

**Master of Business Administration (MBA) in General Management,
University of Wales Trinity Saint David (UWTSD)**
LCMB7020 Dissertation

DISSERTATION TITLE:	The Contribution of Non-Effective Contract Management to Project Failure - Contracting Strategies in Large Construction Projects: Case Studies
STUDENT NAME:	Yi-Chen Cheng
STUDENT NUMBER:	1902780
COURSE NAME:	Master of Business Administration (MBA) in General Management
DEPARTMENT:	Business School
COURSE CODE:	LCMB7020
DATE OF SUBMISSION:	13 June 2020



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The Contribution of Non-Effective Contract Management to Project Failure - Contracting Strategies in Large Construction Projects: Case Studies

1.0 Chapter One: Introduction

Construction is a major industry in the modern world accounting for a significant portion of the Gross National Product (GNP) and Gross Domestic Product (GDP) of most countries including the United Kingdom (UK). The Construction Industry plays powerful role in economic growth in terms of increased economic activity, job creation, infrastructural development and increased demand for goods and services (Behera, Mohanty and Prakash, 2015). In qualitative studies on the importance of contract management in the construction sector, researchers asserted that contract management is a highly critical component in the construction projects based on its implication on cost, time and quality (Halpin, 2017; Behera, Mohanty and Prakash, 2015). Contract management is about making the relevant decisions and actions as well as the timely flow of key information to facilitate the planning and completion of the construction project (Chawla, 2019). According to Kanchana et al. (2018), contract management and administration is geared at ensuring that the specific terms and conditions (project scope, payment details, and work schedule) under the construction contract are fulfilled as agreed upon by the client and the contractor. Effective contract management is responsible for ensuring that the particular construction project is awarded to competent and qualified party, and that all involved parties have a better understanding of the prospects and opportunities as well as risks and challenges associated with the given construction project (Halpin, 2017). Therefore, effective contract management through the adoption of appropriate contracting strategies and guidelines can assist to eliminate or to mitigate the risks, issues and challenges that are within the control of the parties to the particular construction project (Eitjes, 2017). The current study proposes that

ineffective contract management is a key contributing factor to project failure, and that inappropriate contracting strategies might contribute to unexpected incidents, extra expenses or significant delay, thus leading to project failure.

1.1 Statement of the Problem

According to Behera, Mohanty and Prakash (2015), project failure takes place when a particular construction project fails to successfully meet its set objectives, purposes and/or expectations. Halpin (2017) asserted that the significantly low-compliance levels in the contracting strategies in large construction projects contribute to a situation where a majority of entities are not enthusiastic about effective contract management. A majority of contractors/clients increasingly take the practice of contract management for granted, with some of the reasons behind ineffective contract management being poorly-defined project scope and ineffective communication. Other key issues contributing to ineffective contract management include: the lack of qualified personnel, lack of staff training, incorrect interpretation and application of some contract provisions, inadequate resource mobilization, poor record management, lack of appropriate contract management systems, technologies and process, poor procurement planning, among others (Yan and Liu, 2016).

In public and private construction sectors, different contracting strategies such as the Engineering Only strategy, Construction Only strategy, Design and Construct strategy, Design and Construction Management, Public-Private Partnerships, and others are considered to be integral in contributing to the overall performance of a construction project (Rifai, 2017; Gaikwad and Sarode, n.d.). Fewings and Henjewe (2019) noted that a contract strategy for construction projects entails a number of activities and practices geared at ensuring compliance with the terms and conditions outlined in the construction contract. Some of the most

notable terms and conditions in a typical construction contract include owner relations, change management, dispute and claims resolution, payment details, scope of project, stakeholder responsibilities, among others. Mulla and Waghmare (2015) asserted that the ideal situation is where the identified contractors create and sustain the appropriate structures, processes, systems, technologies and resources to manage compliance, and to eliminate or reduce expenditures or the effects of poor performance. As a result, the primary focus of the current study is to evaluate the different contracting strategies that can be used to assist in eliminating or minimizing the probability of project failure within the context of large-scale construction projects.

1.2 Research Aim

The aim of the study is to ascertain the extent to which effective contract management increases the chance of successful attainment of the objectives of a construction project.

1.3 Research Question

To what extent does ineffective contract management contribute to project failure in the construction industry?

1.4 Research Objectives

- (1) To critically evaluate the role that effective contract management plays toward the success of construction projects.
- (2) To ascertain the extent to which less effective contract management contributes to project failure.
- (3) To determine the roles of various project stakeholders in the contract management process.

1.4 Rationale of the study

The steady growth of large and complex projects in the construction sector across the world has resulted into a rising number of studies over the recent years (Luo et al., 2017; Mulla and Waghmare, 2015). Lavikka, Smeds and Jaatinen (2015) noted that, the Construction industry in the United Kingdom accounts for about 4% of the total Gross Domestic product (GDP). GDP is widely used as the primary metrics for the overall health of a country's economy, and basically encompasses the value of all services and goods manufactured within the national boundaries of each country. In the United Kingdom, the value of construction industry stood at £1 trillion in 2015, making it one of the most valuable and productive economic sectors in the country's economy (Mulla and Waghmare, 2015). As clarified by Okere (2012), the ineffective management of contracts in the construction industry can significantly undermine the value of the industry. Some of the negative consequences of ineffective contract management include significant declines in revenues, value of property, loss of employment, inflated project costs, costly litigations, diminished quality of the final product and reduced stakeholder confidence.

Adoption of relevant contracting strategies in the construction industry can help those companies involved in small, medium-sized and mega construction projects to identify and respond to the distinct needs, requirements, demands and expectations of all the involved stakeholders (Fewings and Henjewe, 2019). The different contract strategies commonly used in the modern construction industries include: Traditional Design-Bid Build, Design-Build, Construction Manager, Project Manager, Separate Prime Contracts, Alliance and Collaboration, Public-Private Partnerships, Two-Stage Tendering, Document and Construct (Construction Owners Association of Alberta, 2018; Dhanushkodi, 2012). Through effective contract management, the contractor or developer of construction project is shielded from losses, risks

and litigations relating to the contractor's non-performance, thereby ensuring the set project objectives are met (Lavikka, Smeds and Jaatinen, 2015). The current study seeks to provide meaningful findings geared at helping various stakeholders involved in construction projects to gain a better understanding of how the different contracting strategies can increase or undermine the likelihood of project success. The core findings of this report will offer practical, relevant and up-to-date insights into how stakeholders in the construction industry can realize effective contract management as the panacea to successful project completion.

1.5 Structure of the Dissertation

The remainder of this research encompasses five chapters and each chapter is briefly examined below.

Chapter Two reviews the existing literature on the various contracting strategies, and their importance in the construction industry. It delves into some of the research findings on the need for introducing project management into the contract strategies. It explains the standard terms and conditions of contract and their application in the construction sector, with the most discussed contracting strategies being: traditional design-bid build, design and build, Two-Stage Tendering, Public-Private Partnership/Private Finance Initiative, Construction Manager, Project Manager, Separate Prime Contracts, Document and Construct.

Chapter Three covers relevant information and data on the adopted research methodology, further highlighting the research design, data collection, instruments for data collection and data analysis.

Chapter Four explores the different case studies on contract management in the construction industry. This section analyses the different construction projects for purposes of

drawing out comparison between the different forms of contracting strategies, further stating the most effective ones for the current and future application.

Chapter Five focuses on the critical analysis and discussion of the key findings. It examines the core themes and associated with effective and non-effective contract management as well as trends being followed by the contractors along with their respective scope, valuation and limitations.

Chapter Six concludes the research by outlining the objectives met by the researcher, and also a number of practical recommendations for future use and application of contract management in construction sector.

2.0 Chapter Two: Literature Review

This chapter of the dissertation examines the importance of contract strategies, further examining the opportunities and limitations associated with the various strategies and methods. The discussion delves into the extent non-effective contract management strategies can undermine the successful realisation of project goals and aims, thus leading to project failure. Utilising relevant empirical and theoretical perspectives, the research focuses on the various contracting strategies and their effective application in the construction sector. Throughout the discussion, more attention is placed on highlighting the key role of project management in eliminating or reducing the chances of project failure in the engineering & construction industry.

2.1. An Overview of Construction Projects

The Engineering and Construction sector is considered a key contributor to economic growth and development in both developed such as the United Kingdom and the United States as well as emerging economies such as India, China and Saudi Arabia. According to Favie and Maas (2008), the construction industry is characterised by high level of complex activities, fierce competition, well-informed clients and high-risk conditions. Senouci (2016) mentioned that the competitive bidding system currently utilised in majority of large-scale construction projects is also heavily responsible for the high bargaining power of the clients, leading to circumstances that might contribute to high rates of project failure in the construction sector. Over the last one decade, the world of construction has witnessed an upsurge in the number of large-scale constructions projects with mixed outcomes. Some of the largest construction projects in the world being construction of the Al Maktoum International Airport (Dubai) at an estimated cost of \$32 billion, Jubail II (Saudi Arabia), Dubailand (Dubai) at an estimated cost of \$64 billion, International Space Station (Space) at an estimated cost of over \$1 trillion, South-North Water

Transfer Project (China), London Crossrail Project (Britain) at an estimated cost of \$32 billion, High-Speed Railway (California), Chuo Shinkansen (Japan), Beijing Airport (China), Great Man-Made Project (Libya), and many others.

As a project-based industry, the contract structure, strategies and methods of the construction sector have led to a great deal of fragmentation regarding the involvement of many different types of firms and parties (Patil, 2017). According to Favie and Maas (2008) the degree of complexity of production in the construction sector is relatively high and efficiency levels are fairly low due to the unique, fragmented yet interconnected nature of many large-scale construction projects. In this empirical study, Raja (2012) emphasised that project complexity forces the conventional construction sector to change in favour of contracting strategies that will ensure the successful management and implementation of large construction projects. Masterman (2012) noted that, given the centrality of the contract as a key element of every project activity, contract management is steadily gaining prominence as an integral component of project management. Hence, the need for further analysis of the contribution of non-effective contract management to project failure in the context of large construction projects amidst many constraints and peculiarities associated with each large-scale project (Vrijhoef, 2014).

