COLLABORATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY: INVESTIGATING WHAT, WHY AND HOW

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A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Quantity Surveying

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

I certify that this project report entitled **"COLLABORATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY: INVESTIGATING WHAT, WHY AND HOW"** was prepared by **LIM SIN YING** has met the required standard for submission in partial fulfilment of the requirements for the award of Bachelor of Science (Honours) Quantity Surveying at Universiti Tunku Abdul Rahman.

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ABSTRACT

In a climate of stiff competition, poor collaboration has been identified as the leading root cause of poor project performance. Now more than ever, construction actors are called to draw more attention to the collaboration issues, for a number of reasons. Despite the collaboration working concept gaining growing recognition in the global construction industry, it is still in an infancy level in the Malaysian construction sector, and its value is still being questioned. It is therefore essential to examine the collaboration issues within Malaysian construction practitioners. Specifically, this study aims to recognise the importance of collaboration, identify the common barriers leading to poor collaboration and explore potential strategies for addressing all the associated impediments. This was done by first identifying the research problems and objectives through reviewing of existing literature, followed by a systematic quantitative data collection via questionnaire surveys. A total of 151 responded questionnaires were collected from different groups of Malaysian construction practitioners (clients, consultants and contractors). The data collected were then subjected to reliability analysis, descriptive statistics, and inferential statistics. Based on the findings, “better quality control”, “better time control”, and “effective problem solving” were found to be the significant motivational factors affecting collaboration decisions. Also, “resistant to change current way of working”, “communication problem” and “incompatible personalities and organisational cultures” have been recognised as the top three barriers that impede collaboration. Nevertheless, the findings also revealed that “effective communication”, “mutual objectives”, “trust building”, “performance measurement” and “effective problem resolution” as the best means to promote collaboration. Based on the factor analysis, five underlying factors were identified, comprising “team integration”, “collaborative tools and mechanisms”, “leadership and partners involvement”, “systematic process” and “training and motivation”. In sum, the findings of current study are likely to benefit the overall construction industry, allow industry practitioners to gain deeper insight of the potential hurdles to collaboration and support them with effective strategies for cultivating a collaborative working environment.

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GDP	Gross domestic product
SMEs	Small and medium-sized enterprises
RC	Relational contracting
KPIs	Key Performance Indicators
SPSS	Statistical Package for the Social Sciences
CC	Collaborative contracting
UK	United Kingdom
IPD	Integrated Project Delivery
SCM	Supply Chain Management
KMO	Kaiser-Meyer-Olkin
US	United States
SD	Standard Deviation
PMSs	Performance measurement systems

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CHAPTER 1

INTRODUCTION

1.1 Background

It cannot be denied that Malaysian construction industry has a great contribution in growing wealth and improving quality of life for all citizens (Khan, Liew and Ghazali, 2014). This is the sector which provides the socio-economic infrastructures and basic amenities for country development and to improve the social living standards. According to Tagod, Adeleka and Moshood (2021) the construction industry has been constantly contributing an average of 3.8% of the total nation gross domestic product (GDP) over the past three decades. Furthermore, Omar (2017) elucidated that as Malaysia moving faster to being a developed country, it is expected to rise higher than the stated figure. Remarkably, this industry has shown a solid growth of 4.7% in 2019 and 5.9% for the first quarter of 2020, as compared to the overall GDP growth of 6.7% (Tagod, Adeleka and Moshood, 2021). In addition to economic and societies development, construction industry is also regarded as one of the largest employer of labour (Olanrewaju, Tan and Kwan, 2017) which creates millions of employment opportunities in the market. As reported by Alaloul, et al. (2021), construction sector has hired over seven millions of people as of July 2019. Meanwhile, it is expected to create more than hundred thousand of new job openings by the end of 2026.

Other than that, the significance of construction industry can be seen from its contribution to other sector of economy (Omar, 2017), such as manufacturing, financial, plantation, mining, and public services. Likewise, Khan, Liew and Ghazali (2014) opined that the construction sector is highly assimilated with other industry sectors and having strong linkages with other areas of activity. Thus, the construction industry has been described as an engine for economy growth due to its multiplier effect. In short, construction processes and its products are strongly affecting the entire nation (Yong and Mustaffa, 2012).

In a construction project, several organizations have been brought together in order to meet the client’s need and satisfaction. To achieve the

project success, all parties must work together and depend on one another (Liu, van Nederveen and Hertogh, 2016). In the other words, all parties have to sink, or swim, together (Lloyd-walker, Mills and Walker, 2014). This act of working together and united labour are defined as “collaboration” (Hughes, Williams and Ren, 2012). Collaboration in the construction industry is different from the other sectors as it involved multi players at different stages such as planning, design, construction, and maintenance (Kalay, 2001). The typical players comprising client, designer, contractor, sub-contractors, engineer and supplier who come from different profession and have different knowledge (Mohd Nawi, Baluch and Bahauddin, 2014). As a result, this adversarial nature of construction industry usually leads to disputes, project delays, low performance, and limited collaboration. Hamzeh, et al. (2019) further claim that traditional project delivery approaches are unlikely to foster collaboration but getting the project management more challenging instead.

It is widely held that the subject of team integration in construction industry has been a hot issue over the decades in response to the fragmentation nature and collaborative working issues (Ibrahim, Costello and Wilkinson, 2015). Recently in Singapore, Zhang, et al. (2020) criticised that construction players are solely responsible for its own silo of work, causing the sector to be lag behind in term of productivity. The problem of fragmentation and collaboration has also been reported in various countries, such as the United Kingdom (Nicolini, Holti and Smalley, 2001), Taiwan (Chen and Chen, 2007), mainland China (Zuo, et al., 2013) and Australia (Ey, Zuo and Han, 2014). It is undeniable that the collaboration problem among contracting parties is likely to continue around the world and so in Malaysian construction industry. This industry has been criticised for its fragmentation and adversarial nature over time, which result poor project performance.

In short, Malaysia’s economic is going to lag behind if the construction industry insists to use the fragmented approach that does not encourage team integration. In response, it is imperative to move away from the traditional practice toward a more collaborative approach which could alleviate opportunistic behaviours among project stakeholders (Yong and Mustaffa, 2012). It is with hope that a collaborative working environment can be nurtured in the Malaysian construction industry.

1.2 Problem Statement

Fragmentation has been widely criticised as a collaborative issue in the construction industry, affecting the supply chain in all aspects (Riazi, et al., 2020). It was found that excessive fragmentation has often resulted in project time and cost overruns, disputes, safety problems, client dissatisfaction, poor performance, and many more. Moving towards collaborative working is considered as a significant strategy for surmounting these issues as well as for efficiency industry improvements (Fulford and Standing, 2014). According to Rahman, et al. (2014), the concept of collaboration was gaining increasing acceptance due to the internationalization demand, competition, and unpredictable risk within the business setting. In this sense, a number of construction actors have now paid more attention toward collaborative arrangements and new delivery mechanisms (Bygballe and Swärd, 2019). As suggested by Hosseini, et al. (2018), partnering, joint venture, public-private partnership, alliancing and other form of relational contracting have been widely used as a solution to avoid the competing objectives and controversies that have plagued the industry for too long. However, despite the perceived benefits of collaborative arrangement, the concept is still not fully developed in Malaysia as seen in other countries (Ali, et al., 2010). A study conducted by Ahmad, Saleh and Dash (2018) found that the collaboration level within Malaysian construction industry is much lower than the other countries due to the lack of understanding and proper strategies for collaboration.

It is worth noting that the adoption of collaboration is beleaguered with a number of problems, for instant, mistrust, ineffective communication, adversarial relationships, and unnecessary disputes (Zhang, et al., 2020). These particular issues are arisen from various construction players such as client, main contractor, consultants, sub-contractors, engineers, designers, and suppliers. These industry players possess their own knowledge and specialised skill even though in a same industry. The diversity of these parties tends to induce adversarial relationship due to different perception, and objective (Li, et al., 2001). Consequently, this situation shows conflicts, misunderstanding and mismatches between all project team members which degrades the project performance.

Shehu, et al. (2014) noted that the traditional procurement remains the most commonly used method within Malaysian construction industry. Over the years, a plenty of researchers and construction practitioners have continued criticising the adversarial nature of this relationship. For example, Xue, Shen and Ren (2010) claimed that it is difficult to establish collaboration between various parties in a traditional way. The separation of design and construction phase in traditional contracting practice hinders the integration between different parties by promoting a confrontational culture. This fragmentation nature of the industry often leads to various problems such as claims, project delay, misunderstanding, low quality, dispute, poor communication as well as inefficiency and ineffectiveness of project performance (Nawi, Baluch and Bahauddin, 2014). Yap, Low and Wang (2017) also found that the problem of design changes in Malaysian construction projects is highly caused by the poor integration among team members. They further explained that disintegration between the design and construction teams hinders effective communications, resulting to productivity constraints and rework.

By reviewing the previous studies, it is noted that the fragmentation and adversarial relationship inherent in the Malaysian construction sector were the main obstacles which hinder effective collaboration. Therefore, the adoption and adaption of new collaborative working should be highlighted to facilitate the flow of essential information between various parties. This, in turn, lead to an effective communication and bridge the performance gap between different participants (Xu, et al., 2019).

Although many previous studies have been conducted to explore the drivers to and barriers of collaboration within global construction community, there are still limited studies specifically appraise the effective strategies for engendering collaboration in the Malaysian construction field. Undoubtedly, more studies are required to focus on the development of collaborative practice in Malaysia as this best reflects the current demand by the industry. Therefore, it is comprehensible need to examine the collaborative relationship among Malaysian construction practitioners and to develop valuable strategies that can be used as a mechanism to address the besetting adversarial culture. This is to enhance the likelihood of project success and allow Malaysia construction industry to sustain a competitive edge.

1.3 Research Aim

The main objective of this study is to provide better insight into the collaborative practices in construction industry by evaluating the needs, examining the barriers and exploring the practicalities of collaborative strategies among industry stakeholders which could ultimately enhance their performance in project delivery.

1.4 Research Objectives

The specific objectives are as follows:

1. To identify the need for collaborative working in construction projects.
2. To investigate the barriers to collaboration in construction projects.
3. To explore effective strategies to engender collaboration in the project-based construction setting.

1.5 Research Questions

In response, the corresponding research questions are raised up as below:

1. Why collaborative practices are important in the construction industry?
2. What are the barriers to collaboration in construction projects?
3. How to engender collaboration in the project-based construction setting?

1.6 Research Methodology

After identifying of the research questions, this report is commenced with a comprehensive review of previous researchers' works. The purpose of literature is to provide a general framework about the concepts of collaboration practices. Next, quantitative approach is adopted by conducting questionnaires survey. In essence, all responses in this study were collected via internet-based questionnaires rather than the conventional paper-based. Questionnaires were well-structured and delivered to different groups of participants (contractors, consultants and clients) in order to gather useful data regarding to the research questions. A total of 375 sets questionnaires were distributed to the respondents in order to obtain a desired number of respondents which ensures high accuracy of the results. The results gathered were interpreted and discussed further in the research report.

1.7 Research Scope

This research is primarily focused on the various perception of construction practitioners to the collaboration practices in the Malaysia construction industry. The research area of this study is limited to those construction actors within Klang Valley region. The questionnaire surveys are open to all industry professionals who have recently been active in the Malaysia but not overseas, comprising of clients, consultants, and contractors.

1.8 Significance of Research

Malaysia construction industry can be seen as a highly competitive sector as the nation is experiencing a rapid growth in the past decades, supported by the medium-to-large-scale construction projects (Ali, et al., 2010). According to Kamal and Flanagan (2012), the number of construction companies has been increasing year by year, with exceeding 90 % of the registered construction firms are small and medium-sized enterprises (SMEs). These situation attributes as the "driving forces" for requiring a highly collaborative relationship between construction practitioners in order to sustain their businesses in a high-risk market. However, collaboration is not magically worked between the parties involved especially for those companies with different organisational culture and value. Thus, this research study is going to identify the dominant benefits associated with collaboration practices as well as the significant obstacles which impede these practices. Moreover, effective solutions to these predicaments will also be discussed to shed light on how construction practitioners can collaborate with each other.

The results from this research would be a great contribution towards construction industry by providing more practical and realistic knowledge in relation to collaborative practices. This research also provides a clear picture that people and relationships were considered to be the core of collaboration. The continuity in relationships between companies, teams and individuals are essential to secure collaborative relationship within construction industry (Bresnen and Marshall, 2000). By exploring all these strategies, construction practitioners could deeply understand the basic concept of collaboration and ultimately develop a solid strategy that could engender collaborative relationship within the sector.

In the nutshell, the outcomes of this research are significant and beneficial to all parties in a way to enlighten every single party involved in the construction industry. Provided with the better understanding acquired, each party can uncover the critical issues and perform better on their own duties and responsibilities in improving collaboration practices. The finding of this research will further facilitate the project actors in formulating realistic and workable approaches to make collaborative working more comprehensive. The practitioners will gain some insights on what measures are most favourable in assisting them toward effective collaboration.

1.9 Chapter Organisation

1.9.1 Chapter 1: Introduction

Chapter one is the introductory stage of this research at which all key elements will be well-organised and outlined. It provides the readers a clear picture on the whole research concept. The general background of this research was presented at the very beginning of this chapter. Current issues that hinder collaborative working in Malaysia construction and the significant gaps with existing literature were introduced. The objective, research questions, methodology, scope, and limitations of this report have also been presented.

1.9.2 Chapter 2: Literature Review

This chapter discussed about some of the published scholarly sources regarding to the construction collaboration practices. The main objective of literature study is to create familiarity with existing research and justify future research into an understudied area. Firstly, the definition of collaboration was examined followed by the discussion of current practices of collaboration in Malaysian construction sector. Next, the importance of collaboration practices was explored as well as the potential barriers that hinder collaboration in construction industry. Lastly, this chapter revealed the potential strategies that can be applied to engender collaboration practise in construction setting.

1.9.3 Chapter 3: Research Methodology

The selected research methods were outlined under this chapter. For example, quantitative method such as questionnaire was adopted in this research. After that, the research strategy and design of the research have been introduced followed by the data collection approach and data analysis.

1.9.4 Chapter 4: Results and Discussions

In this chapter, the date collected from different industry professionals was discussed and analysed after going through different types of statistically tests. The main findings were concluded and summarised at the end of the chapter. The outcome of the literature review served as a basis for comparing with the main finding.

1.9.5 Chapter 5: Conclusion

A comprehensive conclusion of the entire research has been drawn in chapter five referring to the corresponding research purposes and research problems. Furthermore, the limitations of conducting this research have also been revealed followed by some recommendations and ideas provided to enhance the quality of future related research.

1.10 Summary

The first chapter of this research was unfolded with the background of this study and further reviewed the collaborative problems faced by Malaysian construction industry. This is followed by the research aim, research objectives and research questions to best describe the main idea and motivation of this study. Moreover, the following parts included research methodology, research scope and significance of the study to provide the readers a brief overview of this research. Lastly, this chapter also concludes with the chapter outline and organization to ensure that the entire research is well-structured in a proper manner.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the previous literature which is closely associated with the construction collaborative practices. Firstly, section 2.2 discusses about the general definition of collaboration to improve the readers' understanding for collaboration. Section 2.3 further describes collaborative practice in the construction industry. The needs for collaboration have been summarized in section 2.4 followed by the barriers to collaboration. Throughout the extensive review, effective strategies to endanger collaboration will be proposed in section 2.6 with the aim to help Malaysian construction practitioners in advancing collaborative capability.

2.2 Basic Concepts for Collaboration

In an effort to point out the relationship between collaboration and the construction industry, it is imperative to gain in-depth insight into the concept of collaboration in the early stage. There are a wealth of empirical studies providing diverse definition for the term of collaboration depending on how the researchers perceive collaboration from differing viewpoints.

According to Camarinha-Matos, et al. (2009), the word "collaboration" is derived from the Latin collaborate that means "to work together". It has been described as a process of joint creation involving a group of entities to enhance the capabilities of each other. "*Collaboration is defined as the agreement among specialists to share their abilities in a particular process, to achieve the larger objectives of the project as a whole, as defined by a client, a community, or society at large*" (Kalay, 2001, p.741). The researcher further describes collaboration is needed when any single individual or organization faces limited resources to accomplish a challenging task independently. Comprehensively, Schöttle, Haghsheno and Gehbauer (2014, p.1275) defined collaboration as "*an interorganizational relationship with a common vision to create a common project organization with a commonly defined structure and a new and jointly developed project culture, based on trust and transparency;*

with the goal to jointly maximize the value for the customer by solving problems mutually through interactive processes, which are planned together, and by sharing responsibilities, risk, and rewards among the key participants". Similarly, Soosay and Hyland (2015) described collaboration as a relationship between multiple entities that seeks to share improved outcomes and benefits. This relationship requires collaborators to establish trust, share information and make joint decisions. In the other words, collaboration allows integration of experiences and professional skills among participants so that more information are available to resolve the complexity of problems (Feast, 2012).

There is often confusion over the concept of collaboration and how it can be distinguished from the word "communication", "cooperation", "coordination" (Martin, Nolte and Vitolo, 2016). Most of the people used these terms interchangeably, especially when referring to a group activity. However, Campbell (2016) stresses that collaboration is usually differentiated from the associated constructs in terms of its "depth of inter-action, integration, commitment, and complexity". Further, Podean, Benta and Rusu (2008) describe the development of collaboration by introducing a 3C model as shown in Figure 2.1. This model demonstrates that collaboration can be seen as an interplay of communication, coordination and cooperation. It provides a guidance for collective activity applicable in any and every human context where such activities occur.

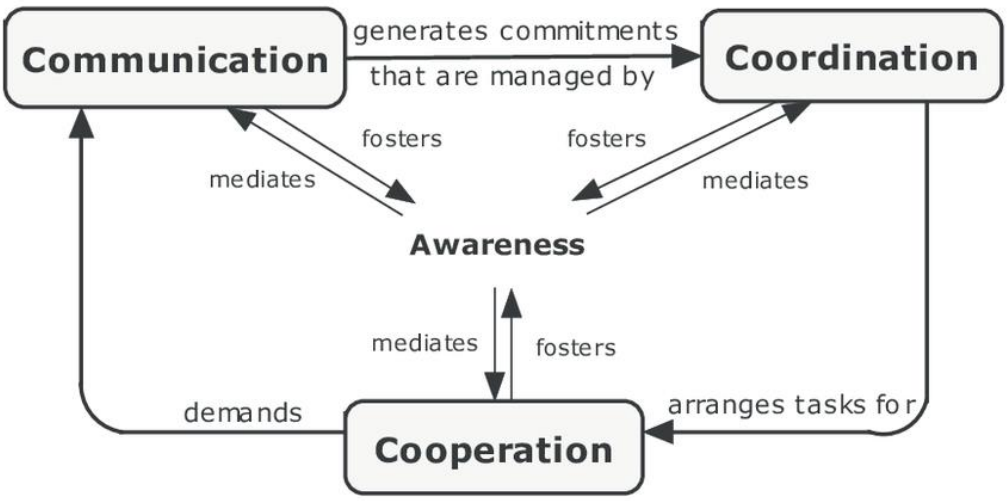

Figure 2.1: 3C Collaboration model (Adopted from Fuks, et al., 2008).

The first process is known as communication, which is the most basic activities that required the least inter-organisational embeddedness (knowledge sharing, mutual goals, risk, cost, time and the like) (Martin, Nolte and Vitolo, 2016). Basically, this process involves switching of messages and information among individuals for a shared benefit (Camarinha-Matos, et al., 2009). Second, coordination related to the management of people, activities and resource (Pereira, et al., 2009). It creates a strong linkage between the other two Cs in order to foster successful collaboration (Fuks, et al., 2008). Coordination promotes efficient use of resources and deals with the interdependencies needed of participants for achieving the accorded plan of action (Gadelha, et al., 2009). Coordination is the most important prerequisite to accomplish collaboration which allows organisations to execute the project scope without exceeding limits of time and cost, while maintaining quality (Oliveira, Antunes and Guizzardi, 2009). Third, cooperation refers to the production, manipulation, and organisation of information, or formation of cooperation objects such as documents and spreadsheets through the interaction among team members (Podean, Benta and Rusu, 2008). It refers to the joint operation of team members within a shared workspace (Pereira, et al., 2009; Gadelha, et al., 2009). The common workspace provides a number of tools to facilitate cooperation. The structure of the workspace and the interaction that is taken place have a significant effect on the work productivity. In short, the 3Cs models can be applied as a common framework for describing the collaboration aspects of a workgroup and to fulfil the collaboration needs of the group members (Fuks, et al., 2008).

