Assessment & Management



Sub-Theme For Framework

3[rd] Inner circle
1.1 Authority Matters
1.2 Building Certification
2.1 Meetings
2.2 Coordination Checklist
3.1 Letter-Writing
3.2 Contract Documentation
4.1 Building Material
4.2 Design Brief
5.1 Building Sustainability & Workmanship Quality Standard
5.2 Contractors’ Submission
5.3 Building Details

Reasons Selected These Sub-Themes And The Importance To

4[th] Inner circle
1.1 For Project Master Planning
1.2 To Ensure Each Event Are Recorded
2.1 Enhance Efficiency Project Flow
2.2 Prevent CLASH
3.1 Minimize Misunderstanding
3.2 Minimize Dispute
4.1 Ease Assess Alternative Proposal
4.2 To Understand Client’s Requirements Better
5.1 Guide To Assess Standard/Workmanship
5.2 For Ease Assess Contractors’ Submission
5.3 For Ease During Site Inspection

Figure 5.1: Diagram of BCA Framework

Table 5.9: Building Contract Administration Framework For Graduate Architects

BCA Building Contract Administration Framework 2024		Classification of information to graduate architects while supporting BCA housing projects in Malaysia				
Classification of information to Graduate architects supporting BCA housing projects in Malaysia has been divided into **5 categories**. The type of importance ranges from **very important to little important**. For example, information under very important means graduate architects essential to know about types of obstacles, root causes, mitigation measures, and solutions to enhance their work performance in BCA housing projects.	Objectives/ Status	**Very Important**	**Important**	**Moderately Important**	**Slightly Important**	**Of Little Important**
	Types of obstacles faced by graduate architects while supporting BCA housing projects in Malaysia	**Deficient in Claims and Legal Matters management** 1. Unaware of legal policy 2. Poor contract management 3. Discrepancy in contract documentation	**Deficient in Communication and Relationship management** 1. Communication breakdown 2. Lack of coordination between project stakeholders 3. Lack of information in drawings 4. Lack of understanding of clients' requirement 5. Misunderstanding terms	**Deficient in project management** 1. Conventional management protocol 2. Incomplete documentation 3. Ineffective management 4. Lack of guidance and proper documentation	**Deficient in design management** 1. Insufficient design detail 2. Constant design changes 3. Design error 4. Unworkable detail 5. Slow decision	**Deficient in quality assessment and management** 1. Inadequate site inspection 2. Unfamiliar building spec 3. Absence of a clear uniform standard of work acceptance 4. Non-integrated project delivery 5. Delay reply queries
	Root causes of obstacles faced by graduate architects while supporting BCA housing projects in Malaysia	**Inadequate quality assessment and management skill** 1. Inadequate Technical skill 2. Unable to Resolve Technical problems 3. Inadequate Quality management	**Inadequate project management skill** 1. Poor Project management 2. Poor Writing skill Inadequate design management skill 1. Unable to Make a Decision 2. Unable to Adapt changes	**Inadequate communication and relationship management skills** 1. Inadequate Interpersonal 2. Inability to chair the meeting 3. Poor Oral skill 4. Inadequate Technical coordination 5. Difficult to Understand clients' aspirations	**Inadequate Claims and Legal Matters management skill** 1.Inadequate Conflict management skill	Not applicable as there are two themes that fall under the same category
	Mitigation measures for the obstacles faced by graduate architects while supporting BCA housing projects in Malaysia	**Instill Claims and Legal Matters management** knowledge 1. Authority approving process 2. Construction contract law	**Instill quality assessment and management knowledge** 1. Construction methods 2. Building materials	**Instill design management knowledge** 1. Architecture 2. Feasibility studies	**Instill Project management knowledge** 1. Project management 2. Valuation study 3. Financial Planning 4. Environmental studies	**Instill Communication and Relationship management knowledge** 1.Structural engineering 2.Town planning 3.Electrical engineering 4.Mechanical engineering 5.Quantity Surveying 6.Interior Design 7.Landscape 8.Geotechnical engineering 9.IT Construction 10.Civil engineering

The sequence arrangement of the BCA framework is based on result survey from the very important means the most selected by respondents. Sub-themes based on the result obtained from the **analysis of the relationship between types of obstacles-root causes-mitigation measures.** From the result of the analysis, types of obstacles play the most significant impact on mitigation measures through root causes.	Relationship between variables	Types of obstacles have a significant impact on mitigation measures through root causes. Hence, the content of the BCA framework should focus on variables from types of obstacles				
	Themes	**Claims And Legal Matters Management**	**Communication And Relationship Management**	**Project Management**	**Design Management**	**Quality Assessment And Management**
	Sub-themes	1.1 Authority Matters 1.2 Building Certification	2.1 Meetings 2.2 Coordination checklist	3.1 Letter Writing 3.2 Contract Documentation	4.1 Building Material 4.2 Design Brief	5.1 Building sustainability & workmanship quality standard 5.2 Contractors' submission 5.3 Building Details
	Values of sub-themes	1.1 for project master planning 1.2 to ensure each event is recorded	2.1 Enhance the efficiency of project flow 2.2 prevent CLASH	3.1minimize misunderstanding 3.2 minimize dispute	4.1 ease assessing the alternative proposal 4.2 to understand the client's requirements better	5.1 guide to assess standard/workmanship 5.2 for ease assess contractors' submission 5.3 for ease during site inspection
	Core Tasks	**1.1 Authority matters** a. Development order b. Building plan c. Amendment development order d. Amendment building plan e. earthwork submission f. Road & drainage submission g. BOMBA & Penyelamat Malaysia h. JPIF car park submission i. Indah Water Konsortium j. Air Selangor submission k. building name l. postal address m. Perbadanan Pengurusan Sisa Pepejal dan Pembersihan Awam	**2.1 Meetings** a. Status update meeting b. Decision-making meeting c. Problem-solving meeting d. Team building meeting e. Idea sharing meeting f. Innovation meeting **2.2 Coordination checklist** a. Architecture b. Structural engineering c. Fire protection d. Hydraulic engineering e. Mechanical service coordination f. Electrical service f. Lifts and escalators g. Civil engineering h. Landscaping	**3.1 Letter Writing** a. Development planning report b. Design report c. site visit report d. progress report e. Letter distribution contract documents g. Letter issuance of certificates h. Letter request for insurance cover note submission i. Letter request for performance bond submission j. Letter request for site organization chart k. Letter request for key personnel CV l. Letter request for masterwork program m. Letter request for a list of contractors' submission	**4.1 Building Material** a. Floor- adhesive, screed, bonding agent, tiles, solid wood, bamboo, waterproofing, EPDM b. Wall - plaster, render, paint, aluminium composite panel, corten, cladding, face brick c. Ceiling - aluminium, plasterboard, metal d. Door – fire-rated door, plywood door, flush door, metal door, aluminium door, sliding door, pivot door, folding door, pocket door e. Window - casement window, sliding window, top/bottom hung window, fixed	**5.1 Building sustainability & workmanship quality standard** a. Quality assessment system in construction b. Construction quality assessment system c. Green Real Estate d. Green building index **5.2 Contractors' submission** a. Project quality plan b. Health, safety, and environmental plan c. Logistic plan d. Schedule of shop drawings e. Schedule of material sample f. Schedule of proposed manpower, machine, and equipment g. Masterwork program h. Site organization chart i. Progress report format j. Certificate registration CIDB

The content of sub-themes was based on solutions for types of obstacles through case studies. In BCA checklist explained about concerned parties involved architect, developer, engineers, planner, surveyor, etc. The period that clarifies the timeline this information will be required, strategies provided to minimize error and information exchanges, etc		n. Temporary building permit o. Suruhanjaya Multimedia Malaysia p. Internal plumbing q. Tenaga Nasional Berhad submission r. Street lighting s. telephone layout t. Landscape u. POS Malaysia submission v. Schedule of parcel submission w. Pesuruhjaya Bangunan x. Kebenaran Mendirikan Bangunan y. Borang B z. Hoarding **1.2 Building certification** a. Certificate of practical completion b. Certificate of making good defects c. Certificate of non-completion d. Certificate of Partial Completion e. Certificate of sectional completion f. Penultimate certificate g. Final certificate h. certificate extension of time i. Interim certificate		n. Letter reply for EOT application o. Letter reply on noting divergence between statutory requirements and other documents i. Letter notifying change in statutory requirements p. Letter reply on direction issued on-site q. Letter reply confirming an instruction r. Letter reply on receipt of 7-day notice requiring compliance with the instruction s. Letter reply on removal or unfixed material t. Letter reply on material not procurable u. Letter request removal of defective work v. The letter notifies antiquities found w. Letter reply on payment of loss and expense claim x. Letter reply on default notice y. Letter of Intent to NSC **3.2 Contract Documentation** a. Letter of Award b. Article of Agreement c. Conditions of contract d. Contract drawings e. Contract Bills	glass window, louver window f. Roof - metal deck roof, pitch roof, flat roof g. Glazing - tempered, float, laminated h. Sundries - RWDP, railing **4.2 Design Brief** a. Occupants b. space requirements c. Aim of project d. Surrounding context e. Preferable materials f. Design goals g. Technologies h. Infrastructure requirement i. Budget	k. JKKP registration l. Project cash flow m. List of subcontractors n. Environmental management plan o. safety plan p. Building settlement monitoring report q. verticality check report **5.3 Building Details** a. floor detail b. wall detail c. ceiling detail d. flat roof detail e. metal deck roof detail f. railing detail g. window detail h. door detail i. car park marking detail j. balcony detail k. ac ledge detail l. facade detail m. entrance statement n. detail o. guardhouse detail p. planter box detail q. ramp detail r. staircase detail s. M&E room detail t. lift core detail u. bathroom detail v. waterproofing detail w. unit layout detail