Mokhtariani, et al. (2017) mentioned that, the construction industry is an integral part of the economic system that deal with the design, development, maintenance and use and also the modification, modulation, deconstruction or demolition of constructed structures and buildings. In the United Kingdom and abroad, the construction sector is considered a key economic sector, and a major contributor to significant environmental changes regarding the associated changes to the built environment and also anthropogenic implications on the natural environment. According to Doloi et al.. (2012), the project lifecycle (conceptual project design, project

definition, project planning, project execution and project termination) of a constructed product is often associated with a series of social, economic, technological, ecological and infrastructural ramifications, thereby making it necessary to evaluate the contracting strategies employed. Mead and Gruneberg (2013) stipulated that construction projects (engineering construction and general construction) are diverse, complex, unique, and temporary and interrelated, and hence they require more planning initiative in terms of contract management and execution.

2.2 Structure of the Construction Supply Chain

In comparison to the supply chain of the manufacturing sectors, the construction supply chain is characterised by a great deal of complexity, costliness, ambiguity, inter-connectivity, high-risk factors and stakeholder diversity. According to Fernandez-Solis (2017), a supply chain is the linkages (both upstream and downstream) between a company and its various suppliers, in the distinct operations and processes that generate value in the forms of services and products to suit the distinct needs, demands and requirements of the ultimate customer. Mokhtariani, et al. (2017) noted that the central position of the main contractor in the supply chain of the construction industry implies that contract management is an integral component of the construction project. Gunduz (2018) indicated that the contractor in construction projects is identified to be directly in charge of the assembly of the different materials, elements and machinery and also the integration of numerous suppliers and systems associated with the particular project. Although the construction supply chain tend to be temporary in nature, the eminent involvement of multi-disciplinary teams in large-scale construction projects implies that the adopted contract structure and strategies must be streamlined to meet the common purpose of delivering the given project within the defined time-schedule, project scope and budget (Masterman, 2012; Favie and Maas (2008).

Main Parties to Construction Contracts

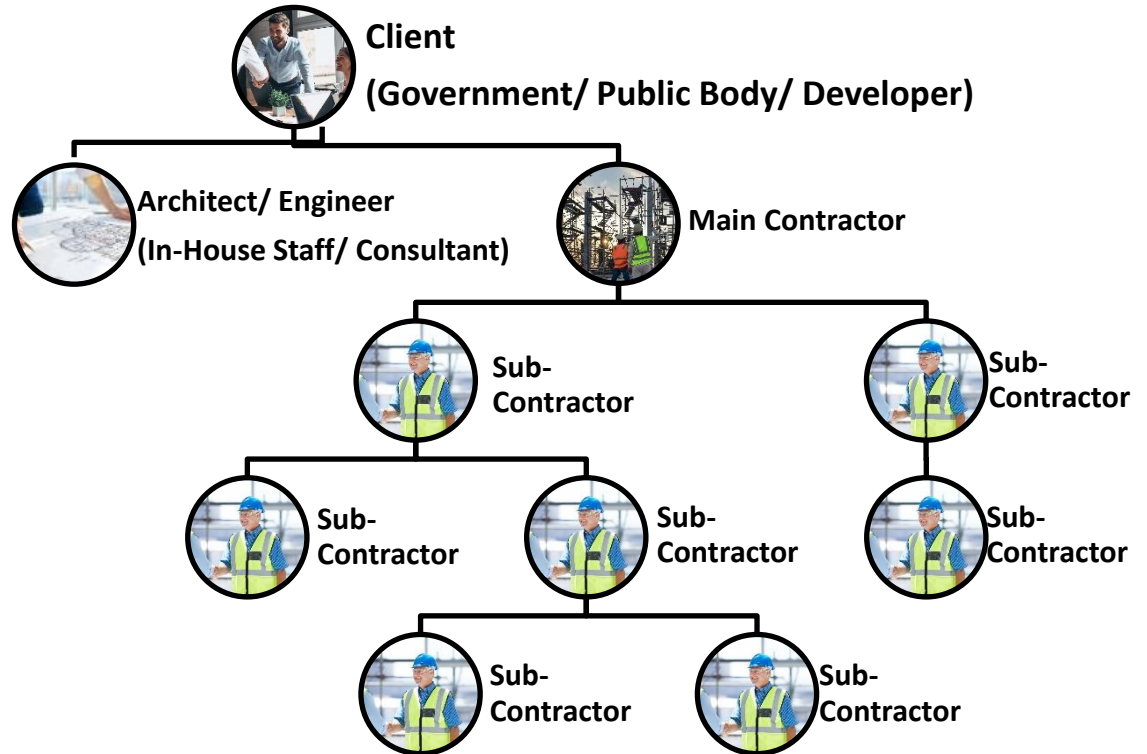


Figure 1: Different Construction Actors (ICAC, 2017).

2.3 Nature of Construction Project Contract

According to Vrijhoef (2014), projects in the construction sector involve sophisticated packages of operations, for which design and contracting firms are heavily responsible. One of the most noteworthy feature of construction projects is the diversity of stakeholders from one project to another and also the heterogeneous mix of different equipment, materials, labour and also the production setting. The qualitative studies of Sunke (2009) demonstrated that the one-

site nature of construction projects contributes to a myriad of project planning and contract management problems, further leading to reduced chances of project success or survival. Mead and Gruneberg (2013) emphasised that faced with the need to respond to rapidly changing legislative and institutional measures, the contractor is increasingly dependent on outside project parties, and hence, any large-scale construction project must be coped with an amalgamation of multiple objectives. As identified in the reviewed literature, some of the main peculiarities of construction projects include: shifting production sites, seasonal dependence, spatial constraints, specific construction legislation and regulations, time/resource trade-offs, highly uncertain planning environment, concurrence of multiple projects and combination of different objectives (cost, time, resource-levelling and quality (Shebob, 2015; Masterman, 2012; Favie and Maas, 2008)).

2.4 Contract Management in Construction Projects

According to Burtonshaw-Gunn (2009), the contract is an importance piece of agreement that expresses and stipulates the specific legal, financial, technical and material components of the construction project. The contract set forth the specific terms and conditions that should be agreed upon by the various parties or stakeholders associated with the particular construction industry project. Ashworth (2012) highlighted that the construction industry has evolved in the first decade of the new millennium toward the adoption of various project delivery systems aimed at ensuring effectiveness and efficiency of contract management and administration in the context of large-scale construction projects. In light of the stakeholder theory, the major parties directly engaged in a construction project include the client or owner, the designer and the construction entity (Fernandez-Solis 2017). In their book, Ochieng, Price and Moore (2013) revealed that, for the successful implementation of a given construction project, the three parties

have to define and formalise their contractual relationships and to decide upon the duration and span of the project, resources and capabilities, tasks and responsibilities, project scope, and expected outcomes. In practice, the client is largely responsible for selecting between the distinct delivery systems for construction projects, thereby determining the contracting strategies adopted (Joseph and Chan, 2017). As shown in figure two, the construction industry is made up of many primary, secondary and tertiary stakeholders, institutions, individuals and actors.

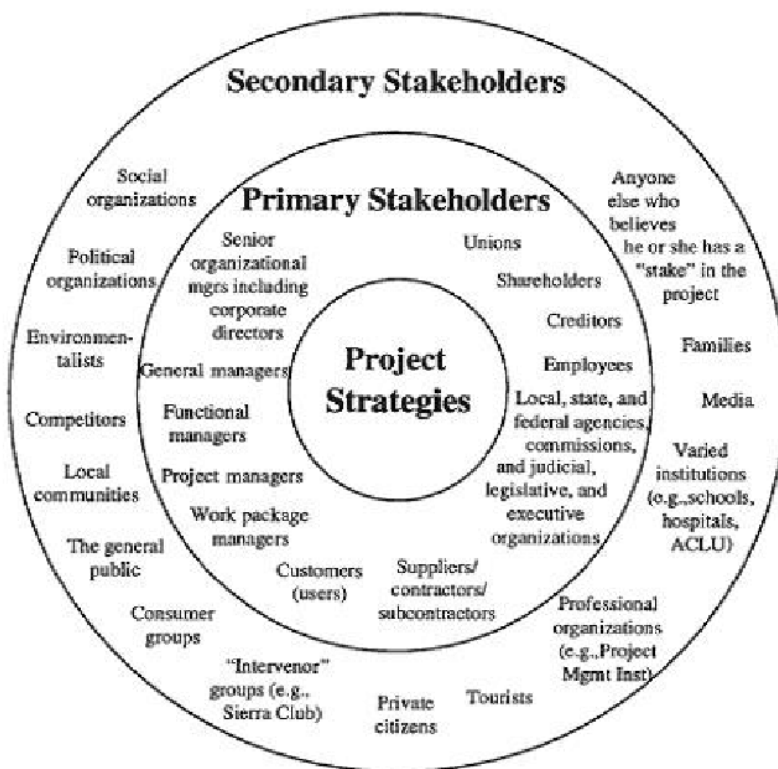


Figure 2: Potential stakeholders for construction projects (Mashwama, 2018).

2.5 Types of Contracting Strategies in the Construction Industry

Sunke (2009) made an evaluation of the different contracting strategies employed in construction sectors across the world. A diverse range of project delivery systems are currently adopted in the construction industry projects including the conventional design-bid build, design-build, construction manager, project manager, separate prime contracts, alliance and

collaboration, public-private partnerships, document and construct, among others (Joseph and Chan, 2017; Sunke, 2009). These contracting strategies are discussed in greater detail below.