Except for face-to-face contacts, collaboration can be taken place in other modes spatially and temporally (Maceachren, 2000). In the case of projects which involve large scale of different stakeholders, it is imperative that the information and resources have to be coordinated over time and space. Collaboration comes in many forms, there are asynchronous collaboration, synchronous distributed collaboration, and asynchronous distributed collaboration (Anumba, et al., 2002). All these forms of collaboration are difference according to the time and place in which collaboration takes place. The classification and the most common example are presented in Table 2.1.

Table 2.1: Collaboration Models.

Form of Collaboration	Time	Place	Examples
Face to Face	Same	Same	Meeting between partner and client in a common room
Asynchronous	Different	Same	Management posts a notice on the board within the organization
Synchronous Distributed	Same	Different	Owner and partner are talking on the phone about the term.
Asynchronous Distributed	Different	Different	Architect faxes client a latest drawing as approval

Vreede (2014) provided that collaborative effort comprises of at least five elements which are people who jointly works as a team, a designed collaboration process, information available, collaboration technology, and leadership. In essence, these five components need to be intelligently integrated in order to attain successful collaboration. On the other hands, Shelbourn, et al. (2007) unfolds that collaborative working could be categorized in three areas which are the "business procedures", "process" or "technology strategy". As to generate effective collaboration, there must be a balanced harmonization between these strategies together with common goal, stakeholder's commitment, mutual trust, effective communication, processes, and technologies.

2.3 Collaboration in construction industry

With these complexities, collaboration in construction industry is considered more intricate and fragmented than the other sector (Faris, Gaterell and Hutchinson, 2019). This industry comprises a variety of SMEs from different professions, who hold different interests, expertise, expectations, resources, and constraints (Liu, Nederveen and Hertogh, 2016). Generally, a project involves a group of players that need close collaboration, for instance, the general contractor, specialist contractor, project client, various suppliers and consultants (Xue, et al., 2017). They are bonded together by contracts with highly stipulated term and condition and hence result in the co-operation problem which leads to adversarial relationship (Li, et al., 2001). Project teams are commonly formed temporarily to deliver a single project over a limited

time. Thus, the finite life span of temporary team members reinforces the difficulty in generating collaborative and integrated working (Yap, Leong and Skitmore, 2020). Moreover, due to the fragmented nature of the industry, many stakeholders be likely to maximize own benefits rather than consider the interest of the other parties, resulting in poor performance and low quality outcome as team collaboration fails (Yap, Leong and Skitmore, 2020). Nowadays, construction projects are increasingly critical and complicated than before associated with low efficiency due to the substantial attention on transactions, hence it urges the need for closer collaboration in the industry with its intention to ensure project success (Hosseini, et al., 2018).

Hibbert, et al. (2008) established a connection between "collaboration" with an array of inter-organizational working arrangements including alliances, joint ventures, partnerships, and network. Similarly, Hughes, Williams and Ren (2012) states that partnering, alliances and joint ventures are another word for collaboration in construction industry as the core principle underpinned these arrangements is united labour. Project alliance is another form of relational contracting approaches that encourages effective collaboration between two or more organizations (Hietajärvi and Aaltonen, 2018). Clearly, there are multiple forms of collaborative working practices available in the industry than before. In order to differentiate these types of collaboration, a comprehensive list of them has been compiled and shown in Table 2.2.

Table 2.2: Forms of Collaboration Working in Construction Industry.

Form of Collaboration	Description	References
Partnership	"*Partnering is not a contract. A partnering charter is developed along with a traditional construction contract to govern the relationship among the parties. Partnering relies solely on the commitment of individuals, as it is not legally binding*." Partnering can be categorised as "strategic" and "project". Former is a voluntary form of partnering that focus on long term relationships whereas the latter is emphasizing on project performance in short-term.	Hauck, et al., 2004; Hughes, Williams and Ren, 2012

Table 2.2 (Cont'd)

Joint Venture	Joint venture is defined as a *"commercial alliance" between two or more entities in order to allow greater ease of work and cooperation toward achieving a common aim, through the manipulation of resources. A new temporary entity is created as an association between partners for the purpose of pursing and performing a project*".	Xue, Shen and Ren, 2010
Strategic Alliance	"*A long-term interorganizational arrangement for common interest, which is extended beyond a specific project*". In other words, "a strategic alliance is a cooperative relationship between parties when some shared expectation about the future exists".	Anvuur and Kumaraswamy, 2007
Project Alliance	Project alliancing differs from strategic alliances in the fact that parties are brought together for a specific project under the legally binding contract. Project alliances have a defined end, typically the practical completion date of a project.	Hauck, et al., 2004
Integrated Project Delivery (IPD)	"*A project delivery method that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction*". Mutual agreement, early involvement, joint decision-making, mutual goal and risk-reward sharing are the core of IPD.	Haugseth, et al., 2014
Supply Chain Management (SCM)	"*SCM is the integrated planning, co-ordination and control of all business processes and activities in the supply chain to deliver superior consumer value at less cost to the supply chain as a whole whilst satisfying requirements of other stakeholders in the supply chain*".	Vorst, 2004

All the arrangements as listed in Table 2.2 are jointly described as relational contracting. This is due to the fact that those contracts are all about building a relationship of trust between the team members, allocating transparency responsibilities and shared benefits among parties, as opposed to transactional relationship (Lahdenperä, 2012). The core of relational contracting is to align project objectives with common business goals in order to create a more supportive and integrative environment (Suprapto, Bakker and Mooi, 2015). Although all these arrangements may vary widely from each other, all these are based on a mechanism that focuses on improved inter-organizational relations and project performance (Kumaraswamy, et al., 2005). According to Lahdenperä (2012) "partnering" is often used as an umbrella term to describe the collaborative working practice, including project alliances. The concept of partnering overhauls the ethics of conventional contracting, in term of the decision making processes and working relationships which allows the project team to effectively collaborate (Ibrahim, Costello and Wilkinson, 2015). Clearly, the adoption of these arrangements is apparently in the rise reflected by the increased use of these relational approach in worldwide.

For example, in UK, Beach, Webster and Campbell (2005) point out there are many contractors have experienced a significant change from traditional practice to partnership. Similarly, Bresnen and Marshall (2002) report two case study examples of successful partnerships and indicate that partnering in practice delivers good performance not only in terms of time, cost, and quality, but also in terms of client satisfaction and cost savings. Apart from that, Chan, Chan and Ho (2003) show that the construction development in Hong Kong is slowly gaining momentum with emphasis on partnering arrangement due to its numerous benefits that could evolve out the inefficiencies of traditional adversarial relationship. In China, public-private partnerships have been practiced for years and greatly contribute to the national and local infrastructure development (Yuan, et al., 2010). In the other case, project alliancing was adopted successfully in Australia for National Museum project (Hauck, et al., 2004). Haugseth, et al. (2014) and Wøien, et al. (2016) reported the use of partnering is escalating in the Norwegian construction industry as an important step towards a cooperative culture.

2.4 Needs of collaboration

Despite many researches positively highlighting the benefits of collaboration practice, it is pity to note that the construction industry still relies mostly upon traditional methods (Naoum, 2003). Evidence shows that enhanced project performance is impossible to be achieved by the industry in isolation. In particular, effective collaboration is needed in all aspects to achieve continuous improvement (Ahmad, Saleh and Dash, 2018).

2.4.1 Better quality outcome

According to Chan, Chan and Ho (2003), partnering produces high quality construction by facilitating communication regarding quality-related issues, enabling structured approach to identify problems, and initiating total quality management. Lu and Yan (2007) asserted that establishment of problem-solving procedures which are mutually agreed between partnered parties can lead to better technical performance. Partnering relationship could increase the learning curve and allow continuous improvement among team members which give the raises to the quality of a project (Olsson and Espling, 2004).

As mentioned by Ling, et al. (2014), most of the construction firms in Sydney regarded “better quality” as significant driver of RC because of the need to achieve better design, higher quality work and innovative output to remain competitive ahead of their competitors. This is in line with the previous findings in the UK (Black, Akintoye and Fitzgerald, 2000; Akintoye and Main, 2007), Malaysia (Rahman, et al. (2014) and China (Xue, et al., 2018), found out that “improving project quality” was the main purposes of collaboration.

2.4.2 Better time control

In term of time control, Ali, et al. (2010) asserted that partnering could help to reduce chances of project delay due to its well-planned project schedule, timely decision-making, reliable working programmes as well as early contractor involvement at the design phase which can help to advise on constructability and optimise value engineering. In addition, Ledger (2010) pointed that collaboration arrangement would lead to an improved communications and problem solving skills and hence help to simplify

unnecessary administrative procedures, reduce project delivery time and achieve time objectives (Ling, et al., 2014; Xue, et al., 2018).

In Great Britain, one study by Olsson and Espling (2004) showed that adoption of partnering approach led to time savings ranged from 10 % to 40 %. Moreover, an earlier study by Chan, Chan and Ho (2003) on Hong Kong partnering project disclosed that "achievement of faster construction time" has achieved the highest ranking of importance among the clients. This is consistent with the findings of Rahman, et al. (2014) which observed that project complete on time is one of the main driver of collaboration among Malaysian contractors.

2.4.3 Better cost control

Partnering helps to lower project cost as it allows sharing of development costs and technologies between stakeholders (Ling, et al., 2014). Through partnering, SMEs enable to share resources thereby maximize resources utilization and reduce total project cost (Black, Akintoye and Fitzgerald, 2000). Besides, Xue, et al. (2018) underscore that cost performance is one of the critical incentives for stakeholder collaboration in China.

One study on partnering in Great Britain showed that partnering approach led to total cost savings ranged from 5% to 30 % (Olsson and Espling, 2004). A similar observation can also be witnessed in UK (Ledger, 2010). Such approach provides better cost control by reducing rework, scheduled times, variation order; improving communication; eliminating blame culture and adversarial relationship; encouraging problem solving; promoting trust; as well as centralising project objectives (Ali, et al., 2010; Chan, Chan and Ho, 2003). An earlier study by Akintoye and Main (2007) recognised that contractors in UK would only enter into collaborative relationship if there are monetary benefits from reduction in construction costs.

2.4.4 Reduction of conflict

Li, et al. (2001) declared that by developing partnering agreement, the issues of conflicting claims, unnecessary dispute and litigations are more likely to be decreased as a result of effective communication and collaborative relationships (Ali, et al., 2010). As reported by Chan, Chan and Ho (2003),

“reduction in litigation” was ranked as the top ten benefits of partnering by both contractors and consultants in Hong Kong. Partnering is viewed as a viable approach to deal with troublesome inter-organizational conflicts and to shift traditional adversarial relationships into construction contracting (Lu and Yan, 2007). An America department reports that the dispute claims have been declined from 28 % to 2 % per year by adopting partnering arrangement (Olsson and Espling, 2004). Previous studies by Black, Akintoye and Fitzgerald, 2000; Beach, Webster and Campbell (2005) reported that majority of project stakeholders in UK believed that partnership approach could induce a less adversarial working relationship as well as reduce the number of disputes with partnered parties.

2.4.5 Innovation

Open communication between each party stimulate innovation process which can help in achieving design and construction objectives (Chan, Chan and Ho, 2003; Ali, et al. 2010). The advancement of technology-based projects requires a higher level of knowledge and skills to be developed than before. However, the construction technology of a single firm is always limited. Therefore, it is imperative to put conscious effort in directing collaboration with other stakeholders. Through collaborative initiatives, organisations are able to improve their innovation capability and stay ahead of the technological advances (Lu and Yan, 2007; Xue, et al., 2018).

Ling, et al. (2014) found that contracting parties in Sydney are compelled to embrace joint working arrangement in order to facilitate creative and innovative approaches. This, in turn, often result in an increased market competitiveness. A similar finding can also be found in UK, where adopting a more innovative approach and optimising the development of research and development could enable the company to stand out within the industry, leading to rapid expansion and foster their competitive advantage (Beach, Webster and Campbell, 2005; Akintoye and Main, 2007).

2.4.6 Long-term relationship

Partnering helps to promote a closer relationship between project stakeholders in many ways, including effective communication, common goal and

objectives, earlier problem identification and the mutually agreed problem resolution mechanism (Chan, Chan and Ho, 2003; Ali, et al., 2010). A previous study in both Beijing and Sydney (Ling, et al., 2014) found that the closer relationships associated with long-term benefit is viewed to be one of the reasons for the move to partnering. This is further supported by Hughes, Williams and Ren (2012), stating that most of the construction practitioners in UK have seen "long term relationship" as the most important aspect of collaboration. Nonetheless, collaborative partnering is needed for organisational growth because it allows the partnered parties to look for future co-operation by sharing of their knowledge, skills and vision (Li, et al., 2001). Beach, Webster and Campbell (2005) affirmed that continued regular repeat business could be the catalyst to practise collaboration working between project stakeholders.

2.4.7 Increased competitiveness

According to Lu and Yan (2007), most of the construction companies in China ranked "to enhance competitive position" as the most important partnering incentive. This is consistent with a study in Beijing (Ling, et al., 2014), stating that project participants in China has now emphasized in the application of collaborative working in order to improve their business competitiveness. Black, Akintoye and Fitzgerald (2000) claimed that UK's construction market is increasingly competitive nowadays, organisations have to cooperate with their suppliers in order to sustain their competitiveness in the global market in term of time, cost and quantity.

In addition, Li, et al. (2001) emphasised that partnering allows the participants to make up for their deficiency by continuous improvement and ultimately enhance the organisational performance and competitiveness. Some of the researchers also stated that partnering can be used to increase an organizational competency as it enables a company to outperform its competitors in the market to meet the client's expectation and requirements by pooling together of their resources (Hughes, Williams and Ren, 2012).

2.4.8 Better safety performance

As mentioned by Ling, et al. (2014), parties who involved in a partnered project will take equal responsibility in securing a safe working environment, subsequently lessening workplace accidents, injuries as well as work-related fatalities (Ali, et al., 2010). A safer workplace could only be happened when partnered parties having a better understanding between each other and having adequate level of knowledges and skills of the works they are to do (Chan, Chan and Ho, 2003). A similar result can be seen in India Tabish and Jha (2015) where partnering noticeably contributed to safety performance. It allows an effective communication and coordination which helps all members have a thorough understanding to the safety policy. In UK, some of the main contractors indicated that partnering allows the utilisation of suppliers' competences in safety management which subsequently reduce the incidence of site accidents (Beach, Webster and Campbell, 2005).

2.4.9 Increased client satisfaction

Akintoye and Main (2007) found that the most important driver identified by the UK contractors for collaborative practices is "in response to customers' needs". This is akin with Black, Akintoye and Fitzgerald's (2000) assertion advocates that "increased client satisfaction" is viewed as the second most essential advantages derived from partnering arrangement among all respondents. There have been several studies asserted that partnering improves satisfaction of client as they are involved directly to the construction progress and well-informed of every single progress to ensure their fully commitment in the project (Chan, Chan and Ho, 2003; Ali, et al., 2010; Lu and Yan, 2007).

2.4.10 Risk sharing

A study by Lu and Yan (2007) found that risk sharing is ranked as a significant partnering incentive by the China's contractors as they are used to bear major construction risk as compared to the consultants. Furthermore, Chan, Chan and Ho (2003) declared that collaboration between partnered parties enables benefits and resources to be shared equally among all parties. Since the risk is equally spread between each other, the participants are more willing to provide reliable schedules, resources, and pricing to minimise the

potential risk (Ledger, 2010). Akintoye and Main (2007) found that construction risks are ranked as third reason for collaborative relationship based on the UK contractors' perceptions. It is believed that parties who involved in collaborative arrangements will have common interest in sharing and pooling the risk.

2.4.11 Effective Problem Solving

Partnering approach allows each member jointly anticipates and shares information about the potential problems that may arise and work out with reliable action plans to deal with those problems in the mutual best interests of the project (Chan, Chan and Ho, 2003; Ledger, 2010). Parties are encouraged to learn from the other and cooperate in problem-solving. Since there are various parties involved, it allows exchange of thoughts and ideas from different perspectives which enables the parties learn from each other to achieve an optimum result (Ali, et al., 2010). Similarly, in UK, some of the contractors indicated that partnering relationship allows them to make use of the specialist knowledge and expertise of their partner, as well as technical competence and problem solving ability (Beach, Webster and Campbell, 2005).

2.4.12 New market opportunities

According to Lu and Yan (2007), forming an alliance with local companies is the best way to expand new geographical market. It not only eases the process of getting construction permission, but also provide valuable knowledge about the local market, such as availability of skill labour and information of existing competitors. Likewise, Ling, et al. (2014) asserted that practitioners in both Beijing and Sydney have viewed collaborative arrangements as a master key for seizing new market opportunities and increasing their competitiveness.

Furthermore, partnering with a local company on a multinational project can also help to overcome the linguistic barriers, legal issues and cross-cultural communication problems between stakeholders (Black, Akintoye and Fitzgerald, 2000). In UK, Akintoye and Main (2007) mentioned that collaborative relationship is essential in response to market opportunity which could lead to economic and technical opportunities or utilisation of expertise available within the companies in respond to the new opportunity.

Table 2.3: Literature Map for Needs of Collaboration in Construction Industry.

Ref	Needs	Ali, et al. (2010)	Ling, et al. (2014)	Lu and Yan (2007)	Olsson and Espling (2004)	Black, Akintoye and Fitzgerald (2000)	Hughes, Williams and Ren (2012)	Li, et al. (2001)	Ledger (2010)	Beach, Webster and Campbell (2005)	Chan, Chan and Ho (2003)	Akintoye and Main (2007)	Rahman, et al. (2014)	Tabish and Jha (2015)	Xue, et al. (2018)	Total
R1	Better quality outcome	√	√	√	√	√					√	√	√		√	9
R2	Better time control	√	√		√	√			√		√	√	√		√	8
R3	Better cost control	√	√		√	√			√		√	√			√	8
R4	Reduction of conflict	√		√	√	√		√		√	√					7
R5	Innovation	√	√	√						√	√	√			√	7
R6	Long term relationship	√	√				√	√		√	√					6
R7	Increased competitiveness		√	√		√	√	√								5
R8	Better safety performance	√	√							√	√			√		5
R9	Increased client satisfaction	√		√		√					√	√				5
R10	Risk sharing			√					√		√	√				4
R11	Effective problem solving	√							√	√	√					4
R12	New market opportunities		√	√		√						√				4

2.5 Barriers to collaboration

Collaborative relationships such as strategic alliances, partnership, joint ventures, IPD and SCM are receiving increasing attention from construction fields nowadays. It is widely recognised that these arrangements have brought valuable collaboration benefits on individual projects. However, despite all these benefits, strong collaborative relationships do not occur naturally, there are still a lot of barriers against the collaboration implementation. The potential issues are addressed in the following section.

2.5.1 Adversarial environment

The adversarial nature of construction field impedes the effectiveness of partnering implementation due to the practices of win-lose situations (Ng, et al., 2002). Ey, Zuo and Han (2014) study on Australian collaborative procurement show that people tend to create an "Us vs. Them" mentality toward people who come from different companies. Project teams are used to silo working by focusing on their own interests, rather than integrated working towards a mutual goal eventually result in a lose-lose scenario (Eriksson, Nilsson and Atkin, 2008; Chan, Chan and Ho, 2003b; Kumaraswamy, et al., 2005).

Moreover, the existence of a competitive culture in the construction industry caused lack of trust and unreliable between project stakeholders (Olanrewaju, Tan and Kwan, 2017). All parties are unwilling to coordinate with others' works due to the misalignment of objectives and high blame culture (Tey, et al., 2012). Likewise, the interview participants in Kwofie, Aigbavboa and Matsane's (2018) study assert that there is an issue with trust when working with other people as they behave as if they are in competition and reluctant to share.

2.5.2 Communication problems

One of a study by Ng, et al. (2002) reported that most of the contractors who had experienced unsuccessful project partnering relationship in Australia indicated "lack of continuous open and honest communication" as one of the major barrier for partnering arrangement. This is in line with Ey, Zuo and Han (2014) which revealed that communication failure is the critical barrier that is

often quoted by practitioners as a potential root causes of disagreement. Tey, et al. (2012) further claim that due to the intensive of labours involved in project, uncontrollable management and poor communication are inevitable between management and employees. Sometimes, it becomes very difficult to progress as different partners are distrustful of one another and are unwilling to communicate and exchange the critical information for no reason (Kwofie, Aigbavboa and Matsane, 2018; Zuo, et al., 2013).

2.5.3 Lack of top management support

Kumaraswamy, et al. (2005) indicated that top management support is extremely important for RC approach, without this, contracting parties may not have any ideas about the potential benefits of RC and how it should be implemented. Despite the fact that new approaches may be more appropriate than conventional approaches, a lack of top management commitment may dissuade an individual from attempting them (Eriksson, Nilsson and Atkin, 2008). Undeniably, the intensity of support from the top management and senior partners significantly affects the successful of projects in an organization (Olanrewaju, Tan and Kwan, 2017; Ng, et al., 2002).