Table 5.10: Building Contract Administration Checklist

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
CLAIMS & LEGAL MATTERS MANAGEMENT – 1.1 Authority matters							
a	Development Order- Jabatan Perancangan Bandar	Written consent from local planning authority for approval of development request and before the development of any building	Developer, Consultants (planner, architect, C&S, M&E, etc)	After masterplan approval	1. Architect to submit DO if land area smaller than certain acreage (DBKL only), other districts to be submitted by the planner 2. Project title needs to be determined, information stated in development data such as total number of housing units, types of units, number of car parks, facility rooms, and location, number of floor levels, etc will be concluded in Borang C1	DO submission checklist	☐Done
b	Building Plan- Jabatan Kawalan Bangunan	The submission consists of full building details of the proposed building work to be submitted for approval before construction work	Developer, Architect	After DO approval	1. land matters to be settled (QT is required) 2. Information such as each unit type, guard house, fencing details, refuse room details, etc need to be incorporated in the submission. All drawings are to be fully colored with color code, i.e. red-tiles finish, yellow-wall, blue-metal works, etc 3. BP to be submitted before DO approval lapsed	BP submission checklist	☐Done
c	Amendment Development Order (ADO)- Jabatan Perancangan Bandar	Revision of approved development order	Developer, Consultants (architect, C&S, M&E, etc)	After BP approval	1. This submission is to be done if changes involve façade design, floor area, number of units, revision of project title, etc 2. Changes in development data, and façade design are to be resubmitted for DO approval. Changes to be colored in RED for new work and BLUE dotted line for work omitted	ADO submission checklist	☐Done
d	Amendment Building Plan (ABP)- Jabatan Kawalan Bangunan	Revision of approved building plan	Developer, Architect	After ADO approval	consent letters from purchasers are required for submission of units sold/undertaking letter is required from the developer if the unit yet sold (NEW)	ABP submission checklist	☐Done
e	Earthwork- Jabatan Perancangan Infrastruktur	The submission consists of platform level and section, location of silt trap, site gate, wash trough, etc	Engineer	After DO approval	The location of the wash trough, signboard, and site gate is indicated in this submission	Earthwork submission checklist	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
f	Road & Drainage- Jabatan Perancangan Infrastruktur	Submission for internal and external road & drain design. A clearance letter is required for CCC inspection	Engineer	After DO approval	1. Internal perimeter drainage and OSD/RWHT location is captured in this submission. This info is required to be captured in the building plan submission 2. CCC clearance letter- G17 3. Manual Saliran Mesra Alam (MSMA) submission is done by engineer 4. Calculation of rainfall to estimate the size of RWHT by engineer	R&D submission checklist	☐Done
g	BOMBA passive and active – Jabatan BOMBA dan Penyelamat Malaysia	Fire-fighting system for building, e.g. compartmentation, fire appliance access, fire extinguishers, EL, smoke detector, etc	Architect, Engineer	BP submission	1. Information needs to be captured in BOMBA passive submission including keperluan kelengkapan BOMBA, fire appliance access calculation, fire hydrant with distance stated, fire appliance access road, emergency light, exit sign, hosereel+DP+FA+FI+breakglass within 30m radius, carbon dioxide, smoke detector, wet riser in 45m coverage, staircase+fireratedoor+compartemented lift lobby in red, travel distance, car park hose reel, break glass, DP, etc 2. To be submitted concurrently with BP/ABP 3. BOMBA active to be submitted after BOMBA passive approval 4. BOMBA passive by Architect; BOMBA active by Engineer	BOMBA submission checklist	☐Done
h	JPIF car park- Jabatan Perancangan Infrastruktur	Car park allocation in a building for residents, visitors, OKU, etc.	Architect	During DO/ADO	1. Car park numbering marking should be similar to sales and purchase drawings. Items to be captured in the drawing includes speed hump, convex mirror, CCTV, zebra crossing, driveway direction, etc 2. Authority CCC inspection is required	JPIF (car park) submission checklist	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
i	IWK- Indah Water Konsortium	Sewerage application and consist of submission PDC 1 – PDC 8	Engineer, contractor	After DO approval	1. PDC 1 application for sewerage planning approval PDC 2 application for sewerage works PDC 3 details for structural plans and design calculations PDC 4 details for electrical design and drawings PDC 5 details for equipment and material data sheets (EMDS) PDC 6 notice of commencement of sewerage works PDC 7 notice of intermediate inspection of sewerage works PDC 8 notice of final inspection 2. CCC clearance letter – G14	IWK submission checklist	☐Done