Sl.No	Procurement methods	Functions of Construction				
		Design	Build	Management	Finance	Operation
1	Traditional Method	Consultant	Contractor	Consultant	Client	Client
2	Design & Build Method	Contractor	Contractor	Consultant	Client	Client
3	Management Contracting	Consultant	Specialized Contractors	Contractor	Client	Client
4	Joint venture/Partnering	All the functions shall be shared with parties in mutually understanding environment				
5	Private Financing Initiative	All the functions shall be carried out by contractor and ownership of project shall be transferred to client				

Figure 3: Main procurement methods in the construction sector (BCE, 2016).*2.5.1 traditional method*

According to Ding et al. (2018), the design-bid-build (DBB) project delivery system has been extensively used in the past, and it entails contractual relationships where the client (owner) contracts a suitable design entity (an engineer or architect) for the core purposes of undertaking preliminary planning, preparation of design and contract documents. After realisation of this project stage, a construction contract is selected based on the criteria and parameters set by the client, and this is followed by commencement of on-site construction (Sunke, 2009). In this contracting system, the involvement of various contracts in the competitive tendering process (negotiated tendering or two-stage tendering) can allow the client to gain the lowest prices, allowing the client to finance the project based on the tendered value. Considering that the design is usually completed prior to the actual construction, the degree of quality uncertainty is reduced in terms of knowing the total cost and delivery period, and this explains why this method is highly predominant in government-lead construction projects (NHS, 1995). Moazzami et al. (2011) mentioned that there are at least three types of construction contract under the traditional

procurement strategy. They include: lump sum contracts (the cost of the project is determined prior to actual construction); measurement contracts (total cost of contract is correctly calculated on project completion and re-measurement based on agreed upon terms and conditions; and cost re-imbursement (contract amount is determined based on the actual costs of materials, labour, overhead expenses and the profit). However, the application of these conventional methods of procurement in the construction industry has been undermined by cases of poor coordination, ineffective communication, time constraints and concerns over rising contract costs and delivery problems (Carty, 1995).

2.5.2 Design and build contract strategy

In this contracting strategy, the contractor is expected to deliver the completed construction structure or building to the agreed programme and cost (Rashid et al., 2015). Davis et al. (2006) mentioned that the contract is solely responsible for conducting both the execution of design and actual construction work and, in some instance, offering specific ‘technical know-how’ for the construction project. Some of the common categories of design and build arrangements in the construction project include contractor-led design, Employer-led design, third-party led design, among others (NHS, 1995). Raja (2018) asserts that with this type of contracting strategy, the single organisation involved in both the design and construction work can make strategic arrangements to cut down costs, to create more efficient design and project control programme, become more innovative and to focus on successful project development. However, Holt, Proverbs and Love (2000) argued that, whilst this type of construction contracting strategy often require fixed lump sum price in the case of a functional building project, noteworthy changes in the design and construction processes might lead to higher costs, making it necessary to specific the terms of the performance requirement in the contract

document. Moreover, a number of key limitations include reduced control by the employer over the design and construction process, huge responsibility placed entered on the contractor can amply the degree of quality uncertainty, client changes top project scope can be very costly (Oztas, 2014).

2.5.3 Two-stage tendering contract strategy

In this contracting strategy, the appointment of the qualified contractor is the first phase, and it is followed by the collaboration between the contractor and a selected project team in the preparation of designs, cost estimates and project scope (Moazzami et al., 2011). Although highly favoured by many clients in the expansive construction sector due to its overall capacity to guarantee significant time saving and cost certainty, this type of procurement system is only favoured in the construction of functional faculties rather than luxury, expensive projects (Ashworth, 2012; Moazzami et al., 2011).

2.5.4 Build-operate-transfer (BOT)

In this contracting strategy, a corporate organisation is bestowed with the responsibility for conducting the design, construction, sustainable financing and provisional operation of the completed project (Patil, 2017; NHS, 1995). At the conclusion of the operation duration, as agreed upon in the contractual arrangement, the operation of the final project is handed over to the owner/client. Elbeltagi (2016) and Ashworth (2012) stated that this contracting approach has been adopted in a number of engineering and construction projects including turnpikes, express routes, railway projects, and other large-scale construction initiatives in the public sector, and large infrastructure projects financed by multinational agencies including the International Monetary Fund, World Bank and others. One of the fundamental features of this contracting structure is the involvement of a consortium of business and organisations in the key phases of

the project including planning and design, financing, construction, operation and maintenance) (Rashid et al., 2015). The involvement companies not only share the costs but also the profits/rewards gained from rent or other agreed-upon arrangements, over the stipulated period of time as agreed in the contractual agreement (Raja, 2018).

2.5.5 Management contract strategy

In this contract arrangement, the responsibility for the design and construction activities is bestowed on the management contractor for an agreed upon management fee, and a number of distinct contracts are assigned to other individual contractors. According to Bowmans (2016), some of the common types of management contract include construction management, management contracting and design and manage. In all the three variants of management procurement, the involvement of the selected works contractors at the different phases of the construction process can allow a great deal of flexibility, increased collaboration and coordination and execution capabilities (design programme, delivery of goods and materials, tender action, construction programme) for improvements in the construction project's constructability (Construction Owners Association of Alberta, 2018). As mentioned by Elbeltagi (2016), leveraged degree of trust and confidence, mutual committed and good teamwork is a pre-requisite for successful realisation of the management contract strategy. McDermott (2017) added that the competitive tendering process can also enable the client to secure significant cost saving and appointment of suitable management contractor based on the provided requirements as well as terms and conditions. However, there exist significant concerns over conflict between contract management team and other direct works contractors, lack of public accountability, fierce competition for construction work on huge projects, overall of design and construction work, and fewer contract variations. Other key drawbacks facing contract management in large-

scale construction projects as identified in the reviewed literature mainly revolves around price uncertainty, the greater needs for proactive and informed client, and the loss of direct control of design quality and cost certainty on the side of the client (Dithebe et al., 2018).

2.5.6 Public-private partnerships

In large infrastructure projects, public-public partnerships have been pursued by the governments in order to engage the private sector in the design, construction, financing, operation and even maintenance of completed projects including public urban infrastructure such as roads (McDermott, 2017). Zhang, Cao and Wang (2008) suggested that, the involvement of private firms in the engineering, procurement and construction of the built facility on a stipulated period and a fixed lump sum price could trigger rises in cost uncertainty, making it one of the most expensive contracting strategies.

2.5.7 Engineering only or engineering and procurement

In this contracting strategy, the owner/client of the project pursues the services of an engineer(s) at the initial phase for purposes of designing, procurement, and preparing the necessary documentations in terms of project scope, regulatory requirements, budget or sanction estimate (Patil, 2017; NHS, 1995). Although the client is expected to provide the payment directly to the engineer based on his/her position as the contracting entity, the engineer is fully tasked with the management, execution and procurement operations associated with the construction project (Ding et al., 2018). However, Elbeltagi (2016) warned that considerable risks of quality performance, project scope and cost falls on the owner of the project, making it a less preferred contracting strategy in large construction projects in the private sector.

2.5.8 Construction only

Following the owner's involvement of an engineer in the design and document preparation processes, the client selects and awards the construction work to a construction contractor. In this contracting strategy, the contractor is responsible for the procurement of raw materials, equipment and goods based on the project engineering or design documentation given to the owner by the engineer (Gaikwad & Sarode, 2016). (Davies, Love and Baccarini, 2008) asserted that given the significant control by the owner over the contribution project, the quality and cost uncertainties can be greatly reduced amidst concerns over the need for the project owner/client to possess the relevant qualifications and capacity in-house in order to manage and coordinate the particular construction project, successfully.

2.5.9 Alliance and collaboration

Rashid et al. (2015) considered this type of contracting strategy to be a fairly sophisticated since the establishment of alliances and collaboration between multiple contractors, suppliers and other key project participants is highly emphasised. Love, Skitmore and Earl (2010) noted that the inter-dependence, collective responsibility and accountability agreed to by the collaborate project team has been praised for its capacity to reduce or eliminate the commercial risks often associated with large, high risks and complex projects and to allow the proper sharing of rewards associated with this type of contract arrangements.

2.6 Research Gaps

Whilst a huge pool of empirical and theoretical evidences currently exist on contract management in the construction industries, there currently exist scant literature on the relationship between contracting strategies and project failure in large construction projects. Much of the literature review on contract management in general and in the construction sector

provides a description of contract management in the construction sectors, with limited studies examining and evaluating the contribution of non-effective contract management to project failure. The current study seeks to remain insightful, practical and valuable in terms of contributing to the current body of knowledge on the nature and status of contract management in the context of large construction projects. By examining the key strengths and benefit of different contracting strategies employed in the case studies, the author intends to combine relevant theoretical and empirical evidences top create solid discussions on the need for effective contract management, particularly in large construction projects.

3.0 Chapter Three: Research Methodology

The secondary analysis methodology is chosen not only because of the cost-effectiveness and convenience it provides (Dale et al., 1988; Smith, 2008) but also because it can re-analyse, re-interpret and replicate existing research and to generate new research areas, ideas and theories for others to follow. The comparative research methods are adopted to review the success and failures of high-profile construction projects, to identify the similarities and differences, to re-analyse the major causes of those failures and provide solutions to mitigate those concerns with detailed discussion. (Esser and Vliegenthart, 2012).

Case studies are analyses of ‘a particular issue, feature or unit’ which are designed to evaluate and confirm the processes of business activities in organisations (Noor, 2008). The case study methodology is increasingly considered essential and appropriate when it comes to exploring a specific area (Patton, 1987). Although case studies have been criticised by some as ‘lack of scientific rigour and reliability’ and might be unable to form the generalizability (Johnson, 1994), the advantages of adopting the case study methodology are likely to prevail. For example, case study is to gain a holistic view of a certain phenomenon or series of events and can set the patterns for other projects to follow (Gummesson, 1991). Another advantage is that case study can be useful in capturing the ebb and flow of business activities, especially where it is changing rapidly (Hartley, 1994).

This section describes the selection criteria for the numerous articles and other research materials utilised in this dissertation. The section offers a simple evaluation of the different procedures adopted and the selection strategies that the researcher employed in choosing the various sources. Using the content analysis approach, the search was performed to gain access to relevant study materials on the topic of effective and non-effective contract management in the

construction sector. A number of peer-reviewed journal articles will be extensively examined and evaluated based on validity, credibility, quality, trustworthy and relevance to the current research (Widdowson, 2011). Considering the strong author's interest in the current field of study, a great deal of attention was placed on ensuring only those research materials and sources that relevantly respond to the key research questions are reviewed.