In Hong Kong, Chan, Chan and Ho (2003b) explain that even though upper management actively promotes the partnering arrangement, the concept does not been conveyed down the layers of management easily. It could lead to misunderstanding by team members from the lower hierarchical levels. Provided the senior management is solely providing lip service rather than actual commitment, the partnering relationship must be doomed to fail. Ey, Zuo and Han (2014) further added that conflicting objectives or KPIs between senior and project management are the major issue which impedes effective knowledge transfer among the partnered parties.

2.5.4 Incompatible personalities and organisational cultures

Ghassemi and Becerik-Gerber (2011) described cultural barriers as the unwillingness of the industry to vary from its traditional methods. emphasised It is difficult for a diverse group of people to reorient themselves into the same team especially when the individuals had previously worked in different organisational cultures (Kumaraswamy, et al., 2005). This is consistent with

Ey, Zuo and Han's (2014) finding in Australia. Multidisciplinary of project team causes misalignment between the technical interdependence and organizational independence (Tey, et al., 2012). This further causes the clashes of culture that impede the development of relational contracting.

In South Africa, Kwofie, Aigbavboa and Matsane (2018) further pointed out that personal dimensions of social barrier form a major inhibiter to collaborative working such as unwillingness to share information. In light of this, Baiden, Price and Dainty (2006) suggested that each member has to fit themselves into a project team and see each member at the same level and are equally important to the project team. A recent study by Zhang, et al. (2020) reported that "inherent difficulties in changing organizational culture" is the biggest barrier for collaborative contracting within Singapore construction industry. There are abundant factors that influencing the organizational culture, changing the mindset is therefore a huge challenge for the industry.

2.5.5 Lack of legislative regulations

Zhang, et al. (2020) claimed that current legislative regulations are geared toward conventional procurement processes, with the aim of facilitating competition, resulting in ineffective collaboration. Traditionally, competitive tendering practices are merely focuses on price, qualification, management capability, and construction methods, which means the existing relationships and prior experience of working together, are not applicable in most of projects (Zuo, et al., 2013). Such regulatory framework therefore acts as a critical barrier for implementing collaboration (Eriksson, Nilsson and Atkin, 2008; Ng, et al., 2002). Similarly, in Australia, Ey, Zuo and Han (2014) further pointed out complexities of the existing commercial and contractual frameworks is one of the barriers to collaborative practices. Olanrewaju, Tan and Kwan (2017) explicated that the nonexistence of an industry-wide standard for partnering arrangement and ambiguous nature of partnering charters was seen as a significant barrier for project partnering.

2.5.6 Lack of financial support

Generally, adoption of rational contracting may incur a substantial amount of money in organising the organisational activities for example coaching and workshops (Ling, et al., 2014). Besides, the companies need to have sufficient money to introduce new systems that can support effective communication and information sharing between partnered parties. As aforementioned, most of the registered construction companies are SMEs in Malaysia. These companies are lack of collaboration capabilities due to insufficient financial resources to invest in technology and innovation to support collaboration nor to evaluate their collaboration practices (Fulford and Standing, 2014).

As Zuo, et al. (2013) described, reluctance from clients' perspectives to commit extra resources and investment forms a significant barrier for partnering implementation in China. Another study in Singapore by Zhang, et al. (2020) further observed that since collaboration contracting is still a relatively new concept thereby lack of incentives support have been deployed from the authorities. In view of this, it is unavoidable that this variable was recognised as one of the critical barriers.

2.5.7 Uneven of risk sharing

Chan, Chan and Ho (2003b) found that it is difficult to allocate the risk evenly in a partnering relationship as the committed parties always tend to grab advantages of the others for their own interest as well as to reduce their own risk. On the other hand, in traditional contracting approach, contracts are awarded separately to different professionals which lead to multiple roles and uncommon responsibility from different contract. This cause an unclear and unequal risk allocation among contracting parties (Tey, et al., 2012).

Furthermore, Olanrewaju, Tan and Kwan (2017) declare that it is difficult to cultivate project partnering without a proper risk-reward framework among partnered parties. A proper risk sharing mechanism should be practiced in order to fully utilise the incentive value of sharing risk while decreasing a contingency charged for bearing risk. This will avert the contracting parties from retrogressing to the adversarial "win-lose" relationships, instead, provides a sound basis for a ''win-win'' climate (Kumaraswamy, et al., 2005).

2.5.8 Lack of commercial control

An earlier study by Eriksson, Nilsson and Atkin (2008) saying that Swedish construction client are unwilling to implement a change in adopting partnering as the traditional position enable the clients to have power and control over the project. However, under collaborative arrangement means they are required to give up some of the control. This is consistent with the findings of (Ling, et al. 2014; Ng, et al., 2002) where lack of empowerment in the client's controlling bodies was indicated as the major barrier for collaborative working. According to Ey, Zuo and Han (2014), one of the Australian practitioners commented that, "it is an uncomfortable feeling, knowing that you do not have one hundred percent control of the outcome". Understandably, clients wish to have a direct control over the project they are involved.

2.5.9 Exclusion of key subcontractors

Traditionally, it has been noticed that the early involvement of sub-contractors in the projects is seldom and this may lead to inefficiencies as the latecomer is usually lack of collaboration with the others (Kumaraswamy, et al., 2005). It may even worsen with uncooperative main contractors as they remain relatively unsophisticated in their approaches to the sub-contractors. These relationships are mostly strained by mistrust between both parties (Eriksson, Nilsson and Atkin, 2008).

According to Ghassemi and Becerik-Gerber (2011), early commitment of sub-contractors is highly successful because they can contribute their specialist knowledge and skills during the design stage which could improve product quality, enhance the building performance and reduce the construction cost. Similarly, Ng, et al. (2002) added that inclusion of subcontractor at the initial stage could help the contractors in attaining their profit margin.

2.5.10 Fragmentation of Construction Process

Fragmentation within construction industry is mainly caused by the segregation of project team. In the traditional approach, team members tend to focus on their own silo of work and to optimise individual benefits of their own field (Ghassemi and Becerik-Gerber, 2011). For instance, project design is commonly completed in silo by the architect before appointment of a

contractor. This fragmentation process obstructs the team integration as well as restricts the contractors' input (Nawi, Baluch and Bahauddin, 2014). During the design phase, designer always pursues a functional design while the contractor is dispirited to voice out their opinions into the constructability issues (Tey, et al., 2012). As such, poor communication between both parties is reported to result in time and cost overruns, project delays, conflicts, increased project complexity, and rework (Nawi, Baluch and Bahauddin, 2014). Another findings by Kwofie, Aigbavboa and Matsane (2018) highlighted that the fragmented project delivery processes hinders effective collaboration as the contracting parties may not knowing who to report, where to go to or who to deliver to in the construction process.

2.5.11 Resistant to change current way of working

Ghassemi and Becerik-Gerber (2011) claim that it is difficult for the industry to shift the mindset built on the traditional procurement as the companies are familiar with the narrow leadership thereby unwilling to move away. This is further supported by Olanrewaju, Tan and Kwan (2017), stating that many contractors fail to adopt collaborative working because they are comfortable with the current models. According to Department of Statistic as of July 2020, there are about three million foreign workers in Malaysia, of which large portion of them were employed in construction. As a result, the diversity of cultures, languages and backgrounds amplifies difficulty to implement a new initiative and alter existing working practises (Zhang, et al., 2020).

2.5.12 Inadequate training and guidance

A previous study in Beijing revealed that relational arrangement was not actively adopted by the practitioners due to their limited knowledge on the benefits of the relational contracting (Ling, et al., 2014). Lack of training and guidance cause the team members do not have a clear picture on the concept of partnering and hence hinder the implementation of partnering approach (Chan, Chan and Ho, 2003b). Ng, et al. (2002) also highlighted that inadequate of information and guidance from the client form a significant barrier for collaboration working as the contractor failed to appreciate the requirements in achieving project partnering.

Table 2.4: Literature Map for Barriers to Collaboration in Construction Industry.

Ref	Barriers	Tey, et al. (2012)	Nawi, Baluch and Bahauddin (2014)	Ling, et al. (2014)	Fulford and Standing (2014)	Zuo, et al. (2013)	Chan, Chan and Ho (2003b)	Eriksson, Nilsson and Atkin (2008)	Ghassemi and Becerik-Gerber (2011)	Kumaraswamy, et al. (2005)	Zhang, et al. (2020)	Ey, Zuo and Han (2014)	Kwofie, Aigbavboa and Matsane (2018)	Olanrewaju, Tan and Kwan (2017)	Ng, et al. (2002)	Total
B1	Adversarial environment	√	√				√	√		√		√	√	√	√	8
B2	Communication problem	√					√					√	√	√	√	6
B3	Lack of top management support						√	√		√		√		√	√	6
B4	Incompatible personalities and	√							√	√	√	√	√			6
B5	Lack of legislative regulations					√		√			√	√		√	√	6
B6	Lack of financial support			√	√	√					√					4
B7	Uneven of risk sharing	√					√			√				√		4
B8	Lack of commercial control			√				√				√			√	4
B9	Exclusion of key subcontractors							√	√	√					√	4
B10	Fragmentation of construction process	√	√						√				√			4
B11	Resistant to change current								√		√			√		3
B12	Inadequate training and guidance			√			√								√	3

2.6 Effective strategies for collaboration

Nowadays, collaborative working is increasingly important in the construction industry. This prompts the need for effective collaborative strategies that is essential to address the challenges related to implementation of this concept in Malaysian construction projects. It is therefore noteworthy to study the critical collaborative success factors for benchmarking and continuous improvement.

2.6.1 Early involvement of project stakeholders

Early involvement of project teams was recognized by many scholars as one of the critical factors in establishing successful collaboration. For instance, Yeomans, Bouchlaghem and El-Hamalawi (2006) and Ng, et al. (2002) suggest that engaging manufacturing specialists at the earliest stage will greatly reduce the potential errors and waste during the construction phase while involvement of design consultants can ensure efficient resolution of technical specification issues. Both Haugseth, et al. (2014) and Lahdenperä (2012) further agree that early involvement of subcontractors allows integration of versatile expertise at the critical design phase, subsequently contributes to constructability of a project. Also, it is believed that inclusion of the supply chain could enhance competitive advantage with shorter lead times and client satisfaction (Hughes, Williams and Ren, 2012).

A previous study in Norway by Wøien, et al. (2016) reported that "early involvement of contractor" is given high priority by both clients and contractors as the most important partnering element. It is the key in building good relationship as well as increasing the transparency and openness of a contract, which make possible for achieving mutual agreements (Törneman, 2015; Nevstad, et al., 2018). In contrast, the exclusion of key subcontractors will lead to an uneven sharing of risk and reward which further hinder the formation of integrated culture (Zhang, et al., 2020).

2.6.2 Effective Communication

Project partnering is lubricated by open communication and closed relationship (Haugseth, et al., 2014). Any disputes and conflicts should be solved on the ground at the lowest possible organisational level and save the time for conveying the issues in between site office and central offices (Wøien,

et al., 2016). To gauge effective collaboration, Chan, et al. (2004) consider communication channels such as scheduled site meetings, phones, facsimiles, and electronic mails. Moreover, a flat organisational structures was recommended to allow direct communication across organisational boundaries so that inputs from various parties were easily recognised without a long chain of command (Baiden, Price and Dainty, 2006).

Hietajärvi and Aaltonen (2018) asserts that lack of interaction between team members may cause partnering failure. One of the practitioner from Norway commented that open and two-way communication constitute the base for initiating a collaborative relationship between client and contractor (Nevstad, et al., 2018). Hauck, et al. (2004) further listed out six key principles which govern the collaborative communication, include fairness, openness, problem-solving orientation, good intention, empathy, and utilisation of technology. In essence, effective communication promotes trust and collaboration among project stakeholders (Keys, Silverman and Evans, 2017).

2.6.3 Top management commitment

Hietajärvi and Aaltonen (2018) and Wøien, et al. (2016) assert that top managers commitment had a significant impact on the project ambience as well as directing the project to a successful outcome. Generally, top management is responsible to ensure work allocations are done fairly among project stakeholders and a mutually agreed performance appraisal system is taken place (Kumaraswamy, et al., 2005).

A recent study by Zhang, et al. (2020) highlighted that "management to take the lead in ensuring a collaborative company culture" was ranked as the second-best solution in adopting CC in Singapore. In view of this, top management can be seen as a critical role in supporting successful partnering spirit because they are the person who works out the scheme and direction of business events (Chan, et al., 2004). Akintoye and Main (2007) opted that they must ensure the company vision is successfully conveyed down through the organisation and always support project managers by providing sufficient resources, handing over authority, supporting emergency, and developing competencies through professional training and development (Ahmed, 2016; Nevstad, et al., 2018).

2.6.4 Choosing the right partners

For the sake of project success, it is imperative to have project stakeholders that can overcome destructive competitive relationships and openly share their opinions (Olsson and Espling, 2004). Haugseth, et al. (2014) further suggested that partnered parties should always be open-minded, solution oriented and communicative. However, awarding of the lowest bid price often means working with new entrants which do not have any experiences in collaborative working (Yeomans, Bouchlaghem and El-Hamalawi, 2006).

The formation of a project team is highly depending on the selection of right-kind of collaborative partners, which allowed the mutual goals and project principles to be cordially accepted by all parties (Wøien, et al., 2016; Hietajärvi and Aaltonen, 2018). A study by Hauck, et al. (2004) on Australian project alliancing revealed 12 major criterions used by client representatives in selecting the project alliance partners, mainly based on their demonstrated ability to work in the collaborative arrangement. In Norway, Nevstad, et al. (2018) indicate that "participants selection" is the second most frequently cited factor that contributed to success of project partnering.

2.6.5 Team building

Akintoye and Main (2007) emphasized that team building within project stakeholders plays an important role in optimising project performances. It allows integrated of team members which in turn, enhance productivity, effectiveness, motivation, goals achievement, team spirits as well as minimise conflict. Other than that, teambuilding could further lead to trust development and alignment of mutual objectives of different parties (Olsson and Espling, 2004).

Törneman (2015) suggested that integrative mechanisms like teambuilding workshops form the basis for partnering arrangements. As a support, Hietajärvi and Aaltonen (2018) explicated that team building workshops could establish a stronger bonding among the multidisciplinary team as every single party was seen as a part of the team without boundaries. It is advisable to carry out kick-offs and social events at the initial project phase which enables all stakeholders get to know people inside the alliance team and encourages better collaboration. Team building activities are one way to

enhance teamwork, socialisation, and collaboration among project stakeholders (Löfgren and Eriksson, 2009). Team building activities, such as field trips, boat-trip, football competition, karaoke, can help to maintain social bonds between project actors and remove any hindrances of communication that occur (Love, Mistry and Davis, 2010).

2.6.6 Trust building

Partnering relationships are planned to fail without a sense of trust. Trust can be emerged from accumulated past experiences and from deepen mutual understanding (Olsson and Espling, 2004). Trust is being mentioned in various partnership researches as a prerequisite, a measure, an objective, or an outcome (Nevstad, et al., 2018). It is an essential element for successful alliances in creating mutual commitment and constructive dialogue among project stakeholders (Yeomans, Bouchlaghem and El-Hamalawi, 2006). The researchers further confirm that it is impossible to achieve successful strategic alliance without a need for trust.

For partnering to work, collaborators should have firm belief in the reliability of the partners in fulfilling their duties. By eliminating the relationship boundaries, it opens the door for stress relief, knowledge sharing, problem-solving, and result-oriented (Chan, et al., 2004). To achieve successful partnering, project managers should equip themselves with high level of openness. Meanwhile, the client should build trust unconditionally with the contractor (Wøien, et al., 2016). It is believed that trust building not only help in reducing transaction costs, facilitating information sharing, encouraging joint projects, but also lay the foundation for expanding moral relations in business (Akintoye and Main, 2007).

2.6.7 Mutual objectives

A study conducted by Wøien, et al. (2016) found that both clients and contractors have prioritised “mutual objectives” as an important partnering element for projects’ success. It should therefore be expected to be widely used in the partnered project. Typically, common goals and objectives will be stipulated in an collaborative agreement (Zhang, et al., 2020), laid the bottom for constructing a collaborative project identity (Hietajärvi and Aaltonen,

2018). The usage of mutual goals enables the contracting parties to see the benefits in a wider scope rather than individual outcomes, thereby enhancing the possibility of a win-win condition between all parties (Löfgren and Eriksson, 2009). The establishment of mutual goals is a critical success factor for collaboration especially in an early planning stage (Love, Mistry and Davis, 2010; Nevstad, et al., 2018). In contrast, diversification of goals and objectives from different parties can cause opportunistic behaviours and hinder the formation of collaborative relationship.

2.6.8 Collaboration workshops

Collaboration workshop is one of the main element that facilitate success in a partnering project especially during the start-up phase (Wøien, et al., 2016). Late formation of start-up workshop may lead to a bad working relationship between stakeholders, which was hard to rectify during the rest of the project (Eriksson, 2010). The key function of start-up workshop was to introduce the senior management into a new way of delivery method and lay a foundation for the implementation of partnering arrangement (Bayliss, et al., 2004).

Haugseth, et al.'s (2014) analysis of Norwegian partnering projects supports that, start-up workshop involves teambuilding activities and signing of partnering charter which are mutually agreed by each party. The charter is then served as a reminder of the collective responsibility for project execution. Plus, continuous workshops are equally important to ensure all parties are strictly adhering to the procedures, and to monitor target outcomes and team commitment. (Hosseini, et al., 2016). Follow-up workshop is another useful tools to trigger collaborative spirit among project stakeholders (Löfgren and Eriksson, 2009).

2.6.9 Involvement of facilitator

Due to a lack of experiences, knowledge and practices relating to collaborative contracting, it is difficult for the parties to understand the general concept of collaboration. In this case, an independent facilitator should be employed to create a mutual conception among team members by introducing the processes, roles, and guidelines of collaborative arrangement (Hietajärvi and Aaltonen, 2018; Ng, et al., 2002). Facilitators play a significant role in partnering

formation especially at the earliest project phase due to their ability of developing the process which could move the project team toward high levels of collaboration (Löfgren and Eriksson, 2009). During the earliest stage of alliance formation, there is a fragile relationship between project stakeholders and trust is yet to be developed (Love, Mistry and Davis, 2010). A facilitator is therefore appointed to manage the project meetings and workshops in order to promote a culture of open communication and establish trust between all parties (Cheng and Li, 2002).

2.6.10 Performance measurement

Yeomans, Bouchlaghem and El-Hamalawi (2006) suggested the use of Key Performance Indicators (KPIs) as an effective measure to evaluate how well are the companies' performance both internally and externally. In order to maintain long-term relationships, it is desirable to apply performance measurement to guarantee everyone is achieving the optimum outcomes. Key target outcomes served as a direction for the team members' operative job and to minimise complications within the project team (Hietajärvi and Aaltonen, 2018).

Besides, the project performance can also be measured in terms of cost, time, scope, function, safety, and quality (Hauck, et al., 2004). One of the key methods to monitor partnering's performance is to carry out joint evaluation within project stakeholders where individuals' performance could be evaluated by setting measurable targets. Team leaders could also be appointed to monitor the partnering process regularly and to make sure the consistency of partnering principles (Chan, et al., 2004). By continually using of such measuring tool, performance can then be monitored concurrently, instead of having to rectify the problems after it has happened (Baiden, Price and Dainty, 2006).

2.6.11 Training and Education

Training is a prerequisite requirement for transforming human behaviour and culture to a desirable level (Li, et al., 2001). Training to the project team members allows better understanding of what partnering is, and its associated advantages over current contracting process (Ng, et al., 2002). Apart from that, seminars can be organised for participants to debate and share opinions as well

as express concerns about the concept of project alliancing. External experts can also be invited to share their experiences and knowledge with other construction practitioners. It is also desirable to learn from successful case studies and international literatures to have a better insight into the benefits of collaborative contracting as well as to clear their doubt about the current practices (Hietajärvi and Aaltonen, 2018; Zhang, et al., 2020) .

2.6.12 New form of contract

For the sake of completeness and discreteness, traditional contracts attempt to facilitate the transaction by relying heavily on legal rules and formal documents. It is widely acknowledged that conventional contract emphasises on rigid contractual structure rather than relational contracting, which promotes inflexibility and non-collaborative relationships (Eriksson, 2010). In view of this, a new form of contract is needed to promote long-term cooperative relationships between clients and other stakeholders (Shelbourn, et al., 2007). Ng, et al. (2002) suggest that a less restrictive tendering method should be implemented with previous project experience as the main criteria for team selection instead of the tender price. This is particularly important as a contract with a low price focus lays the foundations to fewer disputes and improved collaboration (Törneman, 2015) .