0No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
j	AIS- Air Selangor Malaysia	Water application and consists of submission for QT1 – QT11	Developer, engineer, contractor	after DO approval	1. QT1 application for test and inspection of external water reticulation system/supply main QT2 response on the application for test and inspection of external reticulation system/supply main QT3 material inspection reports QT4(a) hydrostatic pressure test and leakage test report for external pipeline QT4(b) hydrostatic pressure test- external pipeline and main pipe complete with Ferrule and communication pipe QT5 water tightness test report for reservoir/suction cistern QT6(a) final joint inspection report (external pipeline) QT6(b) final joint inspection report (reservoir/suction/cistern/pump house) QT7 notification for submission of band guarantee over defect liability period (external reticulation/supply main) QT8 support letter from district O&M for tapping works QT9 certificate of disinfection QT10 application for handing over of external water reticulation system QT11 acceptance of handing over of external water reticulation system 2. CCC clearance letter – G13	AIS submission checklist	☐Done
k	Building name- Jabatan Perancangan Infrastruktur	Approval is required for the APDL application	Developer, Architect	before address submission	Need to approach Dewan Bahasa dan Pustaka for Building name consult and obtain approval before submission to DBKL	DBP submission checklist	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
l	Postal address- Jabatan Perancangan Infrastruktrurt	Units numbering sequence is based on postal address submission	Architect	after DO	1. This approval is crucial for the application of the TNB meter, water meter, and quit rent& assessment 2. The authority will request for site visit when construction reaches 30% progress on site. Approval will be issued after a site visit	JPIF (address) submission checklist	☐Done
m	SWCORP- Perbadanan Pengurusan Sisa Pepejal & Pembersihan Awam	Refuse collection submission to be submitted during the DO and BP stage	Architect	during DO/ADO	The location and distance of the refuse chamber are important. The capacity of the refuse systems is based on the calculated number of units and types of systems that apply	SWCORP submission checklist	☐Done
n	Temporary Building Permit- Jabatan Kawalan Bangunan	Submission of workers' cabins, site office cabins, temporary toilets, store room layout	Architect, contractor	After Borang B superstructure	1. Location and number of temporary buildings proposed by the contractor and submitted through the architect. 2. Permit validity for one year	Temporary permit submission checklist	☐Done
o	SKMM- Telekom Malaysia	Telephone application	Engineer	during DO/ADO submission	Receipt acknowledgment submitted to 10 service providers is required	DO submission checklist	☐Done
p	Internal plumbing- Jabatan Kawalan Bangunan	Require as part of the support document of Borang B	Engineer	After BP approval	1. Proof submission is also required during the CCC stage 2. No approval will be issued	Plumbing submission checklist	☐Done
q	TNB- Tenaga Nasional Berhad	Power supply application	Engineer	During DO application	1. TNB substation to be handed over to TNB a minimum of 6-8 months before CCC to obtain permanent power supply. 2. A clearance letter from TNB is required for CCC	TNB checklist	☐Done
r	Street lighting- Jabatan Perancangan Infrastruktrurt	Application for external street lighting	Engineer	After R&D approval	1. Authority inspection is required after work is completed and to a obtain clearance letter for CCC 2. Types of street lighting (solar/non-solar type) to follow authority requirement	Street lighting checklist	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
s	Telephone layout tapping	Application for telephone services	Engineer	During DO submission	1. Clearance letter require for G20 2. PN10 to be done before request authority inspection	Telephone tapping checklist	☐Done
t	Landscape- Jabatan Lanskap Malaysia	Softscape and hardscape submission	Landscape architect	After R&D approval	1. No clearance letter is required for CCC 2. Authority inspection after work is done is not necessary	Landscape checklist	☐Done
u	POS- Pos Malaysia Berhad	Submission to apply for postcode	Architect	After DO approval	Authority inspection and clearance letter is required after work is done for CCC	POS checklist	☐Done
v	SIFUS- Jabatan Perancangan Bandar	Application for strata title- ownership of the particular unit	Surveyor	BP approval	To check whether the parcel, accessory parcel, common facility, and floor level are marked correctly on plan	DO approval	☐Done
w	COB- Jabatan Kawalan Bangunan	Submission to the commissioner of the building who was appointed to administer and carry out provisions in the Strata Management Act 2013	Surveyor	After BP approval	Submission for acknowledgement	DO approval	☐Done
x	KMB- OSC	Permission was given by the authority to commence work on the site	Architect	After BP approval	Appointment of refuse contractor is required	BP approval	☐Done
y	Borang B- OSC	Notification to be submitted to local authority 4 days before work commencement on site	Architect, engineer	After KMB	There are 2 types of Borang B- Borang B for substructure work and superstructure work	BORANG B checklist	☐Done
z	Hoarding & signboard- Jabatan Kawalan Bangunan	Submission for permit application	Architect	After Borang B	No charges are imposed on hoarding and signboard installed on site for the DBKL area	Hoarding checklist	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
1.2 Building Certification							
a	Certificate of practical completion	Certificate issued when works have been practically completed by the terms and conditions of the contract	Architect	Concurrent with CCC	1. The first moiety of retention fund will be released after the issuance of CPC 2. Recommendation from other consultants is required before issuance of this certificate	Documentation record/PAM handbook	☐Done
b	Certificate of making good defects	Certificate issued upon the expiry of defect liability period (DLP) and completion of making good all defects which may have been required to be made good	Architect	After DLP lapsed	1. Architect and consultants are to issue a schedule of defects within 14 days upon receiving notification of claim CMGD from the contractor 2. The second moiety of retention funds will be released after the issuance of CMGD 3. Recommendation from other consultants is required before issuance of this certificate	Documentation record/PAM handbook	☐Done
c	Certificate of non-completion (CNC)	Certificate issued when a contractor fails to complete the works by the completion date or within any extended time fixed	Architect, quantity surveyor	The completion date in the contract lapsed	1. Work unable to be completed within the completion date or revised completion date 2. Liquidated damages will be imposed daily	Documentation record/PAM handbook	☐Done
d	Certificate of partial completion	Certificate issued when an employer takes possession of any part of the works or sections that are determined by the architect to be practically completed before practical completion of the work	Architect, quantity surveyor	Completion date lapsed	The amount of retention fund, liquidated damages, etc will be recalculated based on incomplete work	Documentation record/PAM handbook	☐Done
e	Certificate of section completion	Certificate issued when such sections of the works stated in the appendix in contract documents had been taken possession by the employer before practical completion of the work	Architect	After milestone work completed	Sectional completion such as TNB substation, mock-up units completion, etc.	Documentation record/PAM handbook	☐Done
f	Penultimate certificate	A payment certificate is issued to NSC/NS before the final certificate	Architect	Before final certificate	This certificate is issued if there is any outstanding amount withheld by the main contractor unreasonably and yet honored to NSC/NS	Documentation record/PAM handbook	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
g	Final certificate	Certificate issued after the issuance of a certificate of making good defects	Architect	After CMGD	This marks the completion of the architect's scope of work in this contract	Documentation record/PAM handbook	☐Done
h	Certificate of extension of time	A certificate was issued to extend the completion date	Architect	Before CPC	1. The contractor will submit supportive documents such as a site diary, progress report, site photos, etc to claim for EOT. 2. Architect to assess before grant EOT	Documentation record/PAM handbook	☐Done
i	Interim certificate	Payment certificate issued to Employer to honor payment to contractor on monthly basis	Architect, quantity surveyor	Every month before the final certificate	Valuation will be done and recommended by a quantity surveyor	Documentation record/PAM handbook	☐Done
COMMUNICATION & RELATIONSHIP MANAGEMENT – 2.1 Meetings							
a	Status update meeting	To update work status progress, targeted work done	Project team	During construction	1. Example such as site meeting 2. to check the submission of the site diary, outstanding correspondence	Documentation record	☐Done
b	Decision-making meeting	To report authority submission status, to request confirmation on design/proposal, to report site progress, etc	Developer, consultants	Since conceptual design	Client consultant meeting minutes to record items such as variation order reports, design proposals, client confirmation items, design changes, etc.	Documentation record	☐Done
c	Problem-solving meeting	To resolve design issues such as clashes of services, insufficient room size, design not catering to site context, etc	Developer, consultants	Design development	Technical meeting minutes to record solutions proposed by consultants and confirmed by the client; dispute mitigation meeting to record solutions acceptable by both parties	Documentation record	☐Done
d	Team building meeting	To coordinate between various trade sub-contractors, i.e. plumbing, lift, electrical, etc	Contractors	During construction	Domestic/nominated sub-contractor meetings minutes to record material submission, work to be done	Documentation record	☐Done
e	Idea sharing meeting	Product presentation by the supplier	Supplier	Design development	Introducing new paint colors, new types of plaster products, etc	Documentation record	☐Done
f	Innovation meeting	New ideas are generated to improve the current design	Architect consultant	Design development	Design meeting minutes to record design proposed or confirmation items by the client	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
2.2 Coordination checklist							
a	Architecture	To comply with building by-law	Architect	Design development	Check on room sizes, ventilation requirements, height, access	Documentation record	☐Done
b	Structural engineering	To check whether the structural element will affect the car park, rooms, etc	Engineers	Design development	Check on column sizes, transfer plate/beam, structure wall thickness, and alignment	Documentation record	☐Done
c	Fire protection	BOMBA requirements will affect room sizes and location	Architect	Design development	Check on BOMBA requirement compliance, travel distance, fire extinguisher, smoke detector, pressurization, wet riser, dry riser, etc	Documentation record	☐Done
d	Hydraulic engineering	This will affect the allocation of box up, ceiling to cover services	Architect, engineer	Design development	Check on the routing of piping, tapping location	Documentation record	☐Done
e	Mechanical service coordination	This will affect unit layout design	Architect, engineer	Design development	Check on fan coil unit position, location of air condition compressor, mechanical ventilation, etc	Documentation record	☐Done
f	Electrical service coordination	This will affect the floor layout, vehicular and human circulation, etc	Architect, engineer	Design development	Check on the location and size of the substation, riser requirement	Documentation record	☐Done