3.1 Online Search strategy

The search strategy combines the key ideas presented in the research topic. In this study, the author focuses on utilising a wide range of peer-reviewed materials as well as unpublished research sources written in the English language from a number of online databases. The search strategy is therefore highly critical in enabling the research to gain access to reliable, accurate, credible and useful materials that will assist in developing solid discussions and conclusions on the presented evidences. The following are some of the key words, terms, and phrases included in the online search strategy: contract management, construction contract, conditions and terms of contract, contracting strategies in construction sectors, planning and scheduling in project management, contract management and contracting strategies applied in construction projects, non-effective contracting strategies, factors behind construction project failures and/or success, contracting of large scale construction projects, traditional and modern contracting techniques, role of client and project management in contracting strategies, Crossrail, Queen Elizabeth Olympic park, Hungerford Bridge, among others. Some of the electronic databases and search engines to be used in the study include: Peer Reviewed Open Access Journals, Jstor, Google Scholar, Directory of Open Access Journals, Ebcobhost, Internet Public Library, Wiley Online University, and few others. By searching and accessing these online databases and search

engines, the researcher will be able to gain access to a wide pool of empirical and theoretical research studies on the topic under analysis.

3.2 Research for Case Study

A case study is described as an empirical inquiry that launches investigation into a modern phenomenon within its real-life setting through the use of both empirical and theoretical evidences. In this paper, multiple-case designs will be adopted since a number of cases shall be studied and examined further (Harrison et al., 2017). In the construction sector, case study research is considered a useful way through which researchers can engage in the exploration, analysis and understanding of complex and advanced issues such as non-effective contracting strategies. A number of construction projects will be selected for the case study and are reviewed and included based on their project scope, contracting strategy(s), total costs, their magnum opus value and complexity (Zainal, 2007). Case studies enable the researcher to examine a pool of data within the specific context of its application, enabling leveraged focus on relevant variables. Case studies also provide useful mechanisms for exploring or describing complex data and information in real-life setting (Harrison et al., 2017). A case study of contracting strategies adopted by contraction companies, for example, can offer access to a wide range of sources on the contracting strategies adopted, but also some of the key factors for strategy success or failure. However, a number of disadvantages including widespread accusations over lack of rigour, limited basis for scientific generalisation, and the shared notion that case studies (particularly of longitudinal or ethnographic nature) stands out as too difficult to conduct and characterised with enormous amount of documentation (Yin, 2003).

3.3 Inclusion Criteria

The inclusion criteria placed more attention on research materials that contain relevant findings on the specific research topic. Emphasis is placed on sources and other reading content that is rich in information and data on contract management in the construction sector. These included an examination of the different contracting strategies adopted in some of the large construction projects in the United Kingdom and abroad. The researcher also aimed at examining literature material on the contribution of non-effective contract management to project failure. The articles included in the review contained relevant, up-to-date and valid information and data on how contracting strategies in large construction projects could contribute to project failure or success ([Appendix 1](#)). Moreover, the inclusion criteria also focused on examining peer-reviewed article written in English, and which carries essential information on the contribution of non-effective contract management to project failure. Specific inclusion criteria were adopted to gain a better understanding of the key contracting aspects and contributing factors to project failure in the context of large construction projects.

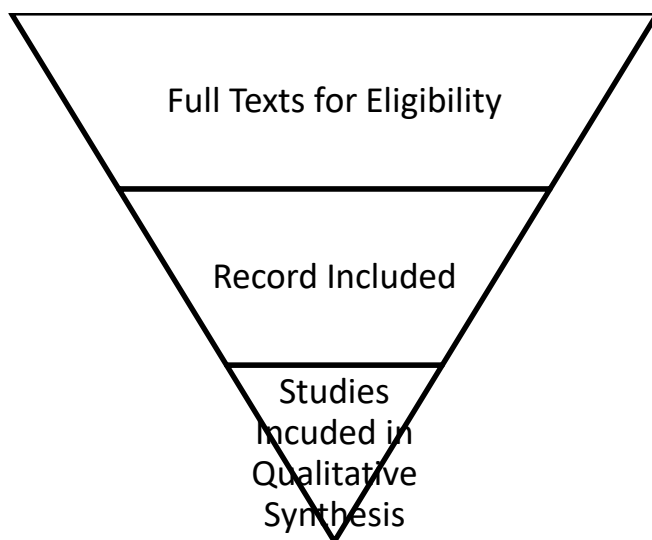


Figure 4: Funnel diagram illustrating the specific criteria adopted in article synthesis

The Joanna Briggs Institute (JBI)- Qualitative Assessment and Review Instrument (QARI) instrument was adopted by the researcher for synthesising the study findings of the various articles included in the review. A great deal of attention was placed on the quality of findings as well as on the similarity and differences of meaning. By conducting extensive content analysis, the researcher aimed to provide a highly synthesised review on the contribution of non-effective contract management to project failure in the construction sector. The adopted search strategy supported solid discussions on the topic under analysis by enabling easy and leveraged access to relevant and timely information on the extent to which gaps and shortcomings in the contract management could lead to adverse outcomes in the context of large construction projects. Numerous online databases and search engines were utilised in the comprehensive search for information to be included in the current study. Some of the databases to be searched include Ebcohost, Web of Science, Google Scholar, and Jstor. These databases were basically used based on the availability of relevant, contemporary and rich peer-reviewed reading materials on the research topic.

3.4 Exclusion Criteria

All research materials examined by the research were closely assessed for relevance, validity and credulity based on the information provided in the main title, Abstract and textual content. Research studies that failed to meet the inclusion criterion were instantly excluded from the review. Sources published in other non-English languages as well as materials dated 2005 backwards were excluded; and this is mainly done for ensuring that only recent, relevant and credible sources are included in the final review. The research also adopted an inductive content analysis approach to enable the categorisation of the content of research studies based on

relevance, eligibility, publication date, research design, key variables, and participants, among others.

3.5 Ethical Considerations and Research Limitations

Although adequate measures are undertaken by the research to ensure an appropriate research methodology and approaches are used in the current study, a number of ethical considerations around conducting this research are still evident. First, the research ensured that the core findings of the study adhere to the common ethical principles of informed consent, confidentiality, non-maleficence, beneficence, integrity, accountability, credibility and transparency. A number of ethical issues including plagiarism could also undermine the overall quality of the research findings, and hence the study will focus on providing original, thoughtful and extensively referenced discussions on the contribution of non-effective contract management to project failure in the construction industry. Whilst the current study applied the multiple case study approach to conduct a comparative analysis of contract management in large construction projects, it is relatively difficult to generalise or replicate some of its findings. The small sample size of case studies used in this study could undermine the extent to which the findings of the study will be transferred or generalised. Equally, whilst many other studies have been conducted on effective contract management, there are limited prior research studies on the contribution of non-effective contract management in project failure within the construction and engineering sectors. Therefore, combined with limited access to key organisations, people and documents that could provide relevant information on the case studies under analysis, the current study will be only limited to secondary sources. Nevertheless, the researcher will address these limitations through conducting a comprehensive examination of relevant, valid, credible and up-to-date sources on the topic under analysis in order to boost the quality of findings.

3.6 Summary

The case study approach is used in the current study as a useful research tool aimed at assisting the research to examine a wide pool of data at the micro-level. Case studies can act a practical solution to examining complex and contemporary phenomenon in the event a sizeable sample population is challenging to acquire since they follow into both qualitative and quantitative approaches. The current study will focus on adopting multiple case study approach in examining the phenomenon of non-effective contract management involving large construction projects (Crossrail project, Hungerford Bridge and the Queen Elizabeth Olympic Park). Given the real-life situations characterising all the case studies under review in this dissertation, the researcher will mainly focus on utilising data sources that are reliable, trustworthy, credible, valid and practical.

4.0 Case Study Analysis

The main case study under analysis is the Crossrail Project. A critical comparison with other cases (Hungerford Bridge, and the Queen Elizabeth Olympic Park, London) will be undertaken to examine the status of contract management in large construction projects. The comparative approach is geared at finding out the similarities and differences between Crossrail and the selected cases. A great deal of attention is placed on determining the extent to which non-effective management of contracting strategies can contribute to the difficulties that characterised the Crossrail project. This will be correlated with findings on how the other cases performance as far as contracting management in large construction projects is concerned.

4.1. Crossrail Project

4.1.1. The Crossrail programmes

Initiated in 2005, the Crossrail Project (hereafter also referred to as Crossrail) is a mega railway construction project in the United Kingdom tasked with the development of the new Elizabeth Line through the heart of London (Comptroller and Auditor General, 2019). Approved in 2007, the Crossrail project sought to deliver a new, high-capacity and high-frequency underground railway for London and the South East (Barsam et al., 2016). As a highly complex civil infrastructure project, Crossrail involved the development of at least 26 miles of tunnel beneath London; construction of 10 new, bespoke rail stations (including at least seven, huge underground stations); construction operations; new electrification work; design and construction of a new fleet of trains; software development and upgrading; among others (Wright et al., 2018). Whilst the Crossrail project was initiated in 2005, the actual construction work for the 10-year programme began 2009. Although the Crossrail project was slated for completion by the end of 2018 and fully operational in 2019, significant concerns over rising project costs, delays,

and other contract management issues undermined the timely delivery of the Crossrail project (Barsam et al., 2016). Empirical evidences demonstrated that the absence of a realistic programme plan, growing cost pressures, and the recurrent re-planning and updating of the business case heavily contributed to the reduced likelihood of delivering the Crossrail project in December 2018 (Tucker, 2017; Montague, 2016).

4.1.2. Crossrail's vision, values and objectives

Right from the start, the Crossrail scheme was widely considered a massive civil infrastructural project with the greater potential to contribute to further modernisation of London through improvements and expansion of the city's rail network capacity and performance. A vision statement developed and adopted by the Crossrail Board in the year 2006 read, *"A world class, affordable railway delivered through effective partnerships and project excellence"* (Department for Transport, 2019). A significant change to the Crossrail's vision saw a refinement of its vision into the simple phrase "Moving London Forward." Moreover, the Crossrail project sought to integrate a wide pool of stakeholders, organisations, agencies, institutions and individual actors to support and promote the realisation of its vision, objectives and core values, which encompasses the most integral aspects to Crossrail, and they included: safety, respect, inspiration, integrity and collaboration (Tucker, 2017). Moreover, the 'Target Zero' campaign is widely considered a highly ambitious plan by the Crossrail scheme to foster the adoption of a safety and health management programme for ensuring that all key stakeholders in the project including contractors, industry partners, and other key players in the supply chain remained safe and healthy amidst their involvement in key high-risk operations (Lloyd-Davies and Rowark, 2017).