2.6.13 Effective problem resolution

Problems and issues faced by construction industry are greatly different in relation to various kind of project environments. It is common to see project team members always fail to reach a win-win solution due to the mismatch of objectives and expectations. In this case, a joint problem-solving between partnered parties is best used as a mutually agreed solution to deal with the problematic issues (Chan, et al., 2004). A joint problem resolution mechanism is the most critical success factor during partnering process. It is important to ensure all the stakeholders are willing to follow its requirements so any issues can be settled at the earliest time possible (Cheng and Li, 2002; Ng, et al., 2002). It also help to reduce the litigation risk and potential claims that could hinder the collaboration (Löfgren and Eriksson, 2009). Effective problem-solving requires commitment from every project stakeholder who must be

tolerant, imaginative, open-minded and likely to accept judgements and learn from others.

2.6.14 Incentivisation

Hauck, et al. (2004) pointed out several incentive structures that can be adopted to motivate people aligning with the mutual goals such as good reputation, references, long-term business, agreements, repayment, public recognition, and risk reduction. Compensation and bonus arrangement should be bound to team performance instead of individual performance so that individual partners have no reason to act in their own best interests (Eriksson, 2010). An incentivization contract can be used to motivate the contracting parties by incorporating financial incentives and penalty provisions (Hietajärvi and Aaltonen, 2018). In Singapore, Zhang, et al. (2020) claim that majority of the practitioners are profit-oriented and might be opposed to adopt CC which might be financially risky. Hence, government incentives would be the most effective way to help the firms in minimising their financial risk in adopting CC.

2.6.15 Change of individual mind-set and attitudes

Törneman (2015) advocates that it is common to see practitioners within construction projects always tend to treat themselves as a single team, rather than as members of an integrated team. Moreover, the researchers further pointed out that personal behaviour of the project participants has a significant impact to the successful of collaborative practices. In fact, it is imperative for team members to accept others' mistakes and move on from the mistakes in order to enhance the effective working relationship in the future (Ng, et al., 2002).

Moreover, each member from the integrated project teams need to be seen at the same level and be treated as the key players in the project team so that the personal contributions can be exploited (Baiden, Price and Dainty, 2006). "Ability to collaborate" and "attitude towards collaboration" appeared as the most important interpersonal skills that contribute to a project success. Project alliancing requires members who are open-minded, reliable and can look beyond the traditional way (Hietajärvi and Aaltonen, 2018).

2.6.16 Structured review meetings

Face to face discussion and conversation were seen as the useful methods of promoting the collaborative working. During the meetings, team members jointly formulate the guidelines and agreements concerning how to maintain communicate effectively and through what channels. It was agreed that regular meetings helped to ensure project members are staying on track and to identify themselves as part of the project (Hietajärvi and Aaltonen, 2018; Love, Mistry and Davis, 2010).

In addition, project meetings allow face-to-face discussion which can help the project team to have better focus on potential problematic issues (Löfgren and Eriksson, 2009). Project review meeting should be held monthly by including all key stakeholders to monitor the status of the partnering contract. It is desirable to rotate the chairmanship among the participants to encourage active commitment, effective communication and to remove traditional hierarchy (Bayliss, et al., 2004).

2.6.17 Access to new technology

The use of information technology creates a possibility for shared databases which could facilitate high level of communication and improve information sharing among project stakeholders (Hauck, et al., 2004). In addition, Löfgren and Eriksson (2009) affirmed that a joint IT database could enhance collaboration among all parties due to its capability of providing useful information at lower cost and shorter time. This is particularly important especially where geographical distance between the sites and the headquarter offices can potentially induce ineffective communication and project delays (Törneman, 2015).

However, it is worthy to note that although there are various collaboration software and technologies available, participants always fail to address the familiarity of the tools thereby impedes successful collaboration. To take this into consideration, there is a need to design a standard and simpler interface for project collaboration software (Shelbourn, et al., 2007).

2.6.18 A clear definition of responsibilities

All parties must have a clear understanding of the organisational mission and be able to explain how the mission is related to their work. To be successful on the partnered project, all team members should clearly define their roles and responsibilities regarding to their right and authority. Otherwise, it may cause misalignment of the project relationship which may lead to partnering project failure (Chan, et al., 2004).

Nevstad, et al. (2018) stressed that task clarification is extremely important to project succeed. Both internal and external stakeholders should clearly understand their roles and responsibilities in relation to "who should do what and who is responsible for what", as well as "what should be done and who should do it". Collaboration can only be emerged when all parties clearly understand of their authorities, roles, and responsibilities which results in effective information and communication flow (Akintoye and Main, 2007).

2.6.19 Long-term perspective

The characteristic of temporary organization should be changed by moving into collaborative relationship which encourages repetitive projects and continuity relationship among the partners (Akintoye and Main, 2007). Chan, et al. (2004) found that more partnered parties are expected to balance the achievement of short-term goals and long-term objectives as well as attain both personal and common missions in the absence of opportunistic behaviour. It has been found that construction managers are more likely to form an integrated team for the reasons of work continuity and long-term harmonise working relationships with key clients which help to sustain a competitive advantage within the industry (Baiden, Price and Dainty, 2006).

2.6.20 New organisation culture

Frequent changes of client team structures will highly affect the progress of the project as the engagement of new members will always reflect different ideas and perspective. Hence, it is necessary to create an organizational dynamic in which client's team is fully supported to be part of the project team and be allowed to fully commit to the project (Keys, Silverman and Evans, 2017). This is further supported by Love, Mistry and Davis (2010) claiming

that frequent change of alliance manager and other personnel at inappropriate times made the project team difficult to develop and achieve trust relationship among each other.

On the other hand, the formation of a common language and terminology within an organisation can help to promote trust among team members as well as enhance the collaborative project identity (Hietajärvi and Aaltonen, 2018). Towards a shift in mindset, team members are able to create a shared culture within the organisation thereby moving to the successful partnering (Olsson and Espling, 2004).

2.6.21 Availability of resources

It is common to see that many organisations are unwilling to share their own resources with the other parties due to the scarcity of resources. In fact, knowledge sharing and pooling of resources between different parties not only can enhance the firm's competitiveness and project's constructability but can be a key factor toward partnering succeed (Chan, et al., 2004). Mutual share of these intangible resources can help to strengthen the team members for construction practices and to achieve desirable performance (Li, et al., 2001). It is important to focus on the resources' quality rather than the quantity. Inappropriate resources could slow down the progress and may lead to mistrust due to the low-quality outcome (Love, Mistry and Davis, 2010).

2.6.22 Colocation

One of the study in Finland (Hietajärvi and Aaltonen, 2018) found that colocation facilitates the informal communication, allows team members to work collectively as well as enhances teamwork among the parties. Moreover, the researchers added that colocation provides a good ambiance for decision making, collaborating, trust building, and developing of interpersonal relationships. Love, Mistry and Davis (2010) mentioned that common workplaces allow high level of openness, effective communications, regular interactions and information sharing among participants. The researcher further held that colocation would help to improve intimacy and minimise any fear that may exist between the partners.

Table 2.5: Literature Map for Effective Strategies for Collaboration in Construction Industry.

Ref	Effective strategies	Wøien, et al. (2016)	Hietajärvi and Aaltonen (2018)	Löfgren and Eriksson (2009)	Love, Mistry and Davis (2010)	Yeomans, Bouchlaghem and El-Hamalawi (2006)	Hauck, et al. (2004)	Chan, et al. (2004)	Keys, Silverman and Evans, (2017)	Kumaraswamy, et al. (2005)	Akintoye and Main (2007)	Ahmed (2016)	Li, et al. (2001)	Törneman (2015)	Olsson and Espling (2004)	Nevstad, et al. (2018)	Haugseth, et al. (2014)	Shelbourn, et al., 2007)	Bayliss, et al. (2004)	Eriksson (2010)	Hosseini, et al ((2018)	Cheng and Li (2002)	Ng, et al. (2002)	Baiden, Price and Dainty (2006)	Zhang, et al. (2020)	Total
S1	Early involvement of project stakeholders	√				√		√			√				√	√	√						√		√	9
S2	Effective Communication	√	√				√	√	√							√	√							√		8
S3	Top management commitment	√	√					√		√	√	√				√									√	7
S4	Choosing the right partners	√	√			√	√								√	√	√									7
S5	Team building		√	√	√						√			√	√				√							7
S6	Trust building	√				√		√			√				√	√										6
S7	Mutual objectives	√	√	√	√											√									√	6
S8	Collaboration workshops	√		√													√		√	√	√					6
S9	Involvement of facilitator		√	√	√																	√	√			5
S10	Performance measurement		√			√	√	√																√		5
S11	Training and Education		√										√										√		√	4
S12	New form of contract													√				√		√			√			4

Table 2.5 (Cont'd)

Ref	Effective strategies	Wøien, et al. (2016)	Hietajärvi and Aaltonen (2018)	Löfgren and Eriksson (2009)	Love, Mistry and Davis (2010)	Yeomans, Bouchlaghem and El-Hamalawi (2006)	Hauck, et al. (2004)	Chan, et al. (2004)	Keys, Silverman and Evans, (2017)	Kumaraswamy, et al. (2005)	Akintove and Main (2007)	Ahmed (2016)	Li, et al. (2001)	Törneman (2015)	Olsson and Espling (2004)	Nevstad, et al. (2018)	Haugseth, et al. (2014)	Shelbourn, et al., 2007)	Bayliss, et al. (2004)	Eriksson (2010)	Hosseini, et al ((2018)	Cheng and Li (2002)	Ng, et al. (2002)	Baiden, Price and Dainty (2006)	Zhang, et al. (2020)	Total
S13	Effective problem resolution			√				√														√	√			4
S14	Incentivisation		√				√													√					√	4
S15	Change of individual mindset and attitudes		√											√	√								√	√		4
S16	Structured review meetings		√	√	√														√							4
S17	Access to new technology			√			√							√				√								4
S18	A clear definition of responsibilities							√			√					√										3
S19	Long-term perspective							√			√													√		3
S20	New organisation culture		√		√				√																	3
S21	Availability of resources				√			√					√													3
S22	Colocation		√	√																						2

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

A good research methodology is very important in addressing the research problem and determining the overall research quality. Likewise, Abdulai and Owusu-Ansah (2014) defined research as "*a structured inquiry that utilises acceptable scientific methodology to solve problems and creates new knowledge that is generally applicable*". Typically, a research process comprises several stages involve identifying, assessing, collecting and analysing as shown in Figure 3.1. This chapter will reveal the research methodologies that has been implemented in this research. Firstly, the exploratory nature of this research and its justification are discussed. Furthermore, research design adopted is explained followed by the sampling technique and sampling size determination. After all, the last section provides a detail explanation of the data analysis method and data collection approach.

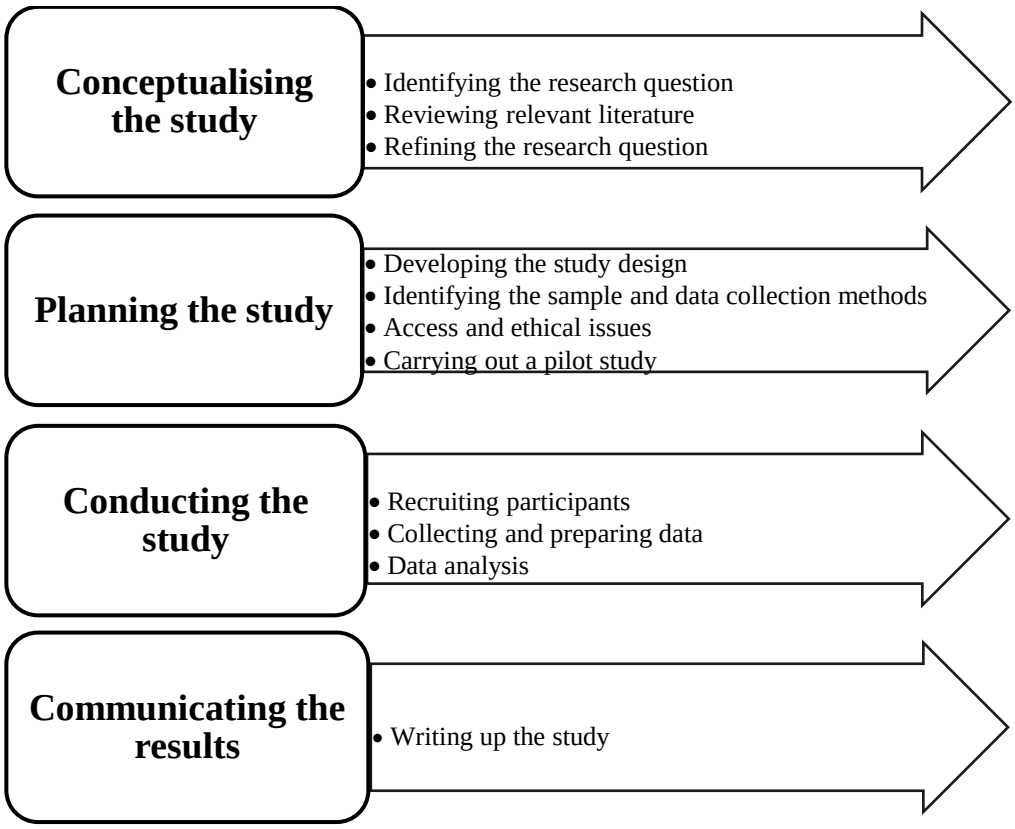

Figure 3.1: An "idealised" research process (Arthur and Hancock, 2009).

3.2 Nature of Research

There are various types of research which can be classified according to the research method used and the research objective. The research methods used can be categories into several classes such as pure research, applied research, descriptive research, correlation research, explanatory research, exploratory research, quantitative research, and qualitative research as shown in Figure 3.2 (Kumar, 2011). Classification of these researches is generally based on the application of the research study, objectives of the research and how the information is sought (Sukamolson, 2007).

This research is more to an explanatory study. It aims to explore the underlying barriers that impede collaboration in Malaysian construction industry and try to clarify how those barriers are correlated to the collaboration practices in construction industry. Explanatory studies are carried out to help the researchers in answering "why" and "how" kind of question (Boru, 2018). Explanatory research puts more emphasizes on causes and reasons in order to reveal the relationships among different aspects of the topic under study.

As aforementioned, one of the objectives of this research is to explore why collaboration practice is important in the construction industry. Explanatory research is therefore best used in this study responds to both "why" and "how" aspect of the research question (Kumar, 2011).

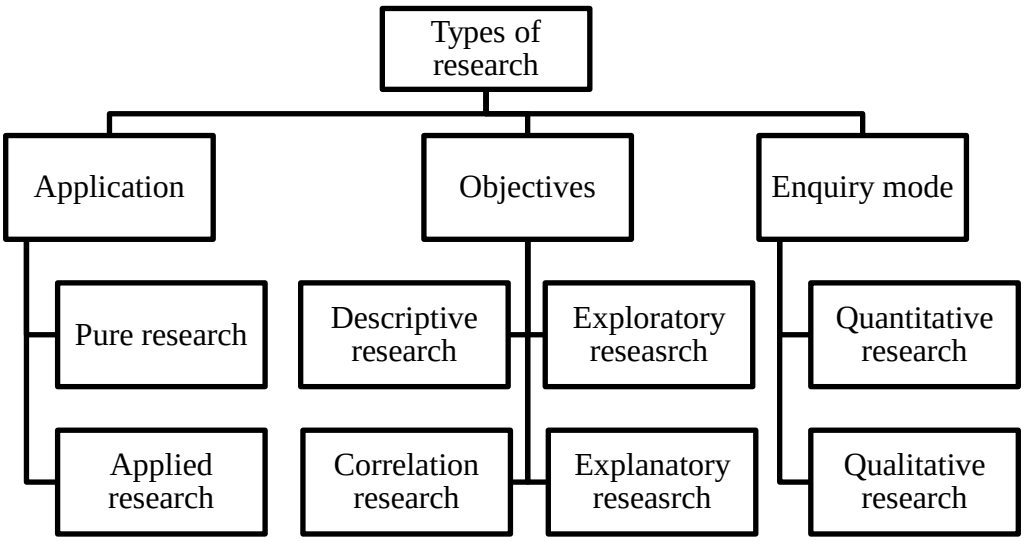

Figure 3.2: Types of Research (Sukamolson, 2007).

3.3 Research Methodology: Quantitative Research

Research design is a procedural plan and structure used to hold all of the research elements together. Research design is a critical part of a research as it outlines the tasks and procedures for collecting, analysing, interpreting, and reporting data (Akhtar, 2014). Selection of an appropriate research approach is extremely important as it assists to determine the most appropriate procedure that could be used to collect useful information (Jilcha Sileyew, 2020).

Generally, qualitative research and quantitative research are the most dominating methods (Boru, 2018). In this study, quantitative methodology has been applied to answer the research questions as stated before. Measurement is the core feature of quantitative research approaches (Arthur and Hancock, 2009). It involves collecting of numerical data and analysing by using mathematically based methods. One of the benefits associated with quantitative research is that it generates reliable and quantifiable data that can be applied widely to the whole population (Boru, 2018).

According to Apuke (2017), there are different types of quantitative research such as survey research, correlational research, experimental research, and causal-comparative research. In this study, survey research was adopted by using a scientific sampling method with a designed questionnaire to collect responses from a targeted population. Questionnaire is generally self-administered with a set of predefined questions prepared by the researchers and then distributed to the respondents for answering. All the respondents are requested to fill up same set of questionnaires and returns it back to the researcher (Osang, et al., 2013). Questionnaire is the most economical way of research method with low cost and less time consuming because it does not require to carry out interview with the respondents. Moreover, it guarantees the anonymity of the respondents and allows the respondents to re-examine their responses (Sukamolson, 2007).

3.4 Sampling Design

Sampling design is an important procedure for acquiring data to represent a definite section of the population. Sampling design is a method adopted by the researcher for selecting objects that can be used as the best example of the population (Mukherjee, 2017). Basically, it is impossible for researcher to

study the entire population due to existing uncontrolled factors such as legitimate reasons, time constraint and availability of resources (Salhin, et al., 2016). In this case, the researcher has an option to select segment of the general population for investigation (Rahi, 2017). This selecting process is called as sampling method and that segment of population is named as sample. One of the benefits for sampling is to reduce the workload and lower the cost that would have been incurred in studying the entire population. The other benefits are less time consuming and high degree of accuracy (Rahi, 2017). Before selecting the sample, researcher should take careful consideration of the research objectives, nature of the population, resources availability, research design applied, and the other issues relevant (Jawale, 2012).

There are various sampling techniques depending on the methodological approaches and research designs applied (Arthur and Hancock, 2009). There are broadly two types of sampling approaches include probability (random) sampling and nonprobability (non-random) sampling (Rahi, 2017). Non-random sampling is rarely used in quantitative research surveys in which the chance or probability of every unit of population to be chosen is unknown. The researcher will first describe the predefined criteria of target population which will be used to prequalify the sample for example age and sex (Arthur and Hancock, 2009). One the other hand, the best idea for achieving a better representative sample is to use random sampling technique. It gives every member of the population an equal possibility of being included in the sample (Polit and Beck, 2010). Random sampling can only be achieved as the population is exactly fixed to a limited number of elements (Datta, 2018). With a random sample, the first step is usually attempted to define a sampling frame from which the sample to be drawn. The sampling frame can be thought of as a list of all members of the target population that are relevant to the study. The source list should be reliable, complete, and correct (Stasny, 2001; Mukherjee, 2017). Inclusion and exclusion criteria for the targeted sample should be clearly stated to determine an appropriate sampling frame to make sure that each member shares an equal chance of inclusion in the research (Arthur and Hancock, 2009).

3.4.1 Sampling method

In view of large population in Malaysia, non-probability sampling technique has been applied such as convenience sampling and snowball sampling. The convenience sampling method includes selected participants who are readily available to the researcher. For example, questionnaire was distributed to a pool of respondents who were readily approachable. Typically, convenience sampling tends to be a preferred sampling technique as it is incredibly economical and uncomplicated as compared to other sampling methods (Taherdoost, 2016a). Besides that, snowball sampling was applied as it is difficult to reach out a small population with the target characteristics. This method initiates with an existing convenience sample as initial respondents. This initial subjects will then recruit future subjects who share similar characteristics, thereby increasing sample size like a snowball growing in size (Etikan, Alkassim and Abubakar, 2015). Furthermore, stratified sampling method was also applied for this study since the target respondents was already known in the early stage with differences in their profession. The target respondents were grouped into three categories, comprising client, contractor and consultants and therefore the samples will be selected randomly from within each category of the respondents.