g	Lifts and escalator coordination	This will affect structural design and floor plan layout design	Architect, engineer	Design development	Lift shaft/lift core sizes	Documentation record	☐Done
h	Civil engineering coordination	Information requires to be inserted into building plan submission	Architect, engineer	Design development	Infra work, e.g. road finishes, drainage	Documentation record	☐Done
i	Landscaping	Information required for DO submission, pool finishes, pool deck, BBQ terrace, outdoor spaces	Landscape architect	Design development	Types of softscape, hardscape	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
PROJECT MANAGEMENT – 3.1 Letter Writing							
a	Development planning report	Known as LCP requested by the authority during DO submission	Planner	During DO submission	1. Prepared by architect/planner 2. Information includes development data, perspective, feasibility study, etc	DO submission checklist	☐Done
b	Design report	Alternative design report submitted by the contractor	Contractor	Tender/ Construction	1. example concrete design report, PT slab design report	Contractor's alternative design	☐Done
c	Site visit report	Report to record site walk/site inspection	Architect	During construction	To include photos, workmanship that needs to be improved, bad practices on site that need to be amended, etc	Documentation record	☐Done
d	Progress report	Report to record site progress	Contractor	During construction	To include site organization chart, work status, 2 weeks planning program, masterwork program, drawing registered, a record of submission, etc	Site meeting record	☐Done
e	Letter distribution of contract documents	Cover letter/transmittal to record contract documents issued	Architect/ consultants	During construction	Contract documents for hydraulic system, ACMV, pool system, RWHT system, etc.	LoA	☐Done
f	Letter issuance of certificates	Cover letter on certificates issued to contractors/developers	Architect	During construction	Such as cover letter for issuance of interim certificates, final certificates, stage billing, etc	LoA	☐Done
g	Letter request for insurance cover note submission	Letter requesting the contractor to submit insurance cover note	Architect	Before work commencement on-site	1. Such as CAR insurance, workmen compensation insurance, etc 2. To state the target date of submission which is before work commencement	LoA	☐Done
h	Letter request for performance bond submission	Letter requesting the contractor to submit a performance bond	Architect	Before work commencement on-site	This could be replaced with a director's guarantee under the client agreement	LoA	☐Done
i	Letter request for site organization chart	Letter request contractor to submit site organization chart to insert info info correspondence loop	Architect	After the project kick start	To understand who is the person in charge, position, contact	LoA	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
j	Letter request for key personnel CV	Letter request contractor to submit key personnel CV to check on the competency of site agent appointed	Architect	After the project kick start	To understand the competency level, previous projects are done, etc	LoA	☐Done
k	Letter request for masterwork program	Letter requesting the contractor to submit a masterwork program for monitoring work progress and assessing EOT	Architect	After the project kick start	To check the duration of the casting cycle, work sequence, etc	LoA	☐Done
l	Letter request for a list of contractors' submission	Letter request contractor to submit necessary documents to kick start project	Architect	After the project kick start	Examples such as JKKP registration, CIDB levy, etc	LoA	☐Done
m	Letter reply for EOT application	Letter reply to the contractor on the EOT application	Architect	During construction	1. reason for unacceptable/insufficient information to be stated 2. The PAM contract clause should be stated for the reason granted 3. reason grant should based on clauses in the PAM contract	Documentation record/PAM handbook	☐Done
n	Letter reply on noting divergence between statutory requirements and other documents	Letter reply to contractor when discovering design/specification which does not conform to latest authority requirement and variation is required	Architect	During construction	Example additional fire lift lobby, checker plaque, TNB signages, etc	Authority's comment	☐Done
o	Letter notifying change in statutory requirements	The letter notifies the contractor that the latest requirement from the authority will cause a variation order	Architect	During construction	Example relocation of water tank due to water pressure level difference, etc	Authority's comment	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
p	Letter reply on direction issued on-site	Letter to formalize verbal direction	Architect	During construction	Non-compliance to specification, workmanship problem issued	Documentation record/Site direction record	☐Done
q	Letter reply confirming an instruction	Letter to formalize verbal instruction issued on-site	Architect	During construction	Revised design detail, revised material specification, etc	Documentation record/CAI	☐Done
r	Letter reply on receipt of 7-day notice requiring compliance with instruction	Letter reply to the contractor on questioning about the necessity to comply with certain instructions within 7 days' notice	Architect	During construction	Example changes during water reticulation installation, sewerage work construction, etc	Authority's comment	☐Done
s	Letter reply on removal or unfixed material	Letter request contractor to halt utilizing a counterfeit product on site	Architect	During construction	Example brand of a material different from contract specification	Documentation record/NCR	☐Done
t	Letter reply on material not procurable	Letter request contractor to expedite in procuring certain types of materials	Architect	During construction	Example sanitary ware, aluminium composite panels, etc	Contract document	☐Done
u	Letter request removal of defective work	Letter request contractor on non-compliance work done on site	Architect	During construction	Example roof leakage, toilet leaking, etc	Contract	☐Done
v	Letter notifies antiquities found	The letter notifying the contractor to stop work when found antiquities on site	Architect	During construction	Example fossils, existing buildings, etc	Documentation record/PAM handbook	☐Done
w	Letter reply on payment of loss and expense claim	Letter reply to contractor regarding request unacceptable or insufficient information to assess claim submitted	Architect	During construction	Example purchase order, delivery order, etc	Documentation record/PAM handbook	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
x	Letter reply on default notice	Letter reply to contractor about non-compliance work done on site	Architect	During construction	Example non-compliance record (NCR)	LoA	☐Done
y	Letter of Intent to NSC	Letter award to NSC	Architect quantity surveyor, engineer	During construction	Example draft letter to electrical NSC, aluminum & glazing NSC, etc	LoA	☐Done
3.2 Contract Documentation							
a	Letter of award	LOA main builders/NSC	QS, M&E, architect	After tender	1. date of commencement/completion 2. liquidated damages amount 3. scope of work 4. period of payment 5. performance bond 6. insurance	Contract	☐Done
b	Articles of agreement	Part of the PAM contract	Architect	During tender	Consist of information such as project title, employer, architect, and other consultant's details, etc	Contract	☐Done
c	Conditions of contract	Part of the PAM contract	Architect	After tender	Consists of 38 clauses of the PAM contract	Contract	☐Done
d	Contract drawings	Converted from tender drawings	Architect	After tender	Consists of a drawing list, specifications, etc	Contract	☐Done
e	Contract bills	Converted from bill of quantity	Architect	After tender	Consist list of tender clarification, preliminary and general, specifications, etc	Contract	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
DESIGN MANAGEMENT – 4.1 Building Materials							
a	Floor	adhesive, screed, bonding agent, tiles, solid wood, bamboo, waterproofing, EPDM,	Architect	Design development	To specify the brand, types, sizes, and model code in drawings	Building specification	☐Done
b	Wall	plaster, render, paint, aluminum composite panel, corten cladding, face brick	Architect	Design development	To specify the brand, types, sizes, and model code in drawings	Building specification	☐Done
c	Ceiling	aluminium, plasterboard,	Architect	Design development	To specify the brand, types, sizes, and model code in drawings	Building specification	☐Done
d	Door	Fire-rated door, plywood door, flush door, metal door, aluminum door, sliding door, pivot door, folding door, pocket door	Architect	Design development	To specify the brand, types, sizes, and model code in drawings	Building specification	☐Done
e	Window	casement window, sliding window, top/bottom hung window, fixed glass window, louver window	Architect	Design development	To specify window component requirement, brand, silicone, Santoprene/neoprene, gasket requirement, etc	Building specification	☐Done
f	Roof	metal deck roof, pitch roof, flat roof	Architect	Design development	To specify fall direction, fall gradient, metal girth thickness, gutter requirement, etc	Building specification	☐Done
g	Glazing	tempered, float, laminated,	Architect	Design development	To specify thickness, certificate requirement, color, types, brand	Building specification	☐Done
h	Sundries	RWDP, railing	Architect	Design development	To specify brand, size, diameter, color, etc	Building specification	☐Done
4.2 Design Brief							
a	Occupants	Number of occupants will be staying/ building users	Architect	Conceptual Design	To confirm the capacity required which will affect room size	Documentation record	☐Done
b	Spaces requirement	Size/lighting/no. of rooms/usage of rooms	Architect	Conceptual Design	To comply with UBBL requirement	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
c	Aim of project	Purpose of the building and targeted price range	Architect	Conceptual Design	The price range will affect the number of car parks required in DBKL's new regulation	Documentation record	☐Done
d	Surrounding context	Neighboring buildings, site context	Architect	Conceptual Design	Information important for building orientation, room allocation, entrance location, etc	Documentation record	☐Done
e	By law requirements	Items to consider during the design	Architect	Conceptual Design	1. Party wall >200mm thick 2. Party wall above the upper surface of the roof > 230mm 3. Staircase tread to be min 255mm and height max 180mm 4. Handrail shall be more than 900mm from FFL 5. The swimming pool marked on the side wall indicates the depth of the pool 6. For a pool with diving boards, the minimum depth shall be 1.53m for diving boards up to 3m, the depth to be 3.3m and for platforms up to 9.7m the minimum depth shall be 4.5m 7. minimum area: master bed is 11m², bed 1 is 9.3m², bed 2 and 3 is 6.5m², kitchen to be more than 4.5m² with min width of 1.5m 8. Height of room: living room and bedroom is 2.5m, kitchen 2.25m, bathroom, wc, latrines, porches, balconies, verandah, garages is 2m. 9. Shophouse height more than 3m, upper floor more than 2.5m.	Documentation record	☐Done
e	Preferable materials	Types of finishes preferred, e.g. marble, timber flooring, solid wood,	Architect	Conceptual Design	Different types of finishes for different types of site conditions, i.e. timber floor for bedroom, tiles for bathroom, cement screed for AC ledge, etc	Documentation record	☐Done
f	Preferable design goals	Types of design preferred, e.g. minimalism, classical, neo-classical, etc	Architect	Conceptual Design	Each developer has their design preference. For high-rise residential, minimalist applied, etc	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