The Crossrail project sought to achieve a number of major objectives. A key objective of Crossrail project was increasing rail capacity and reducing congestion on some of the highly over-crowded transport facilities in London and the South East (Wright et al., 2018). It was also presumed that upon completion of the new Elizabeth Line, capacity on the existing rail networks in central London will increase by a 10% figure and 60% on the Central, Bakerloo, Jubilee and District Lines of the London Underground network, thus enabling the public transport system to efficiently accommodate the steady growth in human population, and the rising demand for peak-time public transport (Montague, 2016). Another key objective of the Crossrail project was improving connectivity between and across key employment destinations (the city of Westminster, Heathrow and the West End (Bond and Paddington Streets) in London, and its environs (Haylen, 2019). By providing extensive connectivity with many of underground lines, London Overground, Docklands Light Railway, Paddington, and other stations, the Crossrail programme was geared at improving the degree of infrastructural connectivity in London and its environs. In terms of economic benefits, the completion of the Crossrail project was viewed as a milestone infrastructural development with massive economic benefits (Department for Transport, 2019). According to the Department for Transport, the benefit-cost ratio associated with the Crossrail project in 2011 was 1.97. This simply implies that every £1 of investments made in the project carried the potential to attain £1.97 of benefits to the national economy. Other assessed economic benefits linked to the highly ambitious Crossrail project included significant reduction in human and automobile traffic congestion, shorter journey times, creation of jobs (more than 14,000 construction jobs and 1,500 jobs in operation and maintenance of the completed railway); and other social benefits (Morrice and Hands, 2017).

Starting from 2008, the enforcement of the Crossrail Act granted the authorities and funding for the Crossrail project, paving the way for the adoption of the Crossrail's execution plan (Morrice and Hands, 2017). As a mega construction and engineering project, the Crossrail was pursued as a highly collaborative program under the joint sponsorship of the Department for Transport (project delivery partner) and the Transport for London (programme partner) (Haylen, 2019). Equally, a myriad of other key stakeholders including contractors, consultants, communities and others were actively and strategically involved in the design and construction of the Crossrail scheme (Crossrail Limited, 2016). Accordingly, the key components of the project's £14.8 billion funding envelope included government contributions (through the Department of Transport to the tune of £5 billion); Transport for London (£9.5 billion); track access charges and fare payers; and other additional contributions (city of London Corporation, Canary Wharf Group, Heathrow Airport Holdings Ltd, Berkeley Homes, among others). Considered to be a fixed cost for the entire project, the funding budget of £14.8 billion funding package was reached upon based on the findings of the Comprehensive Spending Review conducted in October 2010 (Department for Transport, 2019; Haylen, 2019).

4.1.3. Procurement approach and governance

The development of a robust and comprehensive procurement strategy was considered highly essential in realisation of the project's goals and vision (Department for Transport, 2014). Categorised as a utility, the role of the Crossrail project made it critical for adoption of the best procurement model in order to ensure compliance with the Utilities Contracts Regulations 2006, and also with the terms and conditions provided under the Project Development Agreement set under the Crossrail Act 2008 (Pollalis and Lappas, 2019). Therefore, the main aims of the adopted procurement policy included:

- Offering a best affordable value in delivering the set objectives of the Crossrail project
- Performing operations in an objective, fair, accountable and transparent way.
- Adopting best practices and ethical standards.
- Adhering with the regulatory and institutional frameworks.
- Aligning with Crossrail Ltd vision and values.
- Complying with government procurement policies and practices as well as those put in place by the Transport for London, and other key jurisdictions.

Initially, the adoption of the Purchase and Supplier Engineering Procurement approach was widely seen as a key development in ensuring the existence of a comprehensive, dynamic and flexible procurement structure (House of Commons, 2017). However, the enforcement of a procurement governance model shaped the manner in which the Crossrail programme approached the issues of time constraints, and complexity, leading to the increased need for implementation of modern procurement codes and practices (Department for Transport, 2019). According to the National Audit Office (2019), the Crossrail delivery model was a refinement of the procurement strategy that that adopted in the 2012 development of the Olympic Park (Queen Elizabeth Olympic Park) in Newham, East London. Pollalis and Lappas (2019) noted that the preparation and issuance of a technical assurance programme helped to demarcate the various responsibilities and activities of the project between Crossrail Ltd, the greater supply chain, involved civil infrastructure managers and the designated operator.

A myriad of procurement strategies were applied to stipulate the specific contract packaging as well as logistics for contracting of the key categories including Design, Early enabling works, Tunnelling contracts, General Civil Engineering contracts, Advanced works

packages, Station Construction and Fit-out, and Systems contracts (Department for Transport, 2014). Although the inherent position of Crossrail as the employer gave it greater control over the overall management, coordination and integration of this complex project, responsibilities and duties of the project manager and supervisor were delegated to the management of the integrated programme management team (House of Commons, 2017). After awarding of the contract of each station and tunnelling, a 6-week period was allowed for ensuring concentrated interactions between the various stakeholders (especially the contractor and its designers) to review the final project's design for constructability, safety, cost-effectiveness and efficiency. Whilst Crossrail Ltd assumed the ultimate design responsibility, the final design deliverables and requirements were based on the findings included in the contractor's reviews (Pollalis and Lappas, 2019). The NEC3 Engineering and Construction Contract (ECC) Option C was primarily adopted in the realisation of the Crossrail's integrated procurement strategy (Crossrail Limited, 2016). According to the Comptroller and Auditor General, (2019), the NEC3 suit of contracts were selected for all of the key delivery contracts awarded to the different contractors, suppliers and other key parties involved in the Crossrail project.

4.1.4. Non-effective contract management

As a mega-project, the Crossrail programme was a highly complex civil infrastructure construction project that involved the awarding of at least 36 main contracts to different firms for the construction of stations, tunnels, key infrastructures (electricity power lines, water, sewerage systems, signalling, station improvements), and others (McCormick, 2016). According to Green (2019), the increased levels of inter-dependencies between the works of many different contractors that characterised this mega project played a major role in leveraging the delivery risk on the Crossrail project. According to the findings included in the 2019 Public Accounts

Committee report, it was revealed the contracting model adopted in the Crossrail programme paved the way for involvement of a high number of main contractors, who nevertheless raised a myriad of contractual issues that contributed to the rampant delays and cost rises (Committee of Public Accounts, 2017). According to the report, between 2013 and 2018, a myriad of key design changes and deliberate delays to the Crossrail contracts and projects led to a sharp rise in the budgeted costs by over £2.5 billion, with close to £1 billion of the increased costs being due to additional payments to main contractors for design changes and milestone updates made by Crossrail Ltd (Comptroller and Auditor General, 2019). Other cost increases could not be attributed to the failure of one specific contract or project, noteworthy cost increases were recorded on many of the 36 main work contracts on the central section of the Crossrail programme (Green, 2019). This included key areas such as civil engineering, tunnelling, fit-out and station development, installation of key and track systems in the state-of-the art tunnels and adoption of the systems to operationalise the new facilities (both railway and stations) (Plimmer, 2019). Moreover, noteworthy changes in scope of the Network Rail's work also led to a massive cost inflation of the new assets, and combined with the unsettled contractual disputes between network rail and other key contractors, the poor quality of collaboration increased the impact of programme changes and delays (McCormick, 2016).

Another key issue that characterised non-effective contract management in the Crossrail project is related to the enormous amount of 'compensation events' that faced the programme by the year 2016. According to the PAC report, the contractual terms and conditions agreed upon between Crossrail with a majority of its key contractors outlines the requirement for the contractor to provide notification of a compensation event in the case of cost-rises as a result of unexpected or uncontrollable outcomes (Committee of Public Accounts, 2017). In other words,

the contracting model adopted by Crossrail made it possible for the main contractors to issue a compensation event notice following a design change instructed by Crossrail Limited, delays triggered by limited access to a work site or other events deemed to be outside contractors' control (Lloyd-Davies and Rowark, 2017). By 2016, more than 21,000 compensation event notices had been filed, and this created an operating environment characterised by significant delays, change and cost inflation to the tune of £1 billion (Comptroller and Auditor General, 2019). According to Plimmer (2019), the massive amount of compensation events between 2015 and 2016 could be heavily attributed to the introduction of more challenging milestones by Crossrail Ltd and the wanting integration of the work of many different contractors despite the exponentially huge numbers of interfaces and inter-dependences between and among multiple contractors.

Although Crossrail Ltd made significant attempt to reduce the skyrocketing costs and prevalence of delays due to the compensation events through negotiating supplemental agreements with its contractors, complex concerns over whether the Crossrail programme could be delivered on time gained momentum (Comptroller and Auditor General, 2019). It is indicated in the PAC report that, whilst the renegotiation of critical contracts sought to allow for risk diversification, to improve operational efficiencies, to address the build-up of delays, updates and to curb the cost increases through re-settling the commercial terms and incentive fees outlined in the works contracts, the supplemental agreements contributed to cost inflation of £150 million (Committee of Public Accounts, 2017). Equally, Crossrail Ltd solely experienced the massive financial risk associated the implementation of supplemental agreements, and this was made possible through the removal of the central financial incentive for the main contractors to ensure programme costs are controlled (Plimmer, 2019).

Another factor that shaped non-effective contract management in the Crossrail project is the eminent lack of clear coordination mechanisms connecting the activities of all main contractors. According to the National Audit Office (2019), whilst the delivery and commercial strategy of the Crossrail programme emphasised the strong commitment on opening the central segment of the completed railway in December 2018, the contracting model made it difficult for the different contractors and stakeholders to work in liaison toward meeting the opening date. In this case, although the common consensus that the teams involved in the Crossrail programme were exceptionally capable of fulfilling the set outcomes and overcoming the underlying barriers, the massive scale of the programme allowed for high-levels of risks associated with delivery, design and interface (Tucker, 2017). The commercial and contracting approach adopted in the Crossrail project was defined by the large numbers of main contracts with private sector engineering, design and construction companies, small contractors as well as a sophisticated supply chain of suppliers of machinery, specialist skills and equipment (Mead and Gruneberg, 2012).