3.4.2 Sampling size

It is imperative to choosing the appropriate sample size for a research in order to achieve the measurement requirements for a given indicator (Emerson, 2015). The size of the sample will depend on a number of factors such as availability of time and resources, prevalence condition of the study, and potential response rate (Arthur and Hancock, 2009). Jawale (2012) concludes that researchers should not rely solely on their intuitions but use statistical methods to get the appropriate sample size. Determining the right sample size is very important because a small sample size will not be able to provide a fair picture of the population and hence skew the results of the research. Meanwhile, a large sample size will make the entire study becomes complex, costly and time consuming to operate.

Yap, Low and Wang (2017) mentioned that the sample sizes larger than 30 and less than 500 are appropriate for most research. Moreover, where

samples are to be broken into sub-samples, a minimum sample size of 30 for each category is necessary. Since the sampling group of this research was divided into three categories (consultants, contractors, and developers), a minimum sampling size of 90 was expected. On the other hands, according to Fellows and Liu (2015), for studies in which factor analysis is to be used, a data sets of at least 100 is usually required for reliable factor analysis to be applied. Hence, a minimum sampling size of 100 was required in this research to obtain a valid result.

3.4.3 Sampling target

Error that occurs during sampling can be controlled by taking certain prevention such as selecting sample of respondents without bias and increasing the size of the sample to improve the accuracy of the results. Researcher should avoid choosing samples exclusively from targeted groups which might result in inaccurate estimates (Jawale, 2012). Samples of the population for this research was targeting the professionals working in Malaysian construction industry. The respondents were taken from Klang Valley region regardless the current position, past experiences, academic degree, income status and project committed. All parties had an equal opportunity to be included in the sample as long as they are fulfilling the inclusion criteria of this research. This was to ensure the respondents have sufficient industrial knowledge and experience to understand the research questions as stated in the questionnaire. As aforementioned, the target respondents were divided into three categories which were clients, consultants, and contractors. The reason why those parties were chosen was due to the fact that they are the most influential parties who take part in the construction projects. Hence, they have certain level of maturity and understanding in responding to the questions. Moreover, the target respondents for this research were focused mainly on the state of Klang Valley area as it has been reported as the main contributor to the value of construction work done in year 2020 according to the construction statistic (Department of Statiscitc Malaysia, 2020).

3.5 Data collection method

Data collection is one of the most crucial parts when conducting a research study. Generally, data can be collected in two ways either from primary or secondary sources. Primary data refers to raw data that have been collected directly through first-hand sources and then incorporated into the existing store of knowledge (Hox and Boeije, 2005). Primary data is normally unpublished and is more dependable, genuine, and impersonal. The most common example of primary data are experiments, surveys, questionnaire, interview, and observations. Secondary data, on the other hand, is existing data that have been published to the public. Example of secondary data include books, records, biographies, newspapers, statistical data, Internet articles, reputable journal, articles, databases and so on (Jilcha Sileyew, 2020). There are numerous methods can be used for data collection.

In this research, both the primary and secondary data were collected to ensure the appropriateness of the data as well as to reduce the likelihood of errors consistent with the results. It is important that accurate data is collected so that the researcher does not make uninformed decisions. In this case, the primary data was collected by distributing structured questionnaire with close-ended questions to arrive at figures to be recorded and quantified for testing. On the other hand, secondary data was gathered by reviewing previous journal articles from other researchers through the library database or online resources. Relevant results and findings were extracted from the existing research to further improve the richness of the data collected. The use of appropriate sources is the cornerstone that allows researcher to achieve reliable, reasonable, and usable assessment information.

3.5.1 Questionnaire Design

In this research study, the common source of primary data was collected through distributing of questionnaires through social media in Google form. A well-structured questionnaire was designed with a set of predestined questions in order to provide the respondents a logical and continuous flow of thought in understanding the main concept of the research (Igwenagu, 2016). The questionnaire is the most economic research instrument as it can be simply conducted through online based without interview, requires less time and less

energy (Sadan, 2020). Further, the questionnaire can often be distributed to a group of people simultaneously; personal interview, on the contrary, requires more time and resources to follow up (Sukamolson, 2007). Within a constraint budget, it is probably to reach a wider area and gather more information by means of questionnaires than by separately interviewing every single participant.

The questions on the questionnaire may include either open-ended questions or closed-ended questions or both. Open-ended questions give freedom to the participants to provide their own answers to the question whereas in closed-ended questions, the participants have to tick the best answer among the fixed boxes given on the questionnaire (Osang, et al., 2013). For analytical purposes, closed-ended questions were applied in this research to attain quantitative data which are easier to numerically code and analyse (Young, 2015). Moreover, it is advisable to use appropriate wording of questions when designing a questionnaire. Researchers must avoid wording that is sensitive to respondent's psychological state, prevent bias, and consider the readiness of respondents (Sadan, 2020).

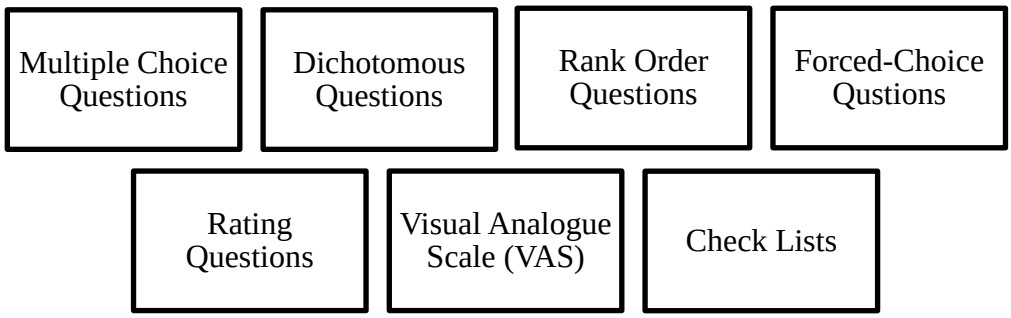

Figure 3.3: Types of closed-ended questions (Sadan, 2020).

The wording used in this questionnaire should not be ambiguous or vague. It is advisable to avoid presenting controversial or emotive items at the beginning of the questionnaire (Rattray and Jones, 2007). Moreover, long question can also threaten the reliability of the instrument. In this research, the questionnaire was developed by using Google form and distributed to the construction personnel by email. The questionnaire was prepared in the close-ended form in this study with the choice of answers provided. The number of

choices is limited to five to narrow down a specific aspect. Proper instructions will be given to the respondents on how to fill the questionnaire. There are various forms of closed-ended questions can be applied as shown in Figure 3.3 whilst multiple-choice questions and rating scales such as the Likert Scale have been adopted in this research to increase the consistency of the responses. Ordinal scales were designed to measure attitudes and opinions of the respondents, ranging from strongly disagree to strongly agree with a neutral point being neither agree nor disagree (Rattray and Jones, 2007).

In this research, a five-page closed-ended questionnaire were prepared, which consisted of four sections. Respondents were asked to give their opinions over a continuous rating scale for the first three section from "1" = strongly disagree, "2" = disagree, "3" = undecided, "4" = agree, and "5" = strongly agree. Specifically, the first section of the questionnaire asked about the perception towards the usefulness of collaboration practices in construction industry while the second part listed out potential barriers to collaboration practices in Malaysian construction industry. Respondents were instructed to scale the following barriers accordingly. Next, the respondents were asked to scale from strongly disagree to strongly disagree on the effective strategies which they most preferred based on their perception of view. At the very last part of the questionnaire, the respondents were required to fill in their basic data such as current position, working experiences, company background, age and characteristic of project involved. The questions were standardized which could be easily transformed into quantitative data for statistical analysis. All participants were asked the same series of questions in exactly the same manner to ensure the consistency of responses. The questionnaire sample was attached in Appendix A at the end of this report.

3.5.2 Pilot test

A pilot test is a small-scale version of study used to evaluate the feasibility of a research and to assist in defining the data collection methods, sampling strategies, and other research instruments before the full deployment of the research. The main objective is to determine potential problems and flaws in the research instruments before implementing the full study (Hassan, Schattner and Mazza, 2006).

In this research, the pilot study was conducted by distributing the pre-testing questionnaire on a small group of selected participants, who share the similarity to the target samples. The respondents were required to provide some feedback that helps to ascertain any ambiguities and inappropriate questions. All the feedback was recorded in order to improve the questions, discard all ambiguous questions and make necessary changes. Each question was assessed accordingly to see whether an adequate range of responses are achieved. Any questions that were not answered as expected was modified and restructured. A well-structured and well-planned pilot study is necessary to provide researchers about the best research instruments and guarantee the success of the full-scale survey (Teijlingen and Hundley, 2002).

3.6 Data analysis

3.6.1 Cronbach's Alpha Reliability Test

Alpha was developed by Lee Cronbach in 1951, is a useful tool to measure the internal consistency of tests and scales. Internal consistency describes the extent to which all the test items are measuring the same underlying concept and measures the extent to which item responses interrelate with each other (Tavakol and Dennick, 2011). Vaske, Beaman and Sponarski (2017) show the general formula for computing Alpha as below:

$$\alpha = \frac{N}{N-1}\left(\frac{\alpha_x^2 - \Sigma_{i=1}^{N} \alpha_{Y_i}^2}{\alpha_X^2}\right) \quad (1.1)$$

Where,

N = the number of survey items in the scale

α_x^2 = the variance of the observed total scores

$\alpha_{Y_i}^2$ = the variance of item i for person y

In this research, Cronbach's alpha is used to examine the reliability of Likert rating scale. The value of Cronbach's alpha ranges from 0.00 to 1.00 with the higher values implying the items are measuring the same dimension. In the contrast, if the Cronbach's α value is near to 0, it means some items are not measuring the same dimension (Bujang, Omar and Baharum, 2018). Similarly,

if the Cronbach α for a set of scores turns out to be 0.90, it means that the test is 90 % reliable, and by extension that it is 10 % unreliable. The recommended Cronbach's Alpha value are shown in Table 3.1.

Table 3.1: Range of Cronbach's Alpha Reliability Coefficient

Cronbach's Alpha	Internal Consistency
$\alpha \geqslant 0.9$	Excellent
$0.9 > \alpha \geqslant 0.8$	Good
$0.8 > \alpha \geqslant 0.7$	Acceptable
$0.7 > \alpha \geqslant 0.6$	Questionable
$0.6 > \alpha \geqslant 0.5$	Poor
$\alpha < 0.5$	Unacceptable

3.6.2 Measures of central tendency: Mean

Arithmetic mean is a parameter that used to measure the central location of the distribution of a quantitative variable and is a crucial statistic that is commonly applied in scientific literature. Mean is the most well-known measure of central tendency because it incorporates the score from every subject in the research study (Rodrigues, Lima and Barbosa, 2017). The mean also called the arithmetic average, is the quantity obtained by summing a collection of scores in a distribution and dividing by the count of that series of numbers. Mean can prove to be an appropriate method for comparing different sets of data. It can be applied on both discrete and continuous data, even though it was most often used along with continuous data. In this research study, arithmetic mean is carried out to calculate the means of each competitive strategy in order to rank the variables as the respondents see important.

According to Sykes, Gani and Vally (2016), the formula of arithmetic mean is shown as below:

$$\text{Mean} = \frac{\sum X}{N} \qquad (1.2)$$

Where

$\sum X$ =The sum all the scores in the distribution

N = The total number of scores

3.6.3 Kruskal-Wallis Test

Kruskal-Wallis is a very popular non-parametric test which is used for comparing more than two independent samples on a continuous dependent variable (Vargha and Delaney, 1998). In this research, Kruskal-Wallis test was used instead of a one-way ANOVA. In the ANOVA, the distribution of each group is assumed normal and there is approximately equal variance on the scores for each group. However, in the Kruskal-Wallis Test, it does not assume that the data come from a normal distribution. There are two different types of rank sum tests that are widely used by the researchers which include Kruskal-Wallis test and Mann-Whitney test. The main difference between both tests is the latter test only looks for differences in median values between two samples (McKight and Najab, 2010).

Kruskal-Wallis Test was adopted in this research to determine if there is a significant difference in the perceptions between contractors, consultants and clients towards the needs, barriers, and effective strategies to collaborative practices in construction industry. There are two hypotheses formulated in order to detect the significance differences in judgement of the variables across the respondent groups. The null hypothesis assumes there is no significant difference exists between these three groups towards the needs, barriers and strategies of collaborative practices whereas the alternative hypothesis assumes there is a significant difference between the groups towards the needs, barriers and strategies of collaborative practices.

The formula for calculating H-value is shown as below (Acar and Sun, 2013):

$$H = \left[\frac{12}{n(n+1)}\sum_{j=1}^{c}\frac{T_j^2}{n_j}\right] - 3(n+1) \qquad (1.3)$$

Where

n = sum of sample sizes for all samples

c = number of samples

T_j = sum of ranks in the j^{th} sample

n_j = size of the j^{th} sample

If H value is greater than the critical value, it indicates that there is significant difference between groups, null hypothesis is rejected. If H statistic is smaller than critical value, there is not sufficient evidence to reject the null of equal medians (Sawilowsky and Fahoome, 2014).

3.6.4 One-Sample T-tests

A t-test is one of the most popular parametric statistical tests that is applied to compare the mean value against a hypothesized value (Pandey, 2015). T-tests can be categories into two different types such as independent t-test and paired t-test. The one sample test compares the mean of a sample data to a pre-specified value and tests for a deviation from that value. In order to get a valid result, researchers must assume that the data is independent, and approximately normally distributed (Kim, 2015).

A null hypothesis and an alternative hypothesis are stated as below:

H_o: The population mean equals the claimed value, or $\mu = \mu_o$

H_1: The population mean does not equal the claimed value, or $\mu \neq \mu_o$

In this research, One-Sample T-tests was adopted to test whether the sample mean is significantly different from a hypothesized constant in regard to the extent of agreement towards the needs, barriers, and effective strategies to collaborative practices. One sample t-test can be calculated using the formula or Statistical Package for Social Science (SPSS). The following is the t-score formula that can be used to calculate the test statistic (Gerald, 2018):

$$t = \frac{\overline{X} - \mu_0}{s / \sqrt{n}} \qquad (1.4)$$

Where

$\bar{x}$ = sample mean

s^2 = sample variance

n = sample size

μ_0 = specified population mean

The t-value will be compared to the critical t-value which is found in the t-distribution table. Higher values of the determined t-score, indicate that a huge difference occurs between the two sample sets. The smaller the t-score, the more similarity exists between the two sample sets (Hayes, 2020).

Statistical significance is determined by studying the P-value. The decision rule is that if the P-value is higher than significant level, then the researchers have no significant prove to reject null hypothesis. In contrast, if the P-value is lower, the researcher can reject the null hypothesis and conclude that there is significant difference between the sample mean with the hypothesized value (Statistics Solutions, n.d.).

3.6.5 Spearman's Correlation Test

Spearman's Rank correlation coefficient is a non-parametric technique used to measure the degree of correlation between two independent variables, by using the ranks to calculate the correlation. The result can vary from 1 to negative 1. It describes the relationship between two variables by using a monotonic function (Lin, et al., 2017). In this research, Spearman's correlation is used to evaluate the relationship between organisational types and the needs for the collaborative practices. Generally, when the coefficients of correlation, $r > 0$, it indicates a strong monotonic relationship whereas when $r < 0$, it indicates a very week relationship between the paired data. A value of 0 indicates that no monotonic behaviour exists between the variables (Lani, 2013).

The formula used to calculate Spearman's Rank is shown below (Lobo and Guntur, 2018).

$$\rho = 1 - \frac{6 \sum d_i^2}{n\,(n^2 - 1)} \tag{1.5}$$

Where

ρ = Spearman rank correlation value

d = margin of each pair value

n = Spearman rank pair values

3.6.6 Factor Analysis

Factor analysis is a data reduction tool used to simplify and summarise a set of complex variables. This technique is commonly applied to reorganise a large set of correlated variables into a smaller set of latent constructs that share a common (Henson and Roberts, 2006). Basically, factor analysis can be categorised into two classes, named exploratory and confirmatory. Exploratory factor analysis seeks to explore the underlying factors from which the observed variables can be represented while confirmatory factor analysis is used to test whether the observed variables are correlated with its predefined factors (Decoster and Hall, 1998). Exploratory factor analysis is applicable when the researchers have limited idea about the structure or have no idea on how many influential factors can be generated from the observed data (Matsunaga, 2010). In this research, Exploratory Factor Analysis was adopted to reduce the 22 items of effective strategies into a small set of underlying factors that encapsulates the essential information for successful collaboration.

Prior to performing an analysis, a Kaiser-Meyer-Olkin (KMO) test was first conducted to indicate if the data set was suitable to proceed with further analysis (Chan and Idris, 2017). On the other word, the purpose of this test is to determine the sampling adequacy in order to identify the factorability of the data. KMO values range from 0 to 1. If the KMO value is exceeding 0.50, it can be assumed that the data set is acceptable (Zulkepli, Sipan and Jibril, 2017).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter focuses on the result of data analysis which is divided into two parts. The upper part exhibits the data collected from 151 Malaysian construction professionals who served as respondents of this research through questionnaire survey. The later part provides the detailed analysis of the research findings that have been organised and interpreted by using SPSS software. The results are also examined and contrasted with previous research and existing literature. The similarities and distinctions between these studies have been further discussed in this chapter.

4.2 Pilot study

Pilot study was carried out to assess the effectiveness and practicalities of the research instruments prior to its full-scale implementation. It was also used to test the comprehensiveness of the questionnaire, as well as to assess whether each question is being well-defined, well-structured and presented in a correct manner (Hassan, Schattner and Mazza, 2006). After a pilot study, the overall reliability of the data was measured through the Cronbach's alpha test. It is mandatory that all researchers should calculate alpha before of their full-scale study to ensure the validity and accuracy of their result (Tavakol and Dennick, 2011).

In this research, pilot test was first administered by distributing electronic questionnaires to 30 construction professionals from Klang Valley area. All the questionnaires were returned, giving a response rate of 100%. There are a total of 46 items from three constructs and each item is measured on a Five-point Likert scale. After that, empirical data were entered onto the SPSS software version 28 and analysed by using Cronbach's alpha. Table 4.2 shows the outcome of the reliability test. As mentioned before, a general rule is that a alpha value of 0.60 - 0.70 indicates an acceptable level of reliability, while 0.80 and above indicates a higher reliability (Ursachi, Horodnic and Zait, 2015). In this research, the computed alpha value of all questions was greater

than 0.80, suggesting that all items have relatively high internal consistency. Therefore, no further alterations should be made to the pilot questionnaires, all these 30 responses would be incorporated in the main study (Yap and Skitmore, 2017; Love, et al., 2013).

Table 4.1: Cronbach's Coefficient α Values for Pilot Study.

Question	Number of items	Cronbach's Coefficient Value
Needs of Collaboration in Construction Industry	12	0.879
Barriers to Collaboration in Construction Industry	12	0.842
Effective Strategies for Collaboration in Construction Industry	22	0.941

4.3 Respondent demographics

Following an initial pilot study, a total of 375 questionnaires were distributed equally to industry professionals from Klang Valley region. By the end of the cut-off day, 124 responses were received over a period of four weeks, of which 121 were considered usable. As stated, the responses from previous pilot study would be included in the full study. To sum up, there were 151 valid responses received, giving an overall response rate of 40.3 %, which was considered sufficient for further assessment (Aibinu and Odeyinka, 2006). Rahman, et al. (2014) hold that a survey is considered unbiased if the return rate is higher than a range of 30 - 40 %. The respondents were split into three specific groups (contractors, consultants, and clients) to uncover whether various groups had different perceptions on the relative importance of each variable. The response rate from clients, consultants and contractors are 32.5%, 29.8% and 37.8%, respectively.

The demographic profile of all respondents is shown in Table 4.2, with the majority of respondents holding a bachelor's degree or higher degree. This may be reflecting the current status of the Malaysian construction industry where employers constantly seek graduates who are adequately equipped with the appropriate skills and competencies. Likewise, a similar observation was reported by (Yap and Skitmore, 2018).

The result reveals that there are 58.9% of the respondents holding managerial posts in their organisation. The respondents' experience profile is further used to evaluate the credibility of their responses. 25.8% of the respondents had worked in the industry for at least six years while 43.1% of them having over 10 years of working experience in the industry. Hence, it can be concluded that the data collected in this survey are reliable as the experienced respondents who participated are competent both academically and professionally. They are expected to have a broader understanding of the procurement procedures involved in construction projects (Kumaraswamy, et al., 2005). The questionnaires were quite uniformly delivered different sizes of company with 76.8% of them were from private sector.

Table 4.2: Demographic profile of respondent.