g	Preferable technologies	e.g. BIM software, 3D printing, drones	Architect	Conceptual Design	Depends on budget and the availability of software by other consultants	Documentation record	☐Done
h	Infrastructure requirement	e.g. roads, pipelines, bridge	Architect	Conceptual Design	Cost consuming	Documentation record	☐Done
i	Budget	To control variation order, revise the design, valuation engineering exercise when burst budget, etc	Architect	Conceptual Design	Cost for expanding	Documentation record	☐Done
QUALITY ASSESSMENT AND MANAGEMENT – 5.1 Building sustainability/workmanship quality							
a	QLASSIC	A system or method to measure and evaluate the workmanship quality of a building construction work based on construction industry standards (CIS7:2006)	Architect	Construction	1. Assessment is done when building vacant possession, 2. optional requirement stated in the contract	Documentation record	☐Done
b	CONQUAS	Construction quality assessment system is a standard introduced in Singapore to assess the construction workmanship quality of building projects	Architect	Construction	1. Assessment is done when building vacant possession, 2. optional requirement stated in the contract 3. Standard is more stringent than QLASSIC	Documentation record	☐Done
c	GreenRE	Green Real Estate- Green certification tool to uphold the standards of the growing green buildings in Malaysia	Architect	Construction	1. Rainwater harvest system 2. solar panel 3. low VOC	Documentation record	☐Done
d	GBI	Green rating system to promote sustainability in the built environment and raise awareness about environmental issues and responsibility to future generations	Architect	Construction	1. Rainwater harvest system 2. solar panel 3. low VOC 4. Fee registration is more expensive than GreenRE	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
5.2 Contractors' submission							
a	Project quality plan	A component of a project management plan that outlines the required tools, tasks, and processes the project will be delivered	Architect, contractor	Construction	1. To check the format of the submission form, site memo, site direction, site diary, site record, etc 2. To be submitted within 2 weeks after the letter of award 3. Content PQP includes title/cover page, general project detail, project brief, key personnel and responsibilities, quality control and record, list of attachments(masterwork program, shop drawing list, as-built drawing&warranty list, subcontractor list, material list, site organization chart, manpower, machinery&equipment, location map, key plan and site plan, inspection form, request for information format, material/sample submission format, document submission form, site diary, etc)	Documentation record	☐Done
b	Health and safety plan	Describe about kinds of potential hazards on site and methods to prevent or eliminate	Architect, contractor	Construction	1. To check on the safety measures allocated on-site, toolbox meeting frequency, HSE report format, etc 2. Content of HSE includes health and safety objectives, project brief, management & supervision, list of personal protection equipment, safety signage&location, emergency response plan&emergency contact number, emergency evacuation plan, escape route and assembly point, etc	Documentation record	☐Done
c	Logistic plan	Organization of all aspects of the supply chain that keeps an operating plan on the right path meeting objectives	Architect, contractor	Construction	This plan will consist of information such as the location of the store room, site office, toilets, and worker quarters for temporary building permit application	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
d	Schedule of shop drawing	List recorded material samples submitted by the contractor by contract specifications to apply in the development	Architect, contractor	Construction	1. such as color chart submission, tiles sample submission, etc 2. To state target date submission for ease of monitoring.	Documentation record	☐Done
e	Schedule of proposed manpower, machine, and equipment	List recorded manpower, types of machinery, and equipment that will be applicable in the development	Architect, contractor	Construction	To trace whether the manpower and machinery allocated is sufficient for the project	Documentation record	☐Done
f	Masterwork program	A program that maps out key milestones of a development project	Architect, contractor	Construction	To check milestone completion date, sequence of work, casting cycle, completion date, etc match with the contract	Documentation record	☐Done
g	Site organization chart	The internal structure of an organization or company based on the site which includes photos, contact information, email	Architect, contractor	Construction	Those who station in the quarter and are not based in the site office are not required to be included in this chart	Documentation record	☐Done
h	Progress report format	Format for report in which contractor updates information about the development	Architect, contractor	Construction	To check the work status report format, list of drawings registered, list of site memos, list of NCR, list of VO, safety report summary, meeting minutes NSC, etc	Documentation record	☐Done
i	Certificate registration with CIDB	This certificate is to confirm contractor engaged is legitimate in carrying out construction-related work	Architect, contractor	Construction	To pay the CIDB levy is 0.125% of the contract sum	Documentation record	☐Done
j	JKKP registration	Registering site whose operation involves machinery to the construction work section at the stage of the department of OSHA within 7 days from the start of operation.	Architect, contractor	Construction	Compulsory registration with JKKP	Documentation record	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
k	Project cash flow	To state the S-curve of project cash flow in progress report for ease of monitoring the financial status of a contractor	Architect, contractor	Construction	Financial S-curve to show finance plan and finance claimed in report	Documentation record	☐Done
l	List of subcontractors	List recorded subcontractors, whether DSC or NSC engaged by contractors	Architect, contractor	Construction	To insert contact, company name, name of person in charge	Documentation record	☐Done
m	Environmental management plan	A framework to mitigate effectively against any impacts that are significant and render them to a minimal acceptable level.	Architect, contractor	Construction	Examples such as noise pollution, air pollution, water pollution, waste management, etc	Documentation record	☐Done
n	Safety Plan	A written plan designed to minimize accidents on a work site and provide proper training protocols to respond to emergency	Architect, contractor	Construction	1. to be submitted on a monthly basis 2. to include data such as total induction course conducted, no. of first aid injuries, no. of loss time injuries, CIDB holder, property damage, average total workers, SO's instruction, local authority's instruction, total man hours, etc	Documentation record	☐Done
o	Building settlement monitoring report	Provide early detection of settlement, track changes, and assist in controlling corrective actions	Architect, contractor	Construction	The number and location of checkpoints will be determined by the engineer. Submit on a monthly basis	Documentation record	☐Done
p	Verticality check report	To check whether a building, structure or retaining wall is completely vertical or leans toward one direction	Architect, contractor	Construction	The number, location, and floor to check determined by the engineer	Documentation record	☐Done
5.3 Building Details							
a	Floor detail	Types of substrate, floor finishes, thickness,	Architect	Design development	To capture the floor drop termination, skirting detail, floor trap location, etc in the drawing	Tender drawings	☐Done
b	Wall detail	Types of wall, thickness, finishes	Architect	Design development	To capture the edge of the wall, and corner wall detail in the drawing	Tender drawings	☐Done
c	Ceiling detail	Types of ceiling, finishes	Architect	Design development	The thickness of the ceiling frame, and spacing to be indicated in the drawing	Tender drawings	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
d	Flat roof detail	The thickness of the roof finishes	Architect	Design development	Waterproofing is required on a flat roof, to ensure sufficient rainwater outlet, scupper drain, calculation of water outlet based on formula	Tender drawings	☐Done
e	Metal deck roof detail	Thickness of roof, gradient pitch, types of metal deck	Architect	Design development	The girth of the metal to be stated	Tender drawings	☐Done
f	Railing detail	Height, size, types of railing, finishes	Architect	Design development	The thickness of the finishes to be stated, base plate design to obtain from an engineer, child's friendly design, the gap between railing members not more than 100mm, etc	Tender drawings	☐Done
g	Window detail	Types of window, size, finishes	Architect	Design development	To state aluminum profile thickness, window restrictor to fix at 45 degrees, silicone brand, and color to specify, etc	Tender drawings	☐Done
h	Door detail	Types of doors, size, finishes	Architect	Design development	To state door leaf thickness, framing type, infill type, etc	Tender drawings	☐Done
i	Car park marking detail	Types of marking- thermoplastic / epoxy, design	Architect	Design development	Numbering to refer JPIF approval drawings, pedestrian land to be painted green, OKU to be painted in blue, etc	Tender drawings	☐Done
j	Balcony detail	Size, finishes	Architect	Design development	To show scupper drain width and depth (if any), floor trap location, RWDP box up (if any), railing detail	Tender drawings	☐Done
k	Ac ledge detail	Size, finishes	Architect	Design development	To show access for maintenance, the parapet wall should be allowed for hot air circulation from an air compressor	Tender drawings	☐Done
l	Façade detail	Design, size, finishes	Architect	Design development	Modular design preferable, to check whether any RWDP is exposed, material usage should comply with BOMBA requirement, etc	Tender drawings	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
m	Entrance statement detail	Design, size, finishes	Architect	Design development	Design from landscape architect. Should setback 2.3m from the site boundary	Tender drawings	☐Done
n	Guardhouse detail	Layout, size, finishes	Architect	Design development	Size not more than 70 sq ft if located on-site boundary, consists of mirror panel for CCTV, fire system, etc, normally toilet attached, etc	Tender drawings	☐Done
o	Planter box detail	Size, types, finishes	Architect	Design development	To capture rainwater outlet, location determined by architect, depth of soil by landscape architect	Tender drawings	☐Done
p	Ramp detail	Gradient, size, finishes	Architect	Design development	Two types of ramps, car ramps and pedestrian ramps. To capture the size and distance of groove, termination detail, etc	Tender drawings	☐Done
q	Staircase detail	Size riser, treads, finishes	Architect	Design development	To check the number, location, occupancy load, the width of the staircase, etc	Tender drawings	☐Done
r	M&E room detail	Size, function, finishes	Architect	Design development	To check on the location and depth of trenches, break tank location and size, number of water tanks, etc	Tender drawings	☐Done
s	Lift core detail	Depth, size, finishes	Architect	Design development	To check on wall thickness, lift button setting out, lift lantern location, etc	Tender drawings	☐Done
t	Bathroom detail	Size, finishes	Architect	Design development	To insert tiles setting out, sanitary ware setting out, fall direction, etc	Tender drawings	☐Done
u	Waterproofing detail	Types, thickness	Architect	Design development	To prepare a waterproofing key plan, obtain a waterproofing proposal from a specialist, resolve waterproofing effect tiles issue, etc	Tender drawings	☐Done
v	Unit layout detail	Layout, size, finishes	Architect	Design development	To insert tiles setting out, kitchen sink setting out, wall setting out, etc	Tender drawings	☐Done