Whilst Crossrail Ltd initially assumed the main responsibility of integrating and managing the entire programme to completion, the ultimate decision to assign these roles to two project management companies (Transcend Ltd and Bechtel) might have exposed it to significant levels of risk. According to Pidgeon (2019), the eminent lack of an effective ‘controlling mind’ meant that the level of coordination between contracts and projects was significantly undermined, and this was due to the reduced commercial levers on the part of Crossrail Ltd to drive effective integration and management of the entire Crossrail programme. Therefore, Crossrail Ltd blatantly failed to provide the requisite levels of accountability needed to foster successful delivery of what could be described as a complex construction project (Comptroller

and Auditor General, 2019). Although the ultimate decision to integrate the contractors from the two commercial delivery partners within the already-established Crossrail central team was inspired by the need for increased collaboration and knowledge-sharing, it nevertheless undermined the coordinating power of Crossrail Ltd over the entire programme (Committee of Public Accounts, 2017).

Non-effective contract management in the Crossrail project was also triggered by the massive dependences and interfaces that characterised the relationships between different contracts and projects of the Crossrail programme (Pidgeon, 2019). According to the National Audit Office (2019), the exponentially huge number of critical contracts and projects under the programme contributed to a significant rise in the number and share of dependences between contracts and different components of this complex mega construction project. Thereby, Crossrail Ltd experienced immense difficulties in attempting to successfully meet its target opening date and costs (Wright et al., 2018). As indicated in the report by the Comptroller and Auditor General (2019), this was heavily exacerbated the significant delays to station contracts, delays in software development, delays to installation of enhancement systems in the new rail stations and underground tunnels, increased workforce and work acceleration on key contracts. For these reasons, the eminent inability of Crossrail Ltd to successfully complete the Crossrail programme in time and on the stipulated budget in December 2018 led to an extension of the period that involved contractors and other key stakeholders would be remain on the construction site, leading to further cost inflation, changes to programme/contracts and possible future project delays (National Audit Office, 2019).

Non-effective contract management was also demonstrated by the lack of a realistic and integrated plan to correspond the ambitious hand-over schedule (the Master Operational

Handover Schedule) set by Crossrail Ltd (Commercial Decisions, 2019). According to Pidgeon (2019), whilst the company has managed to update the long-standing handover schedule three times (2016, 2017 and 2018), the introduction of daunting milestones significantly affected the delivery of critical contracts, leading to the cost increases and delays. Jobling and Smith (2018) noted that, the contract management processes at Crossrail Ltd deliberately failed to take into keen consideration the need for setting in place a logical and highly efficient streamlining of all the key activities across individual contracts and projects. Characterised by a great deal of over-optimism about the programme completion schedule, it became very difficult for Crossrail Ltd to benchmark the actual level of progress as exemplified by the historic progress made by the contracted parties (National Audit Office, 2019). Although supposedly adopted with the key goal of managing involved contractors and speeding-up the programme delivery process, findings by the Comptroller and Auditor General report revealed that Crossrail lacked effective instruments and tools to create and enforce the most cost-effective approach to deliver this complex programme, to meet its eminent role as the manager and integrator of the numerous components of the massive Crossrail programme and to pursue key and radical decisions including on project costs and schedule (Comptroller and Auditor General, 2019).

4.2 Comparative Analysis

Built for the 2012 Summer Olympics and the Paralympics, The London Olympic Park is an expansive sporting complex that comprises a number of sporting venues, the Olympic village, office spaces, and other key infrastructures (transport, water and sewerage systems, electricity) and facilities (London Legacy Development Corporation, 2014). Covering a 2.5 km² site on the Lower Lea Valley in Stratford, East London, and the Olympic park was a mega construction and engineering project intended to catalyse urban regeneration in the East London region

(Government Architect, 2017). According to Mead and Gruneberg (2013), the Queen Elizabeth Olympic Park was materialised after London was successfully secured the Olympic and Paralympic bid in 2005 to host the mega sporting events. The ultimate realisation of the Olympic park project was characterised by massive financial resources, many stakeholders, time constraints, design complexities, and the greater need to successfully deliver a mega construction project that will provide sustained sporting value, social value, stakeholder value and sustainability value. This large-scale project also entailed the awarding of more than 2000 separate contracts, comprising of at least 250 major and large-scale construction projects and a significant portion (Land Management Services Ltd, 2014)

Effective contract management remained at the core of the project's implementation, making it necessary for the involved organisation (Olympic Delivery Authority, ODA) to select and adopt the most effective contracting strategy (London Legacy Development Corporation, 2014). Fundamentally, the NEC3 Engineering and Construction Contract was strategically implemented in the Olympic Park Project, and the hiring of CLM (a consortium) was mainly intended to boost the coordination mechanisms for the major construction and engineering projects and programmes (LLDC, 2016). The NEC3 suit of contracts was adopted by the ODA for a majority of the contracting operations surrounding the Olympic Park project (Alade, 2016). This was essentially selected for its capacity to contribute to increased stakeholder collaboration, accountability and transparency of costs at the different phases of the project lifecycle (Ferrerri and Lang, 2015). A number of key aspects were associated with the NEC3 Contracts adopted in this massive construction project, and they included:

- a. A flexible contracting strategy, providing a reliable procurement solution based on the available design data/information;

- b. A highly collaborative strategy capable of enabling the successful completion of the mega project on stipulated time and budget;
- c. A pro-active risk management plan as a critical feature of the complete procurement agreements;
- d. Absolute visibility of project costs as the fundamental basis for ensuring effective and efficient budget management at the different phases of the mega urban regeneration project.

NEC3 Contract and Option	Application	Rationale
Engineering and Contraction Contract Option C (Target contract with activity schedule)	Major and complex venues and key infrastructure	Target price was best suitable for creating specification
Term Service Contract Option A(priced contract with activity schedule)	Logistics and Security contracts	Pricing scheduled accommodated needed dynamism and flexibility in terms of volume of Services and scale (through improved services schedules_
Engineering and Construction Option A (Priced contract with activity schedule)	Other venues	Designs were best suit and firm, enabling sufficient great certainty

Figure 5: Numerous NEC options adopted in London Olympic Park along with their application and rationale (Cornelius et al., 2011)

The ineffective contract management, right from the design, development and management phases of the Crossrail project was cited to be heavily responsible for the project's failure. On the other hand, the Queen Elizabeth Project stood out for having managed to ensure a great deal of efficiency and effectiveness at the different phases of this massive project (Alade, 2016). Unlike the Crossrail project that failed its completion date and set budget, the Queen Elizabeth Project was completed within the stipulated time and budget, and was characterised by significantly limited compensation events. This is very contrary to the Crossrail project, which witnessed more than 10,000 compensation events, something that is credited for leading to massive cost inflation, delays and significant changes to the project's design and completion schedules (Schabas, 2015).

One of the key factors that contributed to effective contract management of the Queen Elizabeth Project is the superior planning and contract management that was placed in the design, construction, implementation and operation of this massive project (Ferreri and Lang, 2015). It is mentioned that the Queen Elizabeth Project took at least two years of planning, four years of implementation, and a final year of practical testing and rehearsals (LLDC, 2016). On the other hand, whilst the Crossrail appeared to have included many years of planning and actual implementation, the procurement strategies adopted at the different phases of the project were heavily responsible for the increasing costs, design updates and delays that affected the project's completion (Government Architect, 2017). Burrows (2017) asserted that the NEC options adopted during the Queen Elizabeth Project provided a highly efficient, tailored and reliable project management methodology that outlined the specific activities, policies, regulations, procedures and processes to control and manage delivery as required.

Another key aspect that contributed to the effective contract management of the Queen Elizabeth Project was the adoption of an innovative delivery strategy (London Legacy Development Corporation, 2014). Whilst the Crossrail Ltd had made substantial efforts to put in place a solid delivery strategy, it however failed to secure and maintain clear definition of scope, transparency and accountability, and focused delivery (Alade, 2016). In the Queen Elizabeth Project, the NEC options was widely utilised for enabling the project management team to identify and recognise the key project stakeholders, facilitate and mobilise relevant and adequate competencies and resources, foster mutual collaboration and partnerships, boost effective communications and ensure compliance with the stipulated terms and conditions of the contract (Burrows, 2017; LLDC, 2016).

4.3 Hungerford Bridge

Another mega construction projects situated in London is the Hungerford Bridge. The £50 million project was considered one of the millennium projects implemented in the United Kingdom, and it primarily sought to modernise and strengthen footbridges across the Thames in London (Thames Water Utilities Limited, 2013). Faced with a myriad of core challenges including concerns over environmental impact and sustainability, concerns over unexploded bombs in the Thames Water, design and engineering complexities, budget and space constraints, expansive geo-technical assessments, and multiple clients, the Hungerford Bridge Millennium project stood out as a mega construction project in need of better contracting strategy (Alade, 2016).

Similar to both the Olympic Park Project and the Crossrail project, the Hungerford Bridge project also utilised the NEC contract. The extensive examining of design proposals from more than 40 entrants made it possible for the Westminster City Council to settle on the most

appropriate design based on extensive exhibitions and public consultations (Thames Water Utilities Limited, 2013). Equally, the funding for this mega project was sourced from different sources including the City Council, and other key partners. Increased collaboration between contractors, design engineers and other key parties played a major role in the identification and adoption of efficient and innovative methods of constructing the new suspended footbridge over the Thames River on the same alignment as Charing Cross Railway Bridge (Parker et al., 2003). Equally, the design work faced extensive obstacles regarding questions over environmental sustainability, ship impact, and the creation of strong and dynamic substructures. Through immense collaboration and consultation, the client was actively involved in all phases of the project, right from the selection on the contracting methods to the project completion (Thames Water Utilities Limited, 2013). This was not the case with the Crossrail Project, whereby severe lack of relevant coordination mechanisms left the Client exposed to many major risks that subsequently weakened its contract management power.