Parameter	Categories	Contractors	Consultants	Developers	Total	Frequencies (%)
Gender	Male	32	33	29	94	62.3
	Female	25	12	20	57	37.7
Education background	Postgraduate degree (PhD, Master)	3	5	7	15	9.9
	Bachelor's degree / Professional	48	40	42	130	86.1
	Diploma	6	0	0	6	4.0
	High school	0	0	0	0	0
Position in company	Executive	24	18	20	62	41.1
	Manager	16	14	12	42	27.8
	Senior manager	8	7	11	26	17.2
	Director/Top management	9	6	6	21	13.9
Working experience (years)	0-5	19	15	13	47	31.1
	6-10	15	12	12	39	25.8
	11-15	10	7	10	27	17.9
	16-20	7	7	7	21	13.9
	Over 20	6	4	7	17	11.3
Size of organisation	1-10	7	8	0	15	9.9
	11-50	16	23	10	49	32.5
	51-250	17	9	8	34	22.5
	Over 250	17	5	31	53	35.1
Characteristic of project	Private	44	35	37	116	76.8
	Public	13	10	12	35	23.2

4.4 Reliability of Results

In this paper, the reliability of the questionnaire was first tested by using Cronbach's Coefficient Alpha. It is the most widely used method to determine whether the factors and their associated Likert Scale are measuring the same construct (Taherdoost, 2016b). The result of the reliability test by is shown in Table 4.3. Heale and Twycross (2015) regarded a Cronbach's $\alpha \geqslant 0.70$ signifies an acceptable reliability. As stated, the higher the value indicates the higher degree of reliability. As presented in Table 4.3, Cronbach's α for the 46 aspects appraised are 0.856, 0.828 and 0.903 respectively which are higher than 0.70, demonstrating high reliability of majority of the data. Further, statistical analysis was carried out by using SPSS software includes descriptive statistics (means, standard deviations, and frequencies), one-sample t-test, the Kruskal Wallis ANOVA and exploratory factor analysis.

Table 4.3: Cronbach's coefficient α values for main study.

Question	Number of items	Cronbach's Coefficient Value
Needs of Collaboration in Construction Industry	12	0.856
Barriers to Collaboration in Construction Industry	12	0.828
Effective Strategies for Collaboration in Construction Industry	22	0.903

4.5 One-sample t-test

One-sample t-test was employed to determine whether each factor is significantly important. Table 4.4, 4.5 and 4.6 shows the results of one-sample t-test conducted by using the SPSS software in examining the responses of the questionnaire. The test value was set at 3, which is the mean of a 5-point Likert Scale. When $p < 0.05$ and the T-value are positive, it is concluded that the respondents would regard the statement to be significantly important.

The results revealed that all the perceived needs for collaboration had a significance level of less than 0.01 at the 95% confidence level. This seems to suggest that all 12 reasons are responsible for successful collaboration. Apart

from responses from Section 1, all the 12 barriers in Section 2 also have significance levels which are less than 0.01. Therefore, the null hypothesis is rejected which means that all the potential barriers identified have significant effects in hindering the adoption of collaboration. Similarly, as for potential measures, the t-test results reveal that all 22 suggested strategies are perceived to be significant in engendering collaboration within construction industry.

Table 4.4: One Sample T-test on reasons for collaboration.

Ref.	Reason for collaboration	Test value =3	
		t-value	Significance (2-tailed)
R1	Better quality control	24.497	.000**
R2	Better time control	21.142	.000**
R3	Better cost outcome	19.710	.000**
R4	Reduction of conflict	12.198	.000**
R5	Innovation	17.809	.000**
R6	Long-term relationship	17.865	.000**
R7	Increased competitiveness	15.003	.000**
R8	Better safety performance	14.350	.000**
R9	Increased client satisfaction	17.595	.000**
R10	Risk sharing	13.490	.000**
R11	Effective problem solving	16.861	.000**
R12	New market opportunity	18.788	.000**

Note: **. The mean is significant at the 0.01 level of significant.

Table 4.5: One Sample T-test on barriers to collaboration.

Ref.	Barriers to collaboration	Test value =3	
		t-value	Significance (2-tailed)
B1	Adversarial environment	10.577	.000**
B2	Communication problem	16.857	.000**
B3	Lack of top management support	14.276	.000**
B4	Incompatible personalities and organisational cultures	16.194	.000**
B5	Lack of legislative regulations	9.801	.000**
B6	Lack of financial support	8.948	.000**
B7	Uneven of risk sharing	12.358	.000**
B8	Lack of commercial control	9.962	.000**
B9	Exclusion of key subcontractors	9.383	.000**
B10	Fragmentation of construction process	15.468	.000**
B11	Resistant to change current way of working	21.270	.000**
B12	Inadequate training and guidance	14.777	.000**

Note: **. The mean is significant at the 0.01 level of significant.

Table 4.6: One Sample T-test on effective strategies for collaboration.

Ref.	Effective strategies for collaboration	Test value =3	
		t-value	Significance (2-tailed)
S1	Early involvement of project stakeholders	18.407	.000**
S2	Effective Communication	29.789	.000**
S3	Top management commitment	21.744	.000**
S4	Choosing the right partners	17.905	.000**
S5	Team building	23.036	.000**
S6	Trust building	25.020	.000**
S7	Mutual objectives	29.201	.000**
S8	Collaboration workshops	13.759	.000**
S9	Involvement of facilitator	13.744	.000**
S10	Performance measurement	24.887	.000**
S11	Training and Education	20.612	.000**
S12	New form of contract	14.766	.000**
S13	Effective problem resolution	24.102	.000**
S14	Incentivisation	15.994	.000**
S15	Change of individual mind-set and attitudes	22.055	.000**
S16	Structured review meetings	13.879	.000**
S17	Access to new technology	18.477	.000**
S18	A clear definition of responsibilities	23.813	.000**
S19	Long-term perspective	25.930	.000**
S20	New organisation culture	19.097	.000**
S21	Availability of resources	22.133	.000**
S22	Colocation	16.258	.000**

Note: **. The mean is significant at the 0.01 level of significant.

4.6 Mean Ranking

Lu and Yan (2007) adopted the “mean score” method to determine the relative ranking of different partnering incentives, as suggested by both consultants and contractors from China. Likewise, the data collected from this research was analysed using the same technique. The mean values and standard deviations (SD) were computed by using the SPSS software. Later, the following step is to determine the relative ranking of each item by comparing the individual mean scores of every items. These rankings allow an effective cross-comparison of the relative importance of the factors as postulated by three different respondent groups (contractors, consultants and clients). The mean score and ranking for each construct are computed and shown in Table 4.7, 4.8 and 4.9, respectively. The results are ranked according to the same rule applied by Olanrewaju, Tan and Kwan's (2017). In the case when two or more factors have shared similar mean scores, factors with a smaller SD will be given the highest importance ranking whereas for factors that share an equal mean and SD will be appointed at the same rank.

4.6.1 Reasons for Collaboration

Table 4.7 provides the overall mean scores and ranking of potential reasons for collaboration. Overall, the mean scores range from 4.026 to 4.298. As Table 4.7 indicated, the top five most significant attributes that lead to willingness to collaborate are “better quality control” (mean = 4.298), “better time control” (mean = 4.238), “effective problem solving” (mean = 4.232), “better cost control” (mean = 4.232) and “increased client satisfaction” (mean = 4.185).

Time, cost, and quality, known as the “Iron Triangle”, have been the most popular metaphor used to represent the success criteria of a project (Pollack, Helm and Adler, 2018). In the other words, the successful completion of projects is highly depending on how well these criterions are balanced. It is then understandable that project stakeholders are primarily concerned with these three parameters. All of them perceive that better quality control as one of the top three reasons to collaborate. This result is akin to that of Ling, et al. (2014) who found that contracting parties in both Beijing and Sydney are radically driven to adopt RC practices with that aim to improve the quality of project.

A study by Hasmori, et al. (2018) found that contractors are the most responsible party that related to construction delays in Klang Valley. Hence, it is relatable that contractors perceive “better time control” as the most significant driver to collaboration. By entering a collaborative relationship, people should be aware of their duties and obligations without having to be referred or be reminded constantly. Each party has a role to play in ensuring that the project is completed on schedule (Rahman, et al., 2014). However, it is rather surprising that the clients and contractors ranked “better cost control” out of the top five reasons whereas the consultants assigned it at the highest rank. The results reflected that the clients and contractors may be more conscious about project quantity and time performance rather than cost. Ahmad, Saleh and Dash (2018) found that some of the clients criticized that even after entering into collaboration, their organization failed to finish the project within the agreed-upon budget and the final result was going overbudget. This result is consistent with the previous study reported by Challender, Farrell and Sherratt (2014) but conflicting with the conclusions reached by Jacobson and Choi (2008) in US which indicates partnering achieved a 7-26 % reduction in total project costs.

The result indicates that majority of the respondents perceive that effective problem solution as one of the top five drivers to collaboration. Mitkus and Mitkus (2014) stated that conflicts sometimes seem inevitable due to unsuccessful communication among the project stakeholders especially between clients and contractors. Thus, they perceive that collaborative partnering could bring about an improvement in communication between participants which could lead to effective resolution (Beach, Webster and Campbell, 2005). It is remarkable to note that the respondents ranked “risk sharing” as the least important need for collaboration. It is believed that the current standard form of contracts offered a relatively fair balance in terms of risk and liability distribution. (Nevstad, et al., 2018).

4.6.2 Barriers to Collaboration

To better understand the barriers to collaboration practices, certain factors that may affect collaboration were further investigated. Table 4.8 show that “resistant to change current way of working”, “communication problem” and

“incompatible personalities and organisational cultures” have the highest top three ratings. The remaining barriers are ranged from 3.71 to 4.09, suggesting that the significant impact of these barriers should not be overlooked.

“Resistant to change current way of working” is the most significant barriers identified among three groups. Similar result was found in Beijing where most of the clients from China are reluctant to deviate themselves from the conventional hierarchical position of control in their organizations (Ling, et al., 2014). This is akin to Ey, Zuo and Han (2014) who pointed out that clients are hesitant to move toward construction partnering because they are unwilling to give up some power which could weaken their position of authority on the project. Mollaoglu, Sparkling and Thomas (2015) claim that it can be an uphill task to reform an organisational culture that has been in place for decades. This supports the idea that, many contractors are comfortable with the old-fashioned ways of working, thus find it difficult to adapt with such unconventional scheme like collaborative contracting (Zhang, et al., 2020).

“Communication problem” was ranked the second with a mean value of 4.17. This finding reconfirms the statement that, poor communication has long been recognised as a major issue in the construction industry (Nawi, Baluch and Bahauddin, 2014). Based on a study conducted in Malaysia, the main root causes of poor communication on sites are work-related stress, workers’ attitude, misinterpretation of instructions, the operatives’ poor communication skills, linguistic barriers, and mismatch of communication styles between different parties (Olanrewaju, Tan and Kwan, 2017). Similarly, this problematic issue was also found in Australia where the lack of open communication is observed to contribute to the failure of construction partnering mainly due to the adoption of ‘‘win–lose’’ mentality among project participants (Ng, et al., 2002). To achieve successful collaboration, it is critical to establish effective communication channels. Regular meetings, for instance, is suggested as a good channel to improve communication efficiency (Van Gassel, Láscaris-Comneno and Maas, 2014).

One more noteworthy point is that most of the respondents ranked “incompatible personalities and organisational cultures” at higher rank where both contractor and client ranked it forth and the consultant fifth. This is understandable since it is an arduous task to let go the traditional mindset due

to the cultural complexity (Zhang, et al., 2020). Cultures incompatibility can be found between organisations due to their combative organisational forms, expectations, reward systems and organisation's goals (Harris and Lyon, 2013), causing it as a complex, and time-consuming process to alter. Also, construction parties from different organizations will have distinct personal motivations, as well as incompatible systems and routines. It is challenging to understand these motivations, which in turn obstruct the formation of collaboration (Ey, Zuo and Han, 2014; Bygballe and Swärd, 2019). Challender, Farrell and Sherratt (2014) further suggest that for collaborative practices to achieve, a cultural shift is required accompanied by the implementation of BIM as the necessary catalyst.

4.6.3 Effective Strategies to Collaboration

For the 22 strategies pinpointed, the mean scores covered a wide-ranging, from the lowest score of 3.907 for "involvement of facilitator" to the highest score of 4.477 for "effective communication". It is worth highlighting that although "communication problem" has been ranked as the second most significant barrier that limits the successfulness in realising collaboration, "effective communication" on the other hand was ranked as the most critical collaboration factor. This is consistent with that of the study by Soibelman, et al. (2011) indicate that one of the most critical prerequisite to achieve collaboration is efficient communication. In Malaysia, effective communication between project stakeholders was ranked at third significant collaboration factor out of 12 in a research by Liu, Rahmawati and Zawawi (2019) regarding the critical success factors of collaborative approach. The same result was reported by Chen and Chen (2007) in Taiwan. Likewise, Yeung, Chan and Chan (2007) regarded that for the intention of ensuring the success of project alliancing, parties from all levels must pay attention to open communication whether at personal level, business level, or operational level. Chan, et al. (2004) further listed out a lot of communication tools that can be adopted for facilitating collaboration among team members such as email contacts, face-to-face meeting, mobile phones, landlines, teleconferencing, fax, and online meeting tools.

Moreover, as indicated by the research findings, mutual objectives among project stakeholders were identified to be one of the major contributors to collaboration success. Only clients and consultants think that mutual objectives are one of the most significant strategies for collaboration where clients ranked it at first and consultants considered it second. The contractors did not seem to think that the alignment of partners' goal is one of the significant strategies as they rated it lower. This is further supported by Karlsson and Kindbom (2018) as one contractor highlighted that it is sometimes quite difficult to know what the client and the project owner really want. Thus, it is hard to gather a unifying vision from the project team due to the lack of integration. In essence, mutual goals that are commonly used include meeting about environmental rules, delivering the project on time and within budget, attaining good reputations of the partnered parties, enhancing cost-effectiveness, effective technology transfer and sharing of best work practices (Chen and Chen, 2007).

In overall, trust building is ranked as the third critical strategies to the development of collaboration practices with a mean score of 4.358. This item has been assigned a higher rank by both contractors and clients (second and fourth, respectively), but out of the top 10 strategies by the consultants. The discrepancy may be caused by their different areas of involvement in project activities. Törneman (2015) opined that design professionals often insist on creating innovation based on their professional logic without trusting the contractor input, which could hinder the intentions of adopting collaboration throughout entire team. On the contrary, the contractors and clients held different perspectives on this ranking. This is in line with the findings reported by Nevstad, et al. (2018) who believe that a collaborative relationship can be fruitful by developing trust between client and contractor sides without hidden agendas. In general, no successful strategic alliances can be established without trust (Yeung, Chan and Chan, 2007; Challender, Farrell and Sherratt, 2014).

Another point worth mentioning is that performance measurement was ranked as the fourth important factor that leads to collaboration success. This is similar to the findings of Yeomans, Bouchlaghem and El-Hamalawi (2006). They further suggest that the use of performance measurement should cover

wide range of site activities, in order to eliminate any unnecessary waste and unproductive activities. Measurable goals form the foundations performance measurement to determine and evaluate individual progress performance (Chan, et al., 2004). Liu, et al. (2015) mentioned that performance measurement in construction has been based on three levels: industry, corporate and project, with emphasis being placed on KPIs and PMSs. The common aspects for measurement include cost, project duration, quality of workmanship, health and safety, meeting specification, client's satisfaction, user's expectation and so on (Muhammad and Johar, 2017). Furthermore, Yeung, Chan and Chan (2007) stress that performance measurement should be widely developed to provide knowledge and feedback about how joint performance can be improved.

In addition, effective problem resolution is perceived as one of the most agreed strategies to develop collaboration which is ranked at fifth by the respondents. It was well-known fact that unanticipated problems, arguments, conflicts, misunderstandings, and disagreements are usual in a relationship. To address these problems, an effective problem resolution is needed, allowing the formation of collaborative relationship to be realised (Kumar, et al., 2017). This is in agreement with Sting, Mihm and Loch (2020) who emphasis that joint problem solving is an important enabler of collaboration. Joint problem solving enables simultaneous input from diverse parties who own different expertise or knowledge levels and thus unlock creativity, result in higher solution quality. Apart from that, it is believed that senior management also plays a vital role in facilitating the problem resolution process by jointly solve the issues that emerge in the collaborative arrangement rather than lip services (Akintoye and Main, 2007).

Involvement of facilitator is ranked last, despite a high mean value of 3.907. The similar result was found in the findings of Löfgren and Eriksson (2009) in Sweden. It reflects that the Malaysian construction practitioners were still unaware of the practice of partnering facilitators. Overall, the strategies listed in Table 4.9 are considered justified, as they have a collective mean value of almost 4, which is close to the satisfactory level (Ali, et al., 2010).

4.7 Kruskal Wallis Test

Since there are three categories of respondents (contractors, consultants, and clients) involved in the research, the Kruskal Wallis Test was applied to assess whether these three respondents groups had different perceptions on the relative importance of every single, non-normally distributed variable (McKight and Najab, 2010).

4.7.1 Reasons for Collaboration

The results show that the three parties share a common viewpoint on most of the variable ($p = 0.07–0.96$) at 95% level of significance. Nevertheless, the opinions of the contractors, consultants and clients do vary on the factors of "long-term relationship" ($p = 0.03$). The mean values allocated are 86.91, 68.78 and 69.94 by contractors, consultants, and clients, respectively. This finding reflects that most of the Malaysian contractors are driven to collaborate with the intention to maintain a long-term relationship with other construction parties. It is widely acknowledged that construction industry is continuously evolving with the expansions of new business strategies and technologies. Moreover, the number of construction firms in Malaysia has been exploded dramatically in recent times. Not to mention, the imbalance of development projects further added fierce competition to the industry (Mansor, Abdullah and Abidin, 2014). In view of this scenario, the contractors are understandably concerning with the formation of long-term partnership in order to be more competitive in this industry. This is further supported by Ali, et al. (2010), who found that there are numerous existing partnering arrangements in Malaysia comprising two or more local contractors as well as between local and international contractors. In contrast, the consultants and clients do not seem to be influenced much by the intense competitive nature of the industry. Thus, they do not rank the long-term relationship as one of the significant reasons for collaboration practices.

4.7.2 Barriers to Collaboration

The Kruskal-Wallis test is also adopted to compare the respondent groups' opinions towards the barriers to collaboration practices. Table 4.8 shows the outcomes of Kruskal-Wallis test. As all the significance value as presented in

Table 4.8 are greater than 0.05, the null hypotheses are accepted which indicate that with 95% of confidence level, there are no significant difference in perception between the clients, contractors, and consultants.

4.7.3 Effective Strategies to Collaboration

Kruskal-Wallis test is adopted to compare degree of agreement among three respondent groups with each of the 22 aspects of effective strategies. The results show that among all these strategies, "early involvement of project stakeholders" and "choosing the right partners" are statistically different in term of perception by clients, contractors and consultants at 95% of confidence level.

According to the results, there is contrasting ranking of "early involvement of project stakeholders" between the respondent groups. The contractors, consultants and developers rank it at 4^{th}, 18^{th}, and 9^{th}, respectively. It can be concluded that both contractors and clients are optimistic about involving project stakeholders in the early phase of the projects. This relates to the fact that early commitment allows contractors to optimally share and utilise the available resources for delivering a project with improved quality (Rahman and Alhassan, 2012). This in turn, improves client satisfaction. According to Aapaoja, Haapasalo and Söderström (2013), early involvement allows room for creative solutions and the intensive exchange of ideas. However, construction consultants may find it difficult to involve early the construction team. From a previous study conducted by Laryea and Watermeyer (2016), one of the interviewees highlighted that early contractor involvement (ECI) creates tension as each members wants to defend their turf. Consultants may feel uncomfortable at the early stages about a contractor making input into designs. The contractor and a consultant can probably clash over design ideas. Therefore, it may be difficult for some consultants to embrace and implement this kind of practice (Rahman and Alhassan, 2012).

Furthermore, the results indicate that the opinion across the respondent groups are statistically significant different towards the "choosing the right partners" as an effective strategy. The mean ranking analysis revealed that both contractors and consultants ranked this factor out of the top ten ranking while only the clients ranked it at fifth. According to Anvuur and

Kumaraswamy (2007), previous experiences and attitudes influence contact effects. Individuals with favourable past partnering experience are more likely to pursue further contact while parties who have past negative experience will tend to avoid. A previous study by Black, Akintoye and Fitzgerald (2000) revealed the clients' opinions of partnering after experiencing it were less favourable. As a result, clients generally have a negative expectation of partnering as they have failed on a bad note on pain experience. Therefore, it is understandable that clients are more sensitive toward the partner selection in view of the lesson learned before.

Table 4.7: Mean and Ranking of potential reasons (based on overall).