No.	Items	Description	Concerned parties	Period	Strategies	Further Information	Status
w	Site walk list	Items to be considered when conducting a site walk	Architect	Construction	1. Bring floor plan/elevation/section 2. Bring along an S&P drawing to counter-check 3. Check the door swing direction 4. Material used for construction to be checked 5. Check tile setting out/sanitaryware installation 6. Check termination between different floor finishes 7. Check brickwork/jointing/exmet/mortar/alignment/ gap between bricks 8. Plastering – tap with a metal rod, check color 9. Waterproofing – ponding test 10. Aluminium glazing – inner/outer frame, tempered glass logo, silicone color, handle 11. Fcu mount location 12. Kitchen cabinet basin/fridge panel	Site walk record	☐Done

5.7 Summary

Both documentation review and semi-structured interviews in case studies' results showed that there are 5 themes and 11 sub-themes to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia. The sub-themes are authority matters, building certification, meetings, coordination checklists, letter writing, contract documentation, building material, design brief, building sustainability and workmanship quality standards, contractors' submissions, and building details. The draft contract administration framework on housing projects shown in Table 5.6 was validated through a focus group study and finally developed the final BCA framework in Table 5.9 for graduate architects which is the main research outcome. The BCA checklist in Table 5.10 is a supplementary document developed to elaborate on the core task stated in the BCA framework. The next chapter discusses about summary of all the research objectives, contributions, and future studies.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

This chapter consists of five sections. The first section describes a summary of the findings followed by section 2 on the contribution of the research. Section 3 contains recommendations for future research. Section 4 is the limitations of the research, and the last section is reflections on the research.

6.1 Main research outcomes

There are five research objectives that made up the backbone of this research. The main findings of the research objectives are presented in previous chapters.

The first objective (RO1 discussed in Chapter 4), which is 'to identify types of obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia', was achieved through variables drawn from a literature review, filtered with the pilot study and testified by questionnaire survey with 127 responses that analysed using factor analysis, relative important index, and descriptive statistics.

The findings of the literature review showed that there were 40 types of obstacles found. However, only 23 obstacles were utilized for the questionnaire survey due to unclear terms, subjective, duplication, and incomplete variables discovered. The obstacles were categorised into 5 main themes determined by the literature review.

The variables were analysed using descriptive analysis, screening test, reliability test, normality test, factor analysis, relative important index, and mediation test. Relative Important Index (RII) was used to determine ranking and assigning priorities for variables in the BCA framework from very important obstacles to little important obstacles.

From the result, the main obstacle is a deficient in claims and legal matters management (e.g. poor contract management, discrepancy in contract documentation, unaware of legal policy), followed by a deficient in communication and relationship management (e.g. communication breakdown, lack of coordination between project stakeholders, lack information in drawings, lack understanding clients' requirement, misunderstanding terms), deficient in project management (e.g. lack guidance proper documentation, conventional management protocol, ineffective management, incomplete documentation), deficient in design management (e.g. slow decision), and lastly is deficient in quality assessment and management (delay reply queries, inadequate site inspection, absence of clear uniform standard of work acceptance, non-integrated project delivery, unfamiliar building specification).

Respondent chose the main obstacle as deficient in claims and legal matters management as the unclear scope in contract documents hinders graduate architects' work performance the most. This finding is parallel with Sebastian & Davidson (2011) that jargon language used in most contracts inhibits graduate architects from understanding the contract documents.

The second objective (RO2 discussed in Chapter 4), which is 'to investigate the root causes of obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia', was achieved through the findings of 13 types of root causes from literature review and filtered with a pilot study. The root causes were categorised into 5 themes determined by the literature review.

The variables were analysed using descriptive analysis, screening test, reliability test, normality test, factor analysis, relative important index, and mediation test. Relative Important Index (RII) was used to determine ranking and assigning priorities for variables in the BCA framework from very important causes to little important causes.

From the result, the main root causes are inadequate quality assessment and management skills (e.g. inadequate technical skill, inadequate quality management, unable to resolve technical problems), followed by inadequate design management skills (e.g. unable to adapt to changes, unable to make a decision), inadequate project management skill (e.g. poor writing skill, poor project management), inadequate communication and relationship management skill (e.g. difficult understanding clients' aspiration, inadequate technical coordination, poor oral skill, inability to chair meetings, inadequate interpersonal skill) and inadequate claims & legal matters management skill (e.g. inadequate conflict management skill).

Respondent chose the main cause as inadequate quality assessment and management skills because disputes often occurred due to a lack of control of workmanship quality by graduate architects which is consistent with Celadyn (2020) that quality assessment and management skills are needed to have better control of workmanship quality.

The third objective (RO3 discussed in Chapter 4), which is 'to establish mitigation measures for obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia', was achieved through the findings of 20 types of knowledge to be instilled from literature review and filtered by a pilot study. The knowledge was categorised into 5 themes determined by the literature review.

The variables were analysed using descriptive analysis, screening test, reliability test, normality test, factor analysis, relative important index, and mediation test. Relative Important Index (RII) was used to determine ranking and assigning priorities for variables in the BCA framework from very important mitigation measures to little important mitigation measures.

From the result, the very important mitigation measure is to instill claims and legal matters management knowledge (e.g. authority approving process, construction contract law), followed by instilling quality assessment and management knowledge (e.g. construction methods, building materials), instilling design management knowledge (e.g. architecture, feasibility studies), instill project management knowledge (e.g. project management, valuation study, financial planning, environmental studies) and instill communication and relationship management knowledge (e.g. structural engineering, town planning, electrical engineering, mechanical engineering, quantity surveying, interior design, landscape, geotechnical engineering, civil engineering, IT construction).

Respondent chose the very important mitigation measure is to instill claims and legal matters management knowledge because the authority approving process is crucial for overall master program planning which is consistent with the finding by Zahimi et al. (2024) that that authority submission is a lengthy process and various forms and permits need to be submitted and obtained before construction.

The relevancy of results from RO1-RO2-RO3 could be summarized as each obstacle exists due to inadequate of certain skills that could be improved by instilling certain types of knowledge.

From the survey, respondents chose the main obstacle is deficient in claims and legal matters management and the main cause of the obstacle is inadequate quality assessment and management skills and the most effective measure is to instill claims and legal matters knowledge. This could be defined as graduate architects deficient in claims and legal matters management (such as disputes related to defects issues) due to inadequate quality assessment and management skills (such as unsure what to inspect during the site walk) which could be improved by instilling claims and legal matters knowledge (such as early identification of potential claim to successfully prevail on claim disputes arising during construction).

The fourth objective (RO4 discussed in Chapter 4), which is 'to analyze the relationship between the obstacles, root causes and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia', was achieved through the findings of the role of performance barriers (or types of obstacles) that determine the competence development (or mitigation measures for obstacles) through BCA skills (or root causes of obstacles).

A series of assumption tests were conducted before mediation analysis. Regression model to test outliers, ANOVA to test the reliability model, coefficient to test the significance of the relationship between variables, residual statistic to test the discrepancy between observed value and predicted value, and scatterplot to test the divergence from normality for the distribution in data. From the result, there is no multicollinearity, no outliers, and no abnormality in the distribution of data. Therefore, a mediation analysis was conducted.

From the result, the direct effect of performance barriers (IV) on competence development (DV) was found significant. The indirect effect of the performance barrier (IV) on competence development (DV) with the existence of BCA skills (MV) is also found significant. Hence, variables from performance barriers have been selected as sub-themes to develop the BCA framework.

The fifth objective (RO5 discussed in Chapter 5), which is 'to develop a building contract administration framework to resolve the obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia', was achieved through case studies. Seven housing projects at Klang Valley had been selected as case studies which fulfilled the criteria of residential, strata development, high rise building, building under construction, utilize PAM contract and architect is the building contract administrator. Eleven types of documents have been reviewed from case studies. However, there is the information required for the framework but not captured in documents. Hence, semi-structured interviews were conducted.