Although the ICE's Design and Build strategy was earlier on selected in the Hungerford Bridge Millennium project, numerous design changes were later conducted by the Client's engineer in favour of the 'Adopt and Build.' However, this contracting method was nevertheless neglected since it carried the greater potential to contribute to unnecessary extra costs, future design updates and significant project delays (Ramboll, 2016). As such, the ultimate decision to implement a new contracting method, the *NEC Engineering and Construction contracts* was agreed-upon to ensure equitable distribution of project costs and risks between and among the different actors involvement in this mega construction initiative (Ashworth and Perera, 2018). Specifically, the Engineering and Construction Contract Option C (Target contract with activity schedule) was effectively adopted, and this marked a milestone development in the appropriate

and equitable distribution of all the design responsibilities to the designer and main contractor (Dodd and Langford, 2010). Unlike the Crossrail project which blatantly failed to integrate measures aimed at boosting increased collaboration of the entire project team for the very sake of reducing costs and delays, the Hungerford Bridge Project conducted a series of well-measured value-engineering exercises geared at cutting down supplementary costs (Rifai, 2017). Compared to the Crossrail project which failed to meet its budget and completion time, the Hungerford Bridge was successfully developed and opened in May 2002, and remains one of the outstanding architectural and engineering structures in London, and the greater UK (Thames Water Utilities Limited, 2013).

4.4 Summary

This chapter conducts a critical comparison of Crossrail Project with other mega construction projects namely: Hungerford Bridge and Queen Elizabeth Olympic Park, London. Considered to be a highly complex civil infrastructure project, Crossrail is considered a highly ambitious construction project with massive economic, environmental and social implications. However, a number of core issues including cost inflation, delays, radical updates, lack of clear coordination mechanisms, massive number of critical contracts, growing list of compensation events and poor planning might have contributed to ineffective contract management. Comparatively, the effective contract management in the case of the Queen Elizabeth Olympic park project and the Hungerford Bridge. The NEC3 Engineering and Construction contracts were equally adopted in these mega projects, and they proved instrumental in boosting the degree of stakeholder partnership and collaboration, project accountability and transparency, responsibility and pro-active risk management. A number of factors contributed to effective contract management of the Olympic park and Hungerford Projects and they included: superior

planning and contract management; adoption of innovative delivery strategies; and increased collaboration and partnerships at all phases of these mega construction projects.

5.0 Chapter Five: Analysis and Discussion

In the United Kingdom, the expansive construction industry is considered one of the largest and most influential industries offering massive economic returns, job employment and economic stimulus opportunities. Effective realisation of large construction projects requires the involved stakeholders to consistently adhere with the established contractual obligations. Indeed, the Crossrail Project provides a typical example of how non-effective contract management of mega-construction projects could go wrong. This was largely due to the massive delays, cost inflation and inability to reach the stipulated budgetary limits, standards and quality specifications.

The findings from the comparative analysis revealed that contract management can both be effective or ineffective. The uniqueness, complexities and inter-connected activities associated with mega construction projects were heavily evident in the Crossrail project, the Queen Elizabeth Olympic Park Project and the Hungerford Bridge project. In terms of project management, the three projects examined had set ambitious plans of achieving a set of project goals and objectives based on the stipulated time, within budget and according to the set quality specifications and standards (Green, 2019). As such, the contracting strategies and methods adopted in these massive construction projects sought to ensure that the fundamental requirements of each project in its entirety, are fulfilled. Whilst the Olympic Park project and the Hungerford Project managed to engage in extensive planning for supporting and promoting the contract management processes at all phases of each project, cases of poor planning and less-effective contract management in the Crossrail project were cited to undermine its successful completion based on stipulated time, quality specifications and budget (National Audit Office, 2019).

Although the diversity of contracting strategies, procedures and methods employed in the UK's construction sector contributes to the multi-functional perspective on contract management of mega projects, the overall complexity, ambiguity and challenges surrounding practical implementation of the standard form construction contracts represents a major challenge (IACCM, 2013). According to Mead and Gruneberg (2013), contraction contracts are intended to serve a myriad of functions namely: distribution of transactional risks (performance and relational risk); and contract as a formal governance mechanism. Although the reviewed the mega construction projects (Crossrail, Olympic Park and Hungerford Project) appeared to embrace the multi-functional perspective of construction contracts, only the two later projects successfully managed to uphold the multiple functions associated with a construction contract.

5.1 Non-effective Contract Management

As demonstrated in the Crossrail case, project failure occurred when this mega construction project was unable to deliver on its set objectives, deadlines and expectations (Committee of Public Accounts, 2017). However, huge construction projects are characterised with many cases of less-effective contract management as witnessed in the case of Crossrail. As revealed from what the discussion in the Literature review, some of the key reasons that might have influenced the case on non-effective contract management in the Crossrail Project included poor planning, wanting coordination mechanisms, ineffective communication, failures to identify key assumptions, poorly defined project scope and scale, inadequate risk management, massive compensation events, over-optimism, and the blatant inability by the Client to establish and maintain a suitable contract management plan throughout the entire project's lifecycle (Pidgion, 2019). Reduced focus on promoting and supporting effective contract management practices

could undermine the capacity of large-scale projects such as Crossrail to attain their set objectives in terms of budget and schedule.

Another key lesson is that appropriate contract management was extensively considered as an active process throughout the lifecycles of the Olympic Park and Hungerford projects. For example, the Crossrail project failed to conduct comprehensive risk analysis and management to ensure all risks are identified, understood and responded to effectively. This left the client highly exposed to major risks that subsequently undermined its capacity to meet the projects specifications as well as stipulated time and budget (Pidgeon, 2019). According to Halpin, Lucko and Senior (2017), the eminent failure by the Client to properly identify and to define the risks associated with the Crossrail programme and the inability to diversify responsibilities for these risks between key parties and stakeholders significantly enhanced the chances of project failure. In contradiction to the Olympic Park project, the responsibilities for the numerous risks associated with the Crossrail project had not been ascertained through the enforced NEC contract. A comprehensive risk management plan heavily supported the successful realisation of the Olympic park project.

As learned in the cases of Olympic Park Project and the Hungerford Bridge, effective contract management can contribute to increased levels of contractor accountability, responsibility and transparency. These findings coincide with the idea that the untimely commercial and contracting approach assumed in the Crossrail project supported the adoption of supplemental agreements that later on proved very costly to the main contractor. Although this approach was aimed at curbing rising project costs, reducing the build-up of delays and improving operational efficiencies, the growing list of compensation events significantly exposed the contractor to massive financial risks. Therefore, the eminent lack of relevant and

comprehensive accountability systems undermined the spending discipline for the contractor in the Crossrail project, exposing the entire construction project to excessive cost overruns, radical design changes and significant delays. Key takeaways from the reviewed case studies for the contemporary Construction Supply chain include:

- NEC3 Contracts with self-certification are increasingly gaining widespread prominence and application in mega construction projects;
- As the clients, Crossrail, Westminster City Council and the Olympic Delivery Authority (ODA) were specifically tasked with:
 - ✓ Setting Key Performance Indicators (KPIs)
 - ✓ Introducing and enforcing surveillance measures (coordination between Central project management team and Other key actors)
 - ✓ Organising training (Root-Cause Analysis, CQI)
 - ✓ Conducting Performance Assurance
 - ✓ Quality-oriented culture
 - ✓ Connecting Quality to Assurance
- Quality should be entrenched in the comprehensive Contract Management Plan
- ✓ Accountability and transparency across the entire project lifecycle, and tasked with the contractor and project manager
- ✓ Expansive quality management information

In a conference paper on some of the best practices of contract management approaches, Zakaria (2015) mentioned that, non-effective contract management could be heavily attributed to rigid work/culture environment, absence of clear project scope and scale, lack of contract management plan, lack of stakeholder commitment to project, mis- or under-used management

techniques, inadequately defined tasks, roles and responsibilities, and lack of proper performance assurance and measurement parameters. Combined, these contributing factors played a highly instrumental role in the ultimate failure that characterised the Crossrail programme as a mega construction project. In this case, effective and efficient contract management stands out as one of the strategic means through which large-scale construction projects can guarantee their successful completion amidst concerns over increased complexity, uncertainty, ambiguity, changing realities and conditions (Halpin, Lucko and Senior, 2017).

A key finding from those case studies is that effective contract management in the context of massive construction projects might be heavily undermined by the eminent absence of clear and detailed policies, practices and procedures to guide the contract management process. Crossrail failed in meeting its completion schedule due to the inability of the stakeholders to adhere to the guidelines, practices and policies implemented at the various project levels. As revealed from those case studies, effective contract management is made possible when the fundamental contract management structures, responsibilities, standards and roles are clearly defined and assigned. In the Crossrail Project, the overall project management process was excessively left to two project management companies (Transcend Ltd and Bechtel), something that inadvertently reduced the strength of the coordination mechanisms. On the other hand, the Olympic Park and the Hungerford Project was characterised by the implementation of a highly-functioning contract management system that allowed a great deal of decentralisation as one of the most viable means of addressing concerns emerging from lack of accountability and operational inefficiencies. The creation of dedicated contract management sections/units played a key role in fostering professionalization of contracting strategies in the case of the Hungerford and Olympic park projects.

The ineffective monitoring of contract performance also emerged as a key contributing factor to failure in the Crossrail project. Whilst the Crossrail Ltd had initially developed an expansive and highly ambitious Handover schedule, it nevertheless failed to put in place an integrated and realistic plan for ensuring the project is successfully completed within time, budget and quality specifications and standards (Subramani, Sruthi and Kavitha, 2014). On the other hand, the Hungerford and Olympic Park projects were characterised by continuous and extensive expert monitoring and adoption of comprehensive contractor performance measures, and they played a major role in ensuring that the construction project was being delivered as expected. Combined with systematic reporting, project-wide efforts geared at strengthening and promoting contract monitoring played a highly important role in identifying the gaps and limitations that could have otherwise undermined effective contract management in the case of the Olympic park and Hungerford projects (Turner, 2017).