		Overall (N=151)		Kruskal-Wallis	
Ref.	Reasons of collaboration	Mean	Rank	Chi-square Value	Asymptotic significant
R1	Better quality control	4.298	1	0.503	0.777
R2	Better time outcome	4.238	2	5.320	0.070
R11	Effective problem solving	4.232	3	0.201	0.905
R3	Better cost control	4.232	4	0.218	0.897
R9	Increased client satisfaction	4.185	5	0.093	0.955
R12	New market opportunities	4.159	6	0.320	0.852
R6	Long term relationship	4.139	7	7.021	0.030*
R5	Innovation	4.073	8	2.415	0.299
R7	Increased competitiveness	4.053	9	0.605	0.739
R4	Reduction of conflict	4.046	10	2.733	0.255
R8	Better safety performance	4.033	11	1.610	0.447
R10	Risk sharing	4.026	12	4.839	0.089

Note: *. The mean difference is significant at the 0.05 level of significant.

Table 4.8: Mean and Ranking of possible barriers (based on overall).

		Overall (N=151)		Kruskal-Wallis	
Ref.	Barriers to collaboration	Mean	Rank	Chi-square Value	Asymptotic significant
B11	Resistant to change current way of working	4.252	1	0.123	0.941
B2	Communication problem	4.172	2	0.836	0.658
B4	Incompatible personalities and organisational cultures	4.093	3	3.094	0.213
B3	Lack of top management support	4.086	4	2.446	0.294
B12	Inadequate training and guidance	4.060	5	4.455	0.108
B10	Fragmentation of construction process	3.980	6	2.135	0.344
B7	Uneven of risk sharing	3.914	7	2.786	0.248
B6	Lack of financial support	3.748	8	0.627	0.731
B1	Adversarial environment	3.735	9	1.621	0.445
B5	Lack of legislative regulations	3.735	10	0.450	0.798
B8	Lack of commercial control	3.715	11	0.351	0.839
B9	Exclusion of key subcontractors	3.709	12	1.102	0.576

Note: *. The mean difference is significant at the 0.05 level of significant.

Table 4.9: Mean and Ranking of effective strategies for all categories.

Ref	Effective strategies for collaboration	Overall		Contractors		Consultants		Clients		Kruskal-Wallis	
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Chi-square	Asymp.
S2	Effective Communication	4.477	1	4.474	1	4.489	1	4.469	2	0.073	0.964
S7	Mutual objectives	4.404	2	4.368	7	4.378	2	4.469	1	0.670	0.715
S6	Trust building	4.358	3	4.456	2	4.133	13	4.449	4	5.011	0.082
S10	Performance measurement	4.344	4	4.404	5	4.356	4	4.265	10	1.209	0.546
S13	Effective problem resolution	4.338	5	4.439	3	4.333	7	4.224	12	1.881	0.391
S19	Long-term perspective	4.325	6	4.281	12	4.356	3	4.347	7	0.810	0.667
S3	Top management commitment	4.311	7	4.316	10	4.133	12	4.469	3	5.596	0.061
S18	A clear definition of responsibilities	4.305	8	4.386	6	4.356	5	4.163	14	2.633	0.268
S5	Team building	4.291	9	4.333	8	4.311	8	4.224	11	0.662	0.718
S21	Availability of resources	4.252	10	4.263	13	4.133	11	4.347	8	2.795	0.247
S15	Change of individual mind-set and attitudes	4.238	11	4.316	9	4.267	9	4.122	16	1.794	0.408
S11	Training and Education	4.232	12	4.211	15	4.333	6	4.163	15	1.182	0.554
S1	Early involvement of project stakeholders	4.225	13	4.404	4	3.911	18	4.306	9	6.183	0.045*
S20	New organisation culture	4.212	14	4.175	16	4.067	15	4.388	6	3.575	0.167
S4	Choosing the right partners	4.205	15	4.298	11	3.867	20	4.408	5	7.216	0.027*
S17	Access to new technology	4.139	16	4.158	17	4.200	10	4.061	20	0.734	0.693
S14	Incentivisation	4.106	17	4.035	19	4.067	14	4.224	13	2.004	0.367
S12	New form of contract	4.079	18	4.211	14	3.889	19	4.102	19	1.901	0.387
S16	Structured review meetings	4.026	19	4.035	20	3.933	17	4.102	18	0.551	0.759
S22	Colocation	4.013	20	3.965	21	3.978	16	4.102	17	0.976	0.614
S8	Collaboration workshops	3.980	21	4.070	18	3.867	21	3.980	22	1.304	0.521
S9	Involvement of facilitator	3.907	22	3.930	22	3.756	22	4.020	21	1.371	0.504

Note: *. The mean difference is significant at the 0.05 level of significant.

4.8 Spearman's Correlation Test

The statistical relationships between barriers and effective strategies of collaboration practices are measured by Spearman's non-parametric correlation analysis (Yap, Shavarebi and Skitmore, 2020). Spearman's rank correlation coefficient is a non-parametric test that is commonly used to measure the strength of the correlation between two variables (Hauke and Kossowski, 2011). Table 4.11 presents the results of the Spearman's correlation test. Each of the barriers was found correlated with at least five potential strategies. Communication problem (B2), uneven of risk sharing (B7) and fragmentation of construction process (B10) had the least relationship with the preventive strategies.

Trust building was observed as the most effective strategies with the greatest number of significant correlations (11). It is widely acknowledged that relations in the construction industry have always been executed in low trust settings, which is frequently condemned as the major source for the failures of collaboration (Ey, Zuo and Han, 2014; Meng, 2012). In light of this, Kwofie, Aigbavboa and Matsane (2018) elucidate that trust development plays an important role in eliminating and ameliorating the adversarial culture within construction environment through developing of positive relationships. A previous study by Buvik and Rolfsen (2015) shed light on this issue and found that trust-based relationship stimulates the integration of different disciplines into a cohesive unit, increasing cross-functional collaboration in the team. The critical role of "trust building" in facilitating collaboration is identified in the previous studies. Nevstad, et al.'s (2018) study of project partnering in the Norwegian construction industry, for example, revealed that trust building between both client and contractor sides is a prominent factor to achieve partnering success. A similar finding can also be found in Hong Kong (Rahman and Kumaraswamy, 2008) and Thailand (Panahifar, et al., 2018) where trust-based relationship noticeably contributed to collaboration efficiency. Thus, the trust development within construction team was considered as one of the most effective strategies which could stimulate the collaboration practices in construction industry.

Haugseth, et al. (2014) added that involvement of external facilitator is extremely important to the stage of partnering formation especially when the project participants are lack of partnering experience. Moreover, professional neutral third parties are able to provide valuable feedback to the project team during partnering workshops. By doing this, it could help to make sure that the project teams are

aligning the project goals with their respective actions (Sparkling, Mollaoglu and Kirca, 2017). Similarly, Zuo, et al. (2013) study on Chinese construction industry highlighted the critical role of facilitators for the implementation of partnering. The researcher even suggest that the facilitator needs to be fair-minded to all parties and capable of developing an ideal project environment which promotes innovation, cooperation, and teamwork. Furthermore, foreign experts are strongly recommended to assist the implementation process due to their comprehensive related experience and expertise, especially on the facilitator role. This is further justified by Hietajärvi and Aaltonen (2018), according to them, strong connections to foreign countries have laid the foundation for development of collaborative identity in terms of the characteristics and processes.

Moreover, effective problem-solving was also known as a success factor for collaboration which significantly correlated with the potential barriers with significant correlation number of 11. Formulations used to describe this factor vary from “joint risks”, “conflicts” to the broad “problems” (Nevstad, et al., 2018). According to Kumar, et al. (2017), presence of conflicts between partnered parties can hamper sharing of ideas and resources, which will demoralize the purpose of the collaboration. To tackle such problems, an effective problem-solving mechanism is extremely crucial for collaboration to be endured between project teams. When problematic events arose, resolving tense relationships is important to avoid a total breakdown of the interaction and work termination between stakeholders (Faris, Gaterell and Hutchinson, 2019). In a collaborative arrangement, collaborators are better able to anticipate potential problems and subsequently develop an action plan to prevent them or mitigate their effect (Ling, et al., 2014). Also, it is important that disputes are resolved at the lowest possible organisational level, to not affect the effectiveness of the project (Wøien, et al., 2016). In Norway, Hosseini, et al. (2016) conducted a case study and identified conflict resolution mechanism as one of the core collaborative tools. Such mechanism can be implemented through the formation of a steering group or an external coordinator for regulating disputes.

There are a total of 147 numbers of relationships between the barriers to collaboration practices and their effective strategies. This result also shown that “resistant to change current way of working” (B11) are significantly correlated with “new organisation culture” (S20).

In this research, resistant to change current way of working was ranked at first place in overall as the major barrier to collaboration in perception of Malaysian construction practitioners. Due to existence of strong relationship, it could be believed that new organisation culture is one of the crucial remedial measures to overcome the barrier more effectively as compared to other effective strategies. Likewise, Olatunji, Olawumi and Aje (2017) also emphasized “refusal to change” as a huge challenge to the collaborative contracting. In the meantime, official data from the International Labour Organization (2020) shows that there are about 1.98 million foreign labours have been employed in Malaysia. In particular, the construction industry relies substantially on foreign workers which results in poor coordination and cultural constraints between foreign and local workforces (Yap, Low and Wang, 2017) due to the significant differences in term of their customs, cultures, and working practices (Zhang, et al., 2020). In view of the above, Keys, Silverman and Evans (2017) pointed out the importance of organizational dynamics fronting interprofessional collaboration. It is advisable to develop a supportive environment which could promote partnering culture in the project. Nevstad, et al. (2018) suggest that the organization should build a project partnering culture, both internally and externally. Instilling a positive culture not only could alleviate negative outcomes, but also help people shift their rigid mindset for creating a shared culture and understanding of joint expectations and values (Jacobsson and Roth, 2014).

Table 4.10: Correlation between Barriers and Effective Strategies of Collaboration Practices.

Barriers / Strategies	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Total sig.
S1						0.201*			0.162*		0.361**	0.186*	4
S2		0.165*	0.188*								0.273**	0.245**	4
S3			0.235**	0.233**		0.247**		0.178*			0.359**	0.215**	6
S4				0.230**							0.330**	0.354**	3
S5											0.306**	0.183*	2
S6	0.193*	0.261**	0.309**	0.367**		0.244**	0.200*	0.218**	0.168*	0.243**	0.385**	0.292**	11
S7		0.281**	0.248**	0.186*			0.172*				0.351**	0.267**	6
S8	0.260**			0.248**	0.315**	0.250**	0.176*	0.280**	0.217**		0.268**	0.334**	9
S9	0.284**		0.196*	0.201*	0.313**	0.295**	0.168*	0.250**	0.275**	0.160*	0.163*	0.213**	11
S10		0.234**	0.234**		0.174*	0.246**		0.239**	0.251**	0.245**	0.219**	0.184*	9
S11	0.235**		0.280**	0.177*	0.181*			0.181*	0.162*		0.226**	0.234**	8
S12	0.261**			0.217**				0.209*			0.323**		4
S13	0.192*	0.241**	0.199*	0.179*	0.169*	0.233**		0.172*	0.224**	0.218**	0.408**	0.250**	11
S14	0.218**		0.191*		0.228**	0.170*					0.173*		5
S15			0.188*	0.314**	0.168*	0.229**		0.265**	0.225**		0.290**	0.210**	8
S16	0.219**	0.212**		0.216**	0.234**		0.196*	0.302**	0.198*		0.185*	0.245**	9
S17	0.226**	0.190*	0.201*	0.166*	0.192*			0.300**	0.182*	0.217**	0.219**	0.242**	10
S18				0.163*							0.216**		2
S19		0.198*	0.202*	0.185*		0.193*					0.323**	0.162*	6
S20	0.171*		0.348**	0.222**		0.258**				0.200*	0.395**	0.245**	7
S21			0.177*	0.179*		0.222**		0.192*	0.200*		0.267**	0.211**	7
S22			0.198*	0.220**	0.203*	0.178*						0.194*	5
Total sig.	10	8	15	17	10	13	5	12	11	6	21	19	

Note: **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Note to Table 4.10:

B1- Adversarial environment; B2- Communication problem; B3- Lack of top management support; B4- Incompatible personalities and organisational cultures; B5- Lack of legislative regulations; B6- Lack of financial support; B7- Uneven of risk sharing; B8- Lack of commercial control; B9- Exclusion of key subcontractors; B10- Fragmentation of construction process; B11- Resistant to change current way of working; B12- Inadequate training and guidance.

S1- Early involvement of project stakeholders; S2- Effective Communication; S3- Top management commitment; S4- Choosing the right partners; S5- Team building; S6- Trust building; S7- Mutual objectives; S8- Collaboration workshops; S9- Involvement of facilitator; S10- Performance measurement; S11- Training and Education; S12- New form of contract; S13- Effective problem resolution; S14- Incentivisation; S15- Change of individual mind-set and attitudes; S16- Structured review meetings; S17- Access to new technology; S18- A clear definition of responsibilities; S19- Long-term perspective; S20- New organisation culture; S21- Availability of resources; S22- Colocation.

4.9 Factor Analysis

Factor analysis is a statistical technique used to identify the underlying dimensions that can be used to represent relationships among sets of interrelated variables (Chan, et al., 2004). In this research, it was conducted to reduce the 22 items (effective strategies for collaboration practices) into a small number of representative border factors. The extraction and rotation of the factors were launched to generate a small number of factors and obtain a clearer picture of what these factors represent.

Prior to the extraction of the constructs, there are some tests which must be conducted to examine the adequacy of the sample and the suitability of data for Factor Analysis for instance, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. According to Kaiser (1974), KMO value more than 0.90 indicates the sample is marvellous; between 0.60 to 0.89 is considered adequate; value below 0.59 is miserable, where 0.49 is the borderline of acceptability. Based on Table 4.12, the KMO value of this research is 0.839 which greater than the minimum threshold of 0.50 and thus is considered highly acceptable. Moreover, the Bartlett test of sphericity is 1543.631, and the associated significance level is 0.000, which indicates that the population correlation matrix is not an identity matrix (Hadia, Abdullah and Sentosa, 2016). Therefore, this research can be moved forward for Factor Analysis.

Figure 4.1 shows the scree plot of the factor analysis for each driving factor. The scree plot graphs the eigenvalue against the number of components. It shows a clear cut-off between the steep slope of the major factors and the gradual levelling off of the remaining factors. This gradual trailing off is termed the "scree" because it resembles the rubble that forms at the base of a mountain. Five principal components are extracted by specifying eigenvalues greater than one.

Principal component analysis and varimax rotation method were carried out through the SPSS program to extract highly correlated factors into a small number of major components dimensions. Table 4.12 contains the details and initial statistics for each of the 22 factors. The total variance explained by each factor was listed in the column next to factor loading. Five components were emerged from this analysis and together accounted for 64%

of the total explained variations. The percentage variation explained by the components are 16%, 14%, 13%, 11%, and 10%. Although opinions among researchers differ, Howard (2016) recommends that the most popular cut-off for “good” factor loadings onto a primary factor is 0.4. Clearly, since all factor loadings were greater than 0.4, it can be deducted that the loadings and the interpretation of the factors extracted were reasonably stable. The factors are discussed in the following sections.

Table 4.11: KMO and Bartlett's Test

Parameter		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.839
Bartlett's Test of Sphericity		
	Approximate Chi-Square	1543.631
	Degree of freedom	231
	Significance	0.000

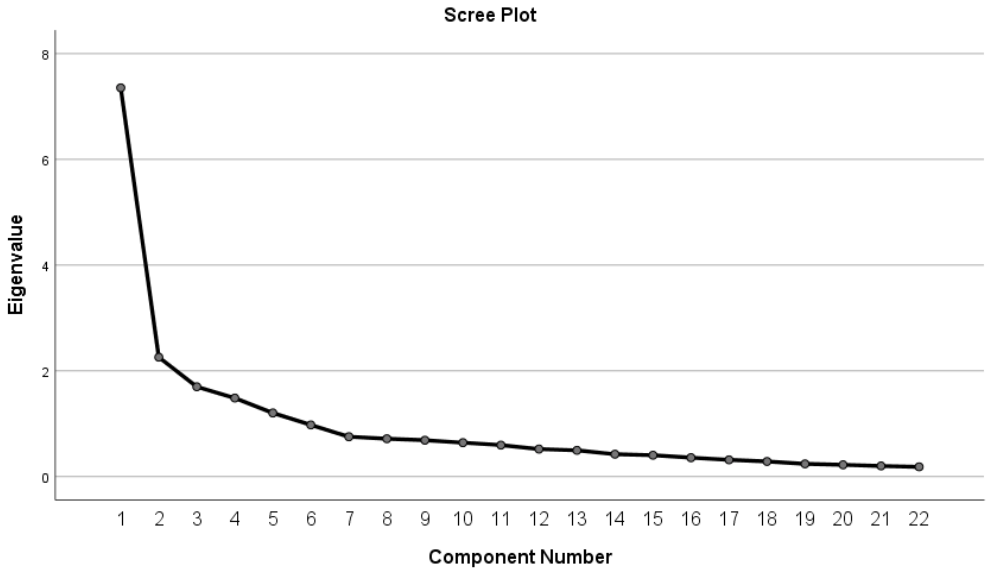

Figure 4.1: Screen plot for 22 items.

Table 4.12: Factor loadings and variance explained.

Effective Strategies for collaboration	Factor Loading	Variance explained (%)
Factor 1: Team Integration		15.739
Effective Communication	0.801	
Mutual objectives	0.770	
Change of individual mind-set and attitudes	0.673	
Team building	0.624	
A clear definition of responsibilities	0.603	
Long-term perspective	0.596	
Trust Building	0.473	
Factor 2: Collaborative Tools and Mechanisms		13.511
Involvement of facilitator	0.854	
Collaboration workshops	0.791	
Colocation	0.780	
Structured review meetings	0.720	
Factor 3: Leadership and Partners Involvement		12.825
Top management commitment	0.804	
Choosing the right partners	0.779	
Early involvement of project stakeholders	0.686	
Availability of resources	0.640	
New organisation culture	0.513	
Factor 4: Systematic Process		11.161
Effective problem resolution	0.792	
Performance measurement	0.776	
Access to new technology	0.602	
Factor 5: Training and Motivation		10.376
Incentivisation	0.800	
Training and Education	0.760	
New form of contract	0.735	

Factor Grouping Description

Factor 1: Team Integration

This factor represents 15.74 % of the total variance with effective communication attaining the highest factor loading (0.801), followed by mutual objectives (0.770). It explains the criticality of team integration for engendering collaboration in construction industry. It is widely known that construction project team is formed by multiple disciplines with different professionalism, knowledge, and experience (Shaikh and Waghmare, 2019). Team collaboration, however, is not an easy task because participants need to deal with diversity and engage in cross-boundary working (Koolwijk, Oel and Gaviria Moreno, 2020). From this perspective, Ibrahim, Costello and Wilkinson (2018) prompt the need of an integrative environment as it promotes a collaborative culture and the continuity of equitable relationships among project team. Faris, Gaterell and Hutchinson (2019) added that improving relationships and moving away from a win-lose culture will lead to significant performance improvements.

According to Choi, et al. (2019), teamwork, collaborative culture, common objective, equitable team relationships, trust, and respect, are the main drivers influencing the development of team integration. It is this joint responsibility and sense of mutuality that leads to the development of a teamwork culture and thus fosters effective collaboration. As underscored by Suprapto, Bakker and Mooi (2015), focusing on relational attitudes (soft and people aspects) as well as the team integration tends to produce better project outcomes because it creates a collaborative system. The determinants of soft and people aspects include mutual commitment, trust, and the recognition of win–win attitudes. These are consistent with Eriksson's (2010) assertion that human-related soft components are the key components of collaborative relationship. Clearly, these studies bring to light that managing of a well-functioning team is vital for engendering collaboration within construction industry.

Factor 2: Collaborative Tools and Mechanisms

This factor accounts for the second largest variation of 13.51% and comprises four attributes namely "involvement of facilitator", "collaboration workshops", "colocation" and "structured review meetings" with factor loadings ranging from 0.720 to 0.854. As highlighted by Merschbrock and Munkvold (2015), a collaborative work environment requires structures, rules and practices that promote cooperation. Also, partnering tools such as partnering workshops, review meetings, team building, facilitator, joint office and the like were identified as the most effective tools in instilling, fostering, and maintaining the partnering spirit (Bayliss, et al., 2004; Hosseini, et al., 2018). For example, partnering workshops and regular meetings are often used to effectuate a cohesive and cooperative atmosphere which allow participants to open communicate (Zhang, 2008). According to Eriksson (2008), little or none use of collaborative tools implies market relationships, leading to competition, while extensive use implies bilateral governance, leading to collaboration. It is therefore presumed that application of collaborative tools and techniques is essential to bring about changes in motivations, attitudes, and expectations (Bresnen and Marshall, 2002).