Twenty respondents who fulfilled the criteria of registering with LAM, working a minimum 2 years and above, supporting BCA work, and involve in projects selected as case studies were chosen for semi-structured interviews. Semi-structured interviews were conducted to enhance information that failed to be disclosed through documentation review. Results obtained from documentation review and semi-structured interviews were analyzed using thematic analysis and content analysis.

The findings from case studies showed that sub-themes for obstacles in claims & legal matters management are graduate architects should pay more attention to authority submission matters and certification sequence. The sub-themes for design management are to understand about design brief and material specification.

Meanwhile, the sub-themes of communication and relationship management are to understand which information to incorporate in meeting minutes and coordination checklists. The sub-themes for quality assessment and management are to understand building details, types of contractors' submissions, and types of workmanship standards. Finally, the sub-themes for project management are to understand contract documentation and excel in letter writing. Other recommendations that were made during the interview include:

1) Introduce good industry practice guidebook (e.g. aluminum window, agglomerated stone tiling, ceramic tiling, design and material selection for quality, drywall internal partition, engineered wood flooring, internal partition prefabricated bathroom unit (PBU), natural stone finishes, painting, timber flooring, timber doors, waterproofing for internal wet areas, wardrobes and kitchen cabinets, waterproofing for external wall, precast concrete elements, vinyl flooring, etc. for reference.
2) Introduce performance testing guidelines for aluminum and glazing systems (laboratory testing), water tightness test for aluminum glazing, testing of tiles adhesive, ponding test, etc.
3) Standardize drawing components, e.g. scale of the drawing, title block, font size, font type, list of drawing register, etc.
4) Introduce a sample of the tender interview questionnaire, e.g. sanitaryware, tiles, aluminum & glazing, main building works, refuse compactor/ spiral waste compartments, kitchen cabinets & appliances, etc.

A draft building contract administration was developed from the result of RO1-RO5. A focus group study was conducted to validate and localize the draft building contract administration framework. The outcome of the focus group study was represented with a diagram. To make the diagram more comprehensive, structured, and organized, the final BCA framework then be developed. The overall outcome for RO1, RO2, RO3, RO4, and RO5 is shown in Table 6.1 while a summary of the outcomes of the research investigations is shown in the following sections.

Table 6.1: Summary of Research Outcomes

Research Question 1	What types of obstacles are faced by graduate architects while supporting BCA of housing projects in Malaysia?
Research Objective 1	To identify types of obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia
Research Methodology	Stage 1: literature review, data coding and analysis Stage 3: questionnaire survey, factor analysis, descriptive analysis, and relative important index analysis
Results	
a) 40 variables were identified through systematic literature reviews and filtered by the pilot study as shown in Table 2.3. However, only 23 out of 40 variables as shown in Table 3.3 were used in the questionnaire survey as several variables were duplicate, subjective, unclear, etc	

b) Results from factor analysis in Table 4.7 showed that 5 themes were formed with 6 variables omitted from the questionnaire survey, which are unawareness of legal policy, discrepancy in contract documentation, misunderstanding terms, lack of guidance proper documentation, insufficient design detail, and design error. The result shows that the variables were grouped based on the correlation among them without any relation.

   Hence, the grouping of variables into 5 themes was determined by the literature review

c) Relative important index RII was adopted to determine the ranking of different variables for the sequence arrangement of sub-themes in the BCA framework

d) The significant impact of the obstacles from the result of the questionnaire survey shown in Table 4.15 from very important to little important: deficient in claims & legal matters management, deficient in communication and relationship management, deficient in project management, deficient in design management, and little important is deficient in quality assessment and management.

e) Respondent chose deficient in claims and legal matters management as very important obstacle to graduate architects while supporting BCA because it is seldom emphasized in the educational syllabus

Research Question 2	What causes these obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?
Research Objective 2	To investigate the root causes of obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia
Research Methodology	Stage 1: literature review, data coding and analysis Stage 3: questionnaire survey, factor analysis, descriptive analysis, and relative important index analysis
Results	
a) 13 variables of root causes for obstacles as shown in Table 2.5 were investigated from the literature review, filtered by pilot study, and adopted in the questionnaire survey b) Results from factor analysis in Table 4.8 showed that all 13 variables are to be categorised based on 2 themes. The variables were grouped based on the correlation among them without any relation. Hence, the grouping of variables into 5 themes was determined by the literature review c) Relative important index RII was adopted to determine the ranking of different variables of root causes for sequence arrangement of sub-themes in the BCA framework	

<table>
<tr><td colspan="2">d) The significant impact of the root causes from the result of the questionnaire survey shown in Table 4.17 from most important to little important: inadequate quality assessment and management skill, inadequate design management skill, inadequate project management skill, inadequate communication and relationship management skill,
and inadequate claim & legal matters management skill
e) Respondent chose inadequate quality assessment and management skills as a very important root cause for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia because these skills are mostly gained through working experience and not directly from the education syllabus.</td></tr>
<tr><td>Research Question 3</td><td>How to mitigate the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?</td></tr>
<tr><td>Research Objective 3</td><td>To establish mitigation measures for obstacles faced by the graduate architects while supporting BCA of housing projects in Malaysia</td></tr>
<tr><td>Research Methodology</td><td>Stage 1: literature review, data coding and analysis

Stage 3: questionnaire survey, factor analysis, descriptive analysis, and relative important index analysis</td></tr>
<tr><td colspan="2">Results

a) 20 variables of mitigation measures for obstacles faced by graduate architects were examined from the literature review and filtered by pilot study as showed in Table 2.7 and adopted in the questionnaire survey</td></tr>
</table>

b) Results from factor analysis in Table 4.9 showed that the variables were grouped into 4 themes with 1 variable omitted from the questionnaire survey which is construction contract law. The variables were grouped based on the correlation among them without any relation. Hence, the grouping of variables into 5 themes was determined by the literature review

c) Relative important index RII was adopted to determine the ranking of different variables for the sequence arrangement of sub-themes in the BCA framework

d) The significant impact of the mitigation measures from the result of the questionnaire survey shown in Table 4.19 from very important to little important: to instill claims & legal matters management knowledge, to instill quality assessment and management knowledge, to instill design management knowledge, to instill project management knowledge, and lastly little important is to instill communication and relationship management knowledge

e) Respondent chose to instill claims and legal matters management knowledge as very important mitigation measure for the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia because this knowledge may assist graduate architects in the overall master planning of the project.

Research Question 4	What is the relationship between obstacles, root causes, and mitigation measures for graduate architects while supporting BCA of housing projects in Malaysia?
Research Objective 4	To analyze the relationship between the obstacles, root causes, and mitigation measures for obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia.
Research Methodology	Stage 1: literature review, data coding and analysis Stage 3: questionnaire survey, regression analysis, mediation analysis

Results

a) The role of performance barriers (or types of obstacles) that determined the competence development (or mitigation measures of obstacles) through BCA skills (or root causes of obstacles) is shown in Figure 4.16.

b) The result showed in Figure 4.23 and Table 4.31 stated that performance barriers (p value<0.05) have a significant positive impact on BCA skills, BCA skills (p value<0.05) play a very significant mediating role between performance barrier and competence development, or in other words, performance barriers (p value<0.05) have significant positive influence on competence development.

<table>
<tr><td colspan="2">c) Competence development is established based on BCA skills from identifying performance barriers faced by graduate architects while supporting the BCA of housing projects in Malaysia.

Therefore, solutions for variables in performance barriers were selected as sub-themes for the BCA framework.</td></tr>
<tr><td>Research Question 5</td><td>How to resolve the obstacles faced by graduate architects while supporting BCA of housing projects in Malaysia?</td></tr>
<tr><td>Research Objective 5</td><td>To develop a building contract administration framework to resolve the obstacles faced by the graduate architects while supporting BCA for housing projects in Malaysia</td></tr>
<tr><td>Research Methodology</td><td>Stage 4: case studies include documentation review, semi-structured interviews, content analysis</td></tr>
<tr><td colspan="2">Results

a) Results of the documentation review shown in Table 5.1 and Table 5.2 from the case studies summarized the types of authority submission, types of certification, list of contract documentation, construction drawing list, types of letter writing, types of meetings, request for information submittal forms, architect’s instructions, list of method statements, design proposals, shop drawings, non-compliance records, material sample submission, contract documents, etc</td></tr>
</table>

b) Results of semi-structured interviews shown in Table 5.4 include detailed descriptions/hints for authority submission sequence, types of error usually made during building certification, the 'dos' and 'don't' when issuing letters, types of items that need to be recorded but often missed out in meeting minutes, types of discrepancy that often occur, types of items that normally client requested to add on at later stage, types of design details that normally missed out during design, items that need to be considered during assess method statement, design proposal and shop drawings, items that need to take into consideration during site inspection, items that need to consider for counter propose material and items that often missed out in contract documents, etc.