6.0 Chapter Six: Conclusions, Limitations and Recommendations

6.1 Conclusion

Contract Management in the Construction and Engineering industry is no doubt highly complex, multi-faceted and characterised with a great deal of uncertainty and ambiguity. Given the nature of large construction project as massive investments, non-effective contract management can prove very costly in terms of leading to cost overruns, delays, exacerbated risks and inability to meet project specifications and standards. A wide pool of research findings on contract management revealed that, non-effective contract management is increasingly responsible for the high rates of project failure in the contemporary construction industry. Equally, different contracting strategies, procedures, and methods are currently adopted in the construction industry with mixed outcomes on the realisation of large-scale projects. Some of the most common contracting strategies in the UK's construction sectors include: design and Build Contract strategy, Two-Stage tendering contract strategy, Build-Operate-Transfer, Management Contract Strategy, Public-Private partnerships, Engineering Only or Engineering and Procurement, Construction Only, Alliance and Collaboration, among others. In a comparative analysis of three large-scale construction projects, the current study revealed that effective contract management can prove instrumental in boosting the attainment of a project's goals and objectives. Whilst the successful completion of the Crossrail Project was heavily dampened by systemic deficiencies in the adopted contract management plans, the ultimate success of the Olympic Park and the Hungerford Projects relied heavily on effective deployment and management of the adopted procurement systems and strategies. In the case of the Crossrail project, concerns over ineffective contract management, right from the design, execution and

management phases weakened the contractual obligations bestowed on the different parties, thereby contributing to the project's ultimate failure. On the other hand, effective contract management in the case of Olympic Park and Hungerford projects was attributed to superior planning and contract monitoring, implementation of innovative delivery strategies, increased procurement collaboration and partnerships, and limited contract modifications. Therefore, whilst both the three mega construction projects adopted the NEC3 Construction and Engineering Contracts, systemic deficiencies and wanting coordination mechanisms in the approaches assumed by Crossrail and its associated paved the way for project failure. Other factors such as inadequate risk management, poorly-elaborated project scale and scope, reduced communications, deprived planning, enormous compensation events, extensive contract modifications, and lack of comprehensive contract management plan characterised the case of non-effective contract management in the Crossrail project. Accordingly, effective contract management must be supported and promoted in the construction industry as the fundamental basis for avoiding some of the key forces capable of contributing to project failure in terms of cost overruns, delays, unclear quality specifications and systematic deficiencies. The current study is highly insightful practical, compelling and useful in terms of knowledge addition. Nevertheless, further empirical and theoretical investigations into the contribution of non-effective contract management to project failure are still required.

6.2 Limitations

In terms of limitations, constraints of time and financial resources undermined the overall scope and reach of the current study. Whilst the study delves deeper into the extent to which ineffective contract management contributes to project failure, the research mainly revealed causal generalisations, and this is an aspect that undermined the investigator's ability to offer

tailored solutions to these issues as well as replication of its core findings. The comparative research analysis was adopted as the selected methodology amidst concerns over the small number of cases under analysis, and the strong reliance on secondary sources for information and data on these cases. Whilst comparative research enabled the researcher to examine the similarities and differences in the effectiveness of contracting strategies adopted in numerous large-scale construction projects, this method of research is heavily criticised for producing descriptive generalisations. Although the comparison research methodology is increasingly considered essential in the generation of empirical evidence on certain phenomenon, some scholars have argued that the comparative mode of research analysis is still inadequate to contribute to the generation of scientific knowledge. Broadly speaking, whilst the current study mainly focussed on comparing the effectiveness of different procurement methods employed in the three construction projects (Crossrail, Olympic Park and Hungerford projects), this methodology is widely perceived to be less adequate substitute for statistical analysis and/or experimental research. This is mainly due to the difficulty surrounding the manipulation of certain phenomenon such as ineffective contract management as a key cause behind project failure in the construction industry. Nevertheless, the researcher utilised a wide range of relevant reading materials to provide a balanced comparison of the selected cases, and this made it possible to ensure comprehensive attention was paid to all the case studies compared.

6.3 Recommendations

A number of practical recommendations geared at promoting and supporting Effective contract management are also covered, and they include: Risk management is key aspect that must be given consideration in order to ensure effective contract management. In the Olympic park and Hungerford Bridge Projects the enforcement of systematic risk assessment systems

played a major role in enabling proper identification of risks, and the adoption of well-measured solutions towards resolving and/or eliminating these project risks (COAA, 2018). Unfortunately, the project management team in the case of the Crossrail Project were unable to put in place comprehensive procurement-related risk management plans geared at boosting their ability to identify and manage prevailing risks, particularly financial risks (Rumane, 2017).

Another key recommendation is related to the impact of contract modification on the contract management process. Only necessary and well-measured contract modifications should be pursued during the project implementation phase. As witnessed in the case of the Crossrail Project, modifications during the implementation of a contraction project could prove highly inevitable, and hence the need for some sustainable changes on the basic designs and requirements of the given project (IACCM, 2013). In the Crossrail project, however, many of the contract modifications paved the way for a series of compensation events that ultimately triggered cost inflations, delays and change to specifications (Crossrail Limited, 2015).

Although various causes and effects these contract modifications were provided and examined in the Crossrail programme, many of the pursued modifications led to significant cost overruns, design updates, and unjustified time extensions (Cornelius et al. 2011). Therefore, unlike the Hungerford and Olympic Park projects which conducted limited contract modifications during the execution process, the various modifications in the Crossrail project were characterised by systemic deficiencies, which blatantly undermined the adoption of sufficient remedial action. This evidently impeded the cost-effective execution of project contracts, something that ultimately worked against the project's handover schedule (Turner, 2017).

Another key recommendation is that the implementation of comprehensive assurance systems and control mechanisms can help to foster effective contract management. In both the

Olympic Park and Hungerford Projects, sufficient interventions had been pursued to support and strengthen the implementation of internal oversight mechanisms including investigation, audit and evaluation functions (Kanchana, Niranjana and Karthick, 2018). Equally, external oversight measures were also integrated for the very sake of offering quality assurance and also for checking on the effectiveness and efficiency of the contract management activities (Yan and Liu, 2016). Compared to the Olympic park and Hungerford projects, the Crossrail Ltd and its associated partners failed to make proper use of the existing assurance systems and control mechanisms (performance measures and periodic internal reviews), and this significantly undermined the overall ability of the Project Client's to manage and monitor all the contracting operations across the Crossrail programme (Schabas, 2015).

The use of modern Information and Communication Technologies (ICTs) can foster realisation of effective contract management in large construction projects. The Olympic Park project made extensive use of both conventional and contemporary information systems to gain real-time, adequate and comprehensive information on the different aspects of the project including expenditure, performance monitoring, cost-overruns, and others (O'Neil, 2019). On the contrary, the eminent absence of such information in the case of the Crossrail project could be argued as a major impediment to informed problem-solving and decision-making, and this is something that evidently undermined efficient, innovativeness and effective management of contracts in the Crossrail programme (Schepker, 2014).

Equally, all the three construction projects (Crossrail project, Olympic Park and the Hungerford Project) placed strong emphasis on the need and importance of procurement partnership and collaboration. However, the absence of the much-needed attention to post-award contract management significantly undermined the quality and quantity of procurement

collaboration in the Crossrail project (Lu, Zhang and Zhang, 2016). For these reasons, the core issues and risks emerging during the post-award contract management of the Crossrail project were exacerbated by the absence of clear interventions aimed at harmonising applicable guidelines, procedures, practices and policies for promoting genuine and effective procurement collaboration and cooperation in a large-construction project (Laan, Voordijk and Dewulf, 2011). This contradicts what we have discussed about the critical value placed on stakeholder collaboration and partnership as the most appropriate means of sharing responsibilities, risks and opportunities geared at supporting successful completion of mega construction projects.

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Appendices

Appendix 1: Characteristics of Identified Studies					
Study setting and author (year)	Study aim	Study design	Study population and sample size	Construction field	Key findings-effective contract management in the construction sector
Italy; Alade (2016)	Evaluation of contract strategy for EPCM	Study design: comparative phenomenology Data collection method: case study Data analysis: comparison	5 cases	Construction	NEC3 Engineering and Construction Contracts are highly efficient in complex and high-risk projects
UK; Wright et al. (2018)	Exploring the contracting strategies adopted in the Crossrail project	Study design: qualitative descriptive approach Data collection method: systematic content analysis	More than 4 papers were examined	Civil Engineering	Crossrail's contracting approach sought to ensure the realization of the project on set time and budget
United Kingdom; Pollalis and Lappas (2019)	Examine the contract management processes in the Crossrail Project	Study design: case study analysis Data collection method: systematic content analysis		Civil Engineering	Although the Crossrail's contracting strategies are efficient, many signalling problems undermined innovation
UK; Committee of Public Accounts (2017)	Explore the journey following in completing Crossrail	Study design: Report	House of Commons Committee of Public Accounts	Parliamentary Report	Completion of Crossrail on schedule and budget will be economically beneficial despite the many contract

					management issues
UK; Tucker (2017)	To determine the effectiveness of the execution strategy for delivering London's Elizabeth line	Study design: systematic review Data collection method: Data analysis: thematic analysis	6 papers included in the review	Civil Engineering	Appropriate execution model can ensure the successful completion of the Crossrail project
UK; Jobling and Smith (2018)	To identify the various causes and factors behind mega project's failure	Study design: systematic review	35 articles were reviewed	Project Management	A number of factors contributes to failure of large projects including lack of investment in front-end planning, stakeholder biases, over-optimism and unrealistic expectations
UK; National Audit Office (2019)	To summarize the key findings on the progress of the Crossrail programme	Study design: Report		Parliamentary report	Mega projects are complex and hence appropriate contract management methods should be adopted
Canada; Moazzami et al. (2011)	Describe appropriate contracting strategy for fast-track project	Study design: content analysis		Engineering	Adoption of relevant contracting strategies can ensure successful completion of mega projects based on stipulated budget, time

					and specifications
UK; Mead and Gruneberg (2013)	Examine effectiveness of the 2012 London Olympic Park construction programme	Study design: thematic analysis		Engineering	Effective contract management is characterized by clear vision, stakeholder collaboration and partnership, adoption of appropriate contracting strategies
UK; Morrice and Hands (2017)	Conceptualization of effective contract management in the context of Crossrail programme	Study design: systematic analysis		Civil Engineering	Selecting the appropriate commercial arrangements between the client and contractors is highly critical to successful delivery of megaprojects such as Crossrail