As pointed out by Lavikka, Smeds and Jaatinen (2015), contractual coordination alone is not enough for creating successful collaborative work, but procedural coordination is also needed during the projects. Therefore, the application of integrative mechanisms across team boundaries are essential with a view to bridging communication gaps and facilitate problem solving (Mirani, 2007). Likewise, Bresnen and Marshall (2002) underlined that formal integrative mechanisms, such as charters, dispute resolution procedures, teambuilding workshops and the use of facilitators are seen as central to the inculcation of collaborative norms and values.

Factor 3: Leadership and Partners Involvement

Factor 3 consists of five items and accounts for approximately 13% of the total variance. The items are related to top management commitment, choosing the right partners, early involvement of project stakeholders, availability of resources, and new organisation culture, all with a factor loading exceeding 0.500. Top management support is widely recognised to be needed for

developing collaborative environment (Yap, Leong and Skitmore, 2020). In the same vein, Suprapto, Bakker and Mooi (2015) asserted that without managerial attention, project teams often face difficulty in incorporating the new vision of collaborative arrangements into their daily practice. Essentially, there is need of a leader who capable of explaining collaboration as a culture or the way the organization works for the team members (Faris, Gaterell and Hutchinson, 2019). In addition to leadership capabilities, top management commitment was also important. Hietajärvi and Aaltonen's (2018) study on an alliance project in Finland revealed that when the project manager led by example and practised collaboration and openness, people are more likely to respond accordingly which could strengthen the collaborative identity and secure people's commitment to the project.

On the other hand, Akintoye and Main (2008) noted that commitment of the partnered parties is equally important in engendering collaboration. People with inappropriate attitudes will not be adapted into collaborative partners easily. Hence, the selection of right partners is the critical prerequisites to facilitate a collaborative project climate, by sorting out unqualified participants (Eriksson, Nilsson and Atkin, 2008). Equally important was that key actors must be involved as early as possible during the project especially main contractors (Lahdenperä, 2012). As highlighted by Nevstad, et al. (2018), early involvement is the key in building good relationships. On the contrary, too late involvement might cause misunderstandings, because participants do not know the people they are going to collaborate with enough.

Factor 4: Systematic Process

The fourth factor extracted with total variance of 11.161% containing three important attributes: "effective problem resolution", "performance measurement" and "access to new technology", with factor loadings of 0.792, 0.776 and 0.602, respectively. This factor indicates that every construction project needs to have a systematic process to solve conflicts, evaluate performance, and support technological improvement. In case of a collaborative project, it is common to see some of the systems and processes are fatally misaligned and all parties do not recognize that until the whole

project is doomed (Love, Mistry and Davis, 2010). Therefore, planning a systematic way to govern projects in achieving effective collaboration is extremely essential to avoid suboptimal outcome. A systematic process can enhance confidence and certainty among involved parties (Faris, Gaterell and Hutchinson, 2019).

It is widely known that construction industry is highly susceptible to conflict and dispute as numerous stakeholders from multiple disciplines are typically involved in a project. In view of this situation, a predetermined method of dispute resolution was recommended by Haugseth, et al. (2014) so that problems can be resolved at the lowest possible level thereby minimising disputes. Moreover, it is important that involved parties need to agree on a systematic way that could help to evaluate project performance. For example, Tabassi, et al. (2011) highlighted the importance of performance measurement as a systematic approach to monitor improvements or lack of improvements among practitioners. Having a standardized system for measuring project performance can provide an insight into the performance of a process and, hence, contribute to efficient and effective decision making as well as successful collaboration (Ibrahim, Costello and Wilkinson, 2015). On the other hand, the adoption of new technological systems such as BIM has also been a prime concern for encouraging the integrated roles of all stakeholders in a project (Gardezi, et al., 2014). Liu, Nederveen and Hertogh (2016) defined BIM as a process rather than just as software which allow information transfer, knowledge creation, technological coordination and resource allocation within project team to operate more systematically.

Factor 5: Training and Motivation

The fifth underlying factor accounted for 10.38% of the total variance, consists of “incentivisation”, “training and education” and “new form of contract”. This factor justifies the importance of the training and incentive to collaboration practices. All factors achieve factor loadings above 0.50 which signify high communalities. Human resources are valuable to all sectors, especially to a labour-intensive sector like the construction industry. In this regard, a powerful human resource development (HRD) system is a critical strategy for construction companies in achieving successful collaboration. A

previous study conducted by Tabassi, et al. (2011) showed that effective training and motivation of employees at all levels are the key component in supporting the achievement of business strategies and teamwork improvement. However, Abdul-Rahman, et al. (2006) reveal that Malaysian construction companies are reluctant to invest on education and training of their employees. As a result, inadequate knowledge and understanding of conceptual framework inhibit the implementation of collaboration arrangement. This notion is further reinforced by findings of (Gunduz and Abdi, 2020).

Taking this into consideration, Ng, et al. (2002) suggested that client should implement comprehensive staff training and guidance during the project partnering arrangement, especially with inexperienced contractors to ensure they have a thorough understanding of the partnering requirements and other key attitudinal qualities. It is sad but true that most of the construction workforces in Malaysia are unskilled without necessary knowledge (Manap, Mohd Noh and Syahrom, 2017). Therefore, Faris, Gaterell and Hutchinson (2019) suggest that research centres and universities could help in increasing awareness towards collaborative approaches and providing training courses for those construction practitioners to gain the required skills. In line with training practices, motivation has also played a significant role in collaboration effectiveness. Tang, Duffiel and Young (2006) pointed out that incentives may create strong motivations for participants as well as builds a more proactive, cooperative relationship between the contracting parties. In contrast, if there is a lack of appropriate rewards and support, it is very easy for team members to lose interests in measuring and improving their performance (Meng, 2012).

4.10 Summary

In short, the results of this study were generated based on the responses collected from 151 construction practitioners in Malaysian construction industry within Klang Valley region, representing an overall response rate of 40.3%. The responses were analysed with Cronbach' Alpha Reliability Test, Mean Ranking, Kruskal-Wallis test, One Sample t-test, Spearman' Correlation Test and Factor Analysis. The result in reliability test indicated that the data gathered in this research were reliable. Moreover, Kruskal-Wallis analysis revealed that there were significant differences on the reasons for collaboration

and effective collaborative strategies based on the perception of different respondent groups (contractor, consultant, and client). Spearman's correlations test showed that there were significant relationships between the barriers and effective strategies for collaboration in construction industry. Moreover, factor analysis was employed and successfully identified five underlying factors for effective collaboration: (1) team integration; (2) collaborative tools and mechanisms; (3) leadership and partners involvement; (4) systematic process; and (5) training and motivation. Meanwhile, the top three most significant barriers for collaboration were resistant to change current way of working, communication problem and incompatible personalities and organisational cultures. On the other hand, better quality control, better time control as well as effective problem solving were perceived as top three reasons lead to collaboration in construction industry. Nevertheless, the top 5 potential collaborative strategies were obtained including effective communication, mutual objectives, trust building, performance measurement, and effective problem resolution.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter five presents the conclusions of whole study by summarising the major findings in accordance with the research objectives which has been discussed earlier in the study. At the end of this chapter, research's contributions and limitations of current work are highlighted followed by the recommendations of the researcher for future work.

5.2 Conclusions

In recent years, Malaysian construction industry has been generally regarded underperforming, inefficient, unproductive and wasteful. To fill in this gap, effective collaboration has been promoted as an ideal solution of ameliorating poor project performance while minimising hostility within construction industry. This study was therefore been carried out to explore the potential drivers, critical barriers, and effective strategies for engendering successful collaboration in Malaysian construction industry. First of all, a thorough literature review was carried out to pinpoint the research problem and objectives. Following this, 12 reasons, 12 barriers, as well as 22 potential strategies were identified. After that, cross-sectional questionnaire surveys were disseminated to glean local information and perceptions of construction professionals of the issues associated with collaboration. Ultimately, a total of 151 responses were collected and analysed.

To this end, the following research objectives were achieved.

Objective I: To identify the need for collaborative working in construction projects.

The first objective of this paper aims to identify the reasons for collaboration in a project-based construction setting. The findings revealed (1) better quality control; (2) better time control; (3) effective problem solving; (4) better cost

control; and (5) increased client satisfaction as the five main drivers to collaboration. This implies that the triple constraint of time, cost, and quality has been the prime concern for the respondents in cultivating construction collaboration. Additionally, the Kruskal-Wallis test revealed that there were significant differences in perception of the certain driver which is long-term relationship by the respondent groups. It was believed that such discrepancies were caused by divergent accountabilities of the groups in the construction projects.

Objective II: To investigate the barriers to collaboration in construction projects.

The potential barriers were investigated and ranked in the research. The top five significant barriers as perceived by the construction players in Malaysia were (1) resistant to change current way of working; (2) communication problem; (3) incompatible personalities and organisational cultures; (4) lack of top management support; and (5) inadequate training and guidance. Surprisingly, the Kruskal-Wallis test showed that all respondent groups were having homogeneous perception on the potential barriers of collaboration in construction industry.

Objective III: To explore effective strategies to engender collaboration in the project-based construction setting.

Moreover, to accomplish third objective for this study, 22 effective strategies to collaboration were identified through the review of existing literature. In the Section C of questionnaire survey, it required the respondents to rank the effectiveness of the 22 strategies listed. In short, the top five strategies to facilitate collaboration are: (1) effective communication, (2) mutual objectives, (3) trust building, (4) performance measurement and (5) effective problem resolution. Besides, factor analysis was conducted to unearth the underlying factors for collaboration success. To this end, the exploratory factor analysis revealed five underlying factors, namely, (1) team integration; (2)

collaborative tools and mechanisms; (3) leadership and partners involvement; (4) systematic process; and (5) training and motivation.

In addition, the correlation between potential barriers of collaboration and their effective strategies were exanimated by using Spearman's Correlation Coefficients test. There are a total of 147 numbers of relationships have been identified within all these variables. This result showed that resistant to change current way of working (B11) are significantly correlated with new organisation culture (S20). It could be believed that adopting a new organisation culture can radically alter the existing way of working into a new collaborative way as compared to other listed strategies. Among all these strategies, "team building" and "a clear definition of responsibilities" had the least correlation with the potential barriers. It is advisable to pay more attention onto these strategies in the future studies.

5.3 Research Implication

The findings of this study contribute with some practical implications. This research examines the drivers and potential barriers of collaborative approach. Particularly, the results of this study are believed to be informative and offer deeper insight for the construction industry professionals in improving their awareness and comprehension of the looming obstacles for effective collaboration. Further, the findings highlight that in order for construction collaboration to succeed, certain conditions must be met, in particular good communication, mutual objectives, trust building, performance measurement, and effective problem resolution should be prioritized. It is believed that integrating these strategies into collaboration relationship can bring significant benefits to the entire construction industry, for instance, a non-adversarial environment, increased client satisfaction, time and cost saving, and better project quality. Clearly, this study paints a picture of an industry trying to strengthen its ability to effectively collaborate.

It is worth highlighting that Malaysian construction practitioners focused too much on short-term competition rather than the long-term collaborative relationships. Given that project performance is highly

associated with collaboration among project teams, industry practitioners shall be ready and aware of the effective strategies to successful collaboration in order to safeguard the overall project performance. Albeit the empirical data were collected in Malaysia, the results should be applicable for construction industry in other countries. This is due to the fact that problems faced by the construction industry are fairly universal across national borders.

In addition to organisation structure itself, training providers and Malaysia authorities can be informed through this study about their roles in engendering collaboration. On the other hand, it could also serve as a guide or a point of reference for concerned authorities toward policy development. It was suggested that enforcement of regulation by the policy makers together with training program and incentive mechanism are the ideal ways to stimulate collaborative practices. Furthermore, universities and research institutes shall be alerted to raise awareness of the issues of collaboration by organizing series of training programme and workshops. To that end, this research will act as a foundation for both academicians and researchers as it provides a clear picture of the current status of the Malaysian construction industry. This is likewise beneficial for other researchers to have a better understanding on relevant topic for future research.

5.4 Research limitations

Albeit the research has achieved its objectives successfully, there are several inevitable limitations should be noted associated with this study. Most importantly, the samples selected for this study were specifically restricted to construction professionals from Klang Valley area due to the time limit, as a result, the outcomes obtained in this study may not be completely generalizable to represent the Malaysian construction industry as a whole.

Second, due to the Covid-19 pandemic, internet-based survey has become an important and only tool for questionnaire distribution instead of paper-based questionnaires. This method was difficult in getting access to certain types of participants, such as those who do not have internet access, the non-tech savvy respondents or those elderly and people who live in remote areas. Moreover, it was proven that digital surveys led to medium to low

response rate and lengthy response period as people may feel uninterest or may accidently ignore the survey. Nonetheless, at the end of the survey, the researcher was able to achieve sufficient amount of sample size by actively approaching potential participants via various distribution channels such as LinkedIn, Facebook and Email. In that case, writing an effective follow up email was also another strategy used to get the responses.

According to Rice, et al. (2017), the ability of a researcher to orally advise and guide respondents during the answering process could significantly improve the participants' comprehension of the task at hand. Online correspondence, on the other hand, makes communication far more complicated, where the researchers could not capture verbal and non-verbal cues of the participants, therefore limited the researcher's ability to ensure respondent comprehension of questions. Generally, a short and brief instruction was provided at the beginning of each question to guide participants through the questionnaire.

5.5 Recommendations for future work

As aforementioned, there are some limitations which are not able to get covered in current research. In light of this, this section unfolds several recommendations in order to rectify problems with the current research for future development. To begin with, it should be noted that the findings of this study are only valid in Malaysia's Klang Valley region. Therefore, it would be worth continuing similar study across a broad geographic area to verify if the results observed in this study hold elsewhere to accurately represent the Malaysian construction industry as a whole.

Without someone to verbally explain the questionnaire fully, respondents may have trouble grasping the meaning of some questions which cause the results can be very subjective. As mentioned earlier, accuracy of data may vary depending on survey length. Taking these problems into consideration, the best way to tackle these pitfalls is to create short and simple questions that are easy to understand to prevent fraudulent data. Additionally, researchers must be very consistent and precise in their instructions, while sill being mindful that certain respondents may only read the first few sentences or

miss the instructions entirely. Therefore, it is advisable to carry out a few practice or screening sessions prior to progress to the actual assessment.

Finally, this research does emphasis some critical barriers of effective collaboration. It was clear from the research that reluctant to change current way of working was found as the major obstacles which hamper collaboration in the construction industry. Therefore, it is imperative to change the mindset of the project stakeholders to reduce the gaps between diverse professionals in order to foster a collaborative culture. It is suggested that top management should take the lead in bringing about a shift in mindsets and cultures. They should have an in-depth understanding and equip themselves with technical knowhow that enabling effectively collaborate, and then driven the practitioners to a greater awareness of collaborative relationship.

Although this research has contributed to a fresh insight of the collaborative strategies in Malaysian construction industry, it is clear that many other factors unmeasured in this research will be related, and further research will be needed to identify the underneath factors. In the future, it might be worthwhile to conduct a series of comparative case studies on various collaborative works to validate the applicability and reliability of the critical collaborative strategies identified in this study. It is recommended to carry out face-to-face interviews with the local experts and professionals from different disciplines to gain deeper insight into current status of construction collaboration issues. Last but not least, a larger sample size should be engaged, and the study should also be extended outside the Malaysian context to examine the similar issues within the other countries. The best collaboration practice found in the future studies can then be introduced and employed as a benchmark measure to enhance the collaboration practices in Malaysian construction industry.

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APPENDICES

APPENDIX A: Questionnaire

COLLABORATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY: INVESTIGATING WHAT, WHY AND HOW

Dear Sir / Madam,

I am a final year undergraduate student who is currently pursuing the Bachelor of Science (Hons) Quantity Surveying from University Tunku Abdul Rahman (UTAR) Sungai Long. I am currently working on my final year project on the title of "Collaboration in The Malaysian Construction Industry: Investigating What, Why and How". The purpose of this survey is to examine the needs, access the barriers and explore the effective strategies for the collaborative practices in the Malaysian Construction Industry. The target respondents for this research are limited to those construction professionals from Klang Valley area only.

This questionnaire consists of FOUR (4) sections, which will take approximately 5 - 10 minutes to complete. I deeply appreciate your help in participating in this survey, your participation will greatly contribute to the success of the survey.

All the survey responses given will be strictly confidential and remained anonymous for academic purpose only. If you have any enquiry about the survey, please do not hesitate to contact me at 018-6634137 or by email at sinying9817@1utar.my.

Thank you so much for your time.

Yours faithfully,

Lim Sin Ying

Section A: Needs of Collaboration in Construction Industry

To your best knowledge, how much do you agree with these reasons to establish collaborative practices in Malaysian construction industry?

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Better quality control	☐	☐	☐	☐	☐
Better time control	☐	☐	☐	☐	☐
Better cost outcome	☐	☐	☐	☐	☐
Reduction of conflict	☐	☐	☐	☐	☐
Innovation	☐	☐	☐	☐	☐
Long-term relationship	☐	☐	☐	☐	☐
Increased competitiveness	☐	☐	☐	☐	☐
Better safety performance	☐	☐	☐	☐	☐
Increased client satisfaction	☐	☐	☐	☐	☐
Risk sharing	☐	☐	☐	☐	☐
Effective problem solving	☐	☐	☐	☐	☐
New market opportunity	☐	☐	☐	☐	☐

Section B: Barriers to Collaboration in Construction Industry

How much do you agree with these barriers that hindered collaborative practices in Malaysian construction industry?

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Adversarial environment	☐	☐	☐	☐	☐
Communication problem	☐	☐	☐	☐	☐
Lack of top management support	☐	☐	☐	☐	☐
Incompatible personalities and organisational cultures	☐	☐	☐	☐	☐
Lack of legislative regulations	☐	☐	☐	☐	☐
Lack of financial support	☐	☐	☐	☐	☐
Uneven of risk sharing	☐	☐	☐	☐	☐
Lack of commercial control	☐	☐	☐	☐	☐
Exclusion of key subcontractors	☐	☐	☐	☐	☐
Fragmentation of construction process	☐	☐	☐	☐	☐
Resistant to change current way of working	☐	☐	☐	☐	☐
Inadequate training and guidance	☐	☐	☐	☐	☐

Section C: Effective Strategies for Collaboration in Construction Industry

In your perception, do you agree that the following strategies able to help in engendering collaborative practices in Malaysian construction industry?

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Mutual objectives	☐	☐	☐	☐	☐
Choosing the right partners	☐	☐	☐	☐	☐
Effective Communication	☐	☐	☐	☐	☐
New organisation culture	☐	☐	☐	☐	☐
Top management commitment	☐	☐	☐	☐	☐
Availability of resources	☐	☐	☐	☐	☐
Team building	☐	☐	☐	☐	☐
Early involvement of project stakeholders	☐	☐	☐	☐	☐
New form of contract	☐	☐	☐	☐	☐
Structured review meetings	☐	☐	☐	☐	☐
Collaboration workshops	☐	☐	☐	☐	☐
Involvement of facilitator	☐	☐	☐	☐	☐
Effective problem resolution	☐	☐	☐	☐	☐
Access to new technology	☐	☐	☐	☐	☐
Performance measurement	☐	☐	☐	☐	☐
Trust Building	☐	☐	☐	☐	☐
A clear definition of responsibilities	☐	☐	☐	☐	☐
Incentivisation	☐	☐	☐	☐	☐
Change of individual mind-set and attitudes	☐	☐	☐	☐	☐
Training and Education	☐	☐	☐	☐	☐
Colocation	☐	☐	☐	☐	☐
Long-term perspective	☐	☐	☐	☐	☐

Section D: About yourself
*tick only one choice per question.

1. Your age:
   - □ 21-30 years
   - □ 31-40 years
   - □ 41-50 years
   - □ 50 years and above

2. Your gender:
   - □ Male
   - □ Female

3. Education background:
   - □ Postgraduate degree (PhD, Master)
   - □ Bachelor's degree/Professional
   - □ Diploma
   - □ High school

4. Type of organisation:
   - □ Developer/Client
   - □ Consultant
   - □ Contractor

5. Your position:
   - □ Executive
   - □ Manager
   - □ Senior manager
   - □ Director/Top management

6. Working experience:
   - □ 0-5 years
   - □ 6-10 years
   - □ 11-15 years
   - □ 16-20 years
   - □ 20 years and above

7. Size of organisation:
   - □ 1-10 employees
   - □ 11-50 employees
   - □ 51-250 employees
   - □ 250 employees and above

8. Characteristic of project (Please select the mostly involved project only):
   - □ Public
   - □ Private