Overall, the types of obstacles, root causes of obstacles, mitigation measures for the obstacles, and the relationship between these variables faced by graduate architects while supporting BCA of housing projects in Malaysia need to be identified and assigned with ranking for each of the variables to determine the sequence arrangement of building contract administration framework. Case studies that consist of documentation reviews and semi-structured interviews were conducted to obtain the content of the framework that fits graduate architects. Results for RO1, RO2, RO3, RO4, and RO5 are summarized and presented in Table 5.10.

6.2 Contributions of the study

This research proposed a building contract administration framework with a supplementary BCA checklist focusing on housing projects for graduate architects. The BCA framework and checklist were intended to enhance the work performance of graduate architects supporting BCA work by extending the body of knowledge on building contract administration and benefit practitioners in the relevant field. The contributions of the study are discussed in subsequent sections and divided into contributions from the point of theoretical and practical aspects.

6.2.1 Theoretical contributions

Theoretical contribution from this research extends the existing body of knowledge related to claims & legal matters management, quality assessment and management, communication and relationship management, design management, and project management to graduate architects supporting BCA focusing on housing projects in Malaysia. The chances for the proposed BCA framework with a checklist to be applicable to and accepted by universities are promising because of several reasons.

1) The framework is based on realistic practice. For example, the framework identified the types of obstacles, root causes, and mitigation measures for obstacles faced by graduate architects that serve as a better description of activities that may be executed in different project life cycles with different solutions to inspire graduate architects who support BCA work.
2) The framework integrates descriptions and strategies of various BCA core tasks into the BCA checklist; therefore, the framework can be applied to housing projects with varying complexities and resource demands.

3) The framework takes into account the objective obstacles faced by graduate architects but also subjective perceptions of them and hence provides a comprehensive description of various strategies that are impactful while supporting BCA for housing projects in practice.
4) Indirect contribute knowledge to architecture syllabus. Educators may utilize this study to improve their teaching syllabus by accommodating in market's demand and facilitating students' entry into the labor market.
5) The framework serves as a useful guide for graduate architects and assists them when supporting BCA work in housing projects.

6.2.2 Practical contributions

The research provides 5 demonstrable original practical contributions for the graduate architects in building contract administration. Such contributions underpin the process of maintaining the competency of graduate architects while supporting BCA. Thus the practical contributions of the graduate architects are:

1) Reduce housing projects delayed: One of the reasons for the delay is due to consultant-related factors where the consultant issued unworkable design details, delay in replying to the contractor's queries, unable to make a decision, pending confirmation, communication breakdown, etc. By having this building contract administration framework, graduate architects will be more familiar with their scope of work which indirectly minimizes the delay caused by consultants.
2) Improve coordination among project stakeholders: The building contract administration framework will assist in decreasing unpractical, unproductive, and unrealistic solutions from graduate architects. The number of trials and errors of design, construction methods, and material on site will be able to reduced. Re-work is avoidable.

3) Time-saving: Graduate architects exploring BCA work could be minimized and graduate architects will be able to advise developers accurately in terms of the time frame for master planning
4) Reduce the risk of mistakes: The BCA checklist could assist graduate architects in reducing the risk of making mistakes while preparing the documentation for signature, and error issuance instructions could be prevented
5) Expedite the process of gaining professional qualification: The building contract administration framework will give insight to graduate architects on the scope and responsibilities of a building contract administrator. The graduate architect will be able to get a glimpse of architectural professional practice in reality and better prepare for their professional examination.

6.3 Recommendations for future research

This research has generated some significant findings that have given rise to several recommendations that will facilitate graduate architects while supporting BCA of housing projects in Malaysia. For future studies, the author recommends conducting research in the following areas which will contribute to more efficient building contract administration in Malaysia:

1) To undertake similar research and to replicate units of analysis to develop a building contract framework for other building typologies, such as commercial buildings, and mixed developments that this research did not explore.
2) To standardize the building contract administration framework as consider local architects are getting more and more international projects instead of nationwide. A universal building contract administration framework is preferable.

3) To develop and incorporate comments from the post-occupation evaluation (POE) into the framework to minimize repetitive unworkable building design and detail.
4) To incorporate guidelines of good industry practices, guidelines for performance tests, guidelines for drawing drafting, strategies to generate tender interview questionnaires, etc in the BCA framework

6.4 Limitation of the Research

This research took an explorative approach by developing a new framework for graduate architects supporting BCA for housing projects in Malaysia. However, several limitations should be taken into account.

1) **Response rate**

   The low overall response rate due to respondents who received the electronic version of the survey turned out to be more time-consuming and difficult than anticipated despite the results of the pilot work.

2) **Target respondents**

   The survey was distributed to only graduate architects who registered with LAM/PAM with a minimum of 2 years of working experience in building contract administration. Only graduate architects who registered with the Board were selected because they provided access to their membership data

3) **Sample size**

   The sample size is small as the number of graduate architects registered with LAM is not significant due to high registration fees and many architecture institutions are not accredited by LAM. Hence, graduate architects need to resit the examination for Part I and Part II

4) Data collection

Raw data collected are in reality ratings and not ranks. The data was collected electronically. The absence of hard data may have contributed to the respondents' inability to rank order the frequency. In addition, survey respondents are probably more familiar with ranking than rating scales. Hence, the respondents more frequently used the extreme values, 1 and 5, in particular as ratings of the perceived occurrence of the various obstacles, root causes, and mitigation measures.

5) Lack of prior research studies on the topic

Previous research from the graduate architects' point of view on BCA work remains limited as they relied more on building contract administrators. They seldom discussed about root causes of the issues and emphasized more on improving design skills, graphic skills, mentorship, and apprenticeship for graduate architects rather than developing a framework for their self-improvement.

6.5 Final reflections on the research

This chapter concludes the main findings of the research by summarizing the research process, explaining the findings, describing the contribution of the research, making recommendations for future research, and stating the limitations of the research. The main achievements of the research are also discussed in this chapter.

This research identified the obstacles, investigated the root causes, established mitigation measures, and analyzed the relationship between the variables to develop a framework for graduate architects while supporting BCA of housing projects in Malaysia.

All the variables identified from the literature review were categorized into 5 themes and filtered with a pilot study before the survey. A mixed methodology was applied for this research. There are a total of 5 research objectives where the quantitative method is applied for RO1 – RO4 to determine the sequence arrangement and sub-theme for the framework and the qualitative method for RO5 to determine the content of the framework.

A draft building contract administration framework was developed as a result of RO1-RO5. A focus group study consisting of 5 practicing architects had been formed to validate and localize the framework. The outcome of the focus group was summarized and represented with a diagram. To make the diagram more comprehensive, organized, and structured, the final BCA framework then developed. A supplementary BCA checklist was established when each of the core tasks in the final framework was explored.

In summary, the building contract administration (BCA) framework and the BCA checklist developed are to enhance the work performance of graduate architects while supporting the BCA of housing projects in Malaysia.

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LIST OF PUBLICATIONS AND PAPERS PRESENTED

The following is a list of papers that were produced and published out of this research:

1) Tiew, S. Y. (2022). "Factors affecting the performance of graduate architects in contract implementation management: a case study on housing projects in Malaysia." Engineering, construction, and architectural management(ahead-of-print).

2) Tiew, S. Y., et al. (2022). "Performance Barriers in relation to Professional Development of Graduate Architects in Construction Industry: a Systematic Literature Review." Journal of Construction Business and Management **5**(2): 29-43.

3) Tiew, S. Y., et al. (2023). "Factors influencing the effectiveness of graduate architects as construction contract administrators (CCA)." Engineering, construction and architectural management.

4) Tiew, S. Y., et al. (2023). "Identify Building Contract Administration Knowledge for Graduate Architects to Enhance Work Performance." Economics & Management Information: 1-18.

5) Tiew, S. Y., et al. (2023). "Factor Analysis-Based Studies on Effectiveness of Graduate Architects in Building Contract Administration (BCA)." Journal of Construction Business and Management **6**(1): 53-64.

6) Tiew, S. Y. (2024). "Improving professional development through building contract administration (BCA) framework of housing projects for graduate architects." Engineering, construction and architectural management.

7) Si Yee, T. (2024). "Performance barriers and competence development of graduate architects in construction contract administration (CCA): the mediating role of CCA skills." Engineering, Construction and Architectural Management.

8) Si Yee, T. (2024). "A Construction Contract Administration (CCA) Framework for Graduate Architects' Professional Development." Engineering, Construction and Architecture Management.

9) Participated with the title of "Development of A Building Contract Administration Framework Focusing on Housing Projects For Graduate Architects" on 29 April 2024 and obtained 2nd runner up in the Faculty level UM-3-Minute Thesis (UM3MNT).