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A FRAMEWORK FOR IMPLEMENTING TARGET VALUE DELIVERY TO ENHANCE VALUE CREATION IN THE CONSTRUCTION INDUSTRY

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Copyright Statement

Declaration

I hereby, declare that this dissertation has not been submitted in part or in whole as paperwork for a degree at any other university. I hereby declare that this dissertation is entirely my own work and that all parts and thoughts which have been taken from other persons are marked and identified by reference.

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Date……………………………

ABSTRACT

The general view of most construction challenges points towards an inability to deliver value. Value creation has not been established enough in the construction industry, regardless of past initiatives to improve it. The literature review highlights the importance of practices that promote value creation, such as target value design (TVD), which has roots in both lean construction and value management, both of which support project environments with favourable features to generate value. With recent reports of TVD successes in various countries, researchers suggest more studies are needed on its wider applications in other procurement routes employing evidence-based decisions, especially in developing countries. However, the application of TVD in the Nigerian construction industry (NCI) has not been fully explored. Additionally, it is not clear how the current design management practices in the NCI align with the underlying benchmarks and practices of TVD. Attempting to develop an appropriate approach that advances current practice is challenging, largely due to a lack of empirical supportive data. Globally, the basic principles of TVD take time to comprehend and can seem discouraging when implemented for the first time on actual projects; the different levels of collaboration can be easily confused and wrongly used interchangeably in TVD projects, and there is also a need for TVD projects to report on value generation and quality as past research has focused more on cost and time savings.

In view of these challenges, this study of the NCI was undertaken to explore the current design management practices in relation to TVD, to implement TVD and to develop and test a framework to support construction stakeholders in the implementation of TVD. The applied nature of Design Science Research (DSR) was deemed appropriate for this research. Both qualitative and quantitative methods were used in this investigation. Data were collected from across the building, highways infrastructure and rail sectors of the NCI through observing 17 projects, conducting four in-depth case studies, conducting 101 interviews, and analysing 189 questionnaire survey responses. Initial results revealed a limited awareness of TVD, and that some fundamental TVD practices recognized by the literature partially aligned with current NCI design management practices. From the case studies findings, the level of implementation of individual TVD benchmarks ranged up to 81%. This is the first recorded case of TVD implementation in the NCI, with findings that support evidence of a positive impact in the literature. TVD has been successfully applied in both design and build and traditional procurement routes, especially at the construction stage of public and private sector projects concerning provisional and prime cost sums. Additionally, TVD in bid process was reported as beneficial as it fostered the early participation of selected tenderers during the tender process. Results reveal that TVD flourishes with both face to face and virtual collaboration.

The major conclusion is that value creation can be improved using a more structured process. The findings have highlighted the need for a guide to assist NCI professionals, thus prompting the development of the Framework for Implementing Target Value Delivery (FFITVD) with additional embedded processes and strategy enhancing its contribution, which have not been addressed in other frameworks. Thus, this framework expands over and beyond previous frameworks, which focused more on the pre-design and design stages of projects. Testing the FFITVD on a live construction project revealed that the framework is comprehensive enough to be understood by stakeholders and has the capability of sustaining the implementation of TVD. This research has continued to influence research in the USA, academics in the UK and practice in the NCI.

DEDICATION

This thesis is dedicated to my late parents Prof B. D. Musa and Hajiya Gazala Musa. It has always been my dream to follow in my father’s footsteps and become a Professor in my field; this is a big stepping-stone in that goal. I also dedicate this thesis to my loving wife Malliya Musa for her immense support, and to my children Ali M. Musa and Jamal M. Musa.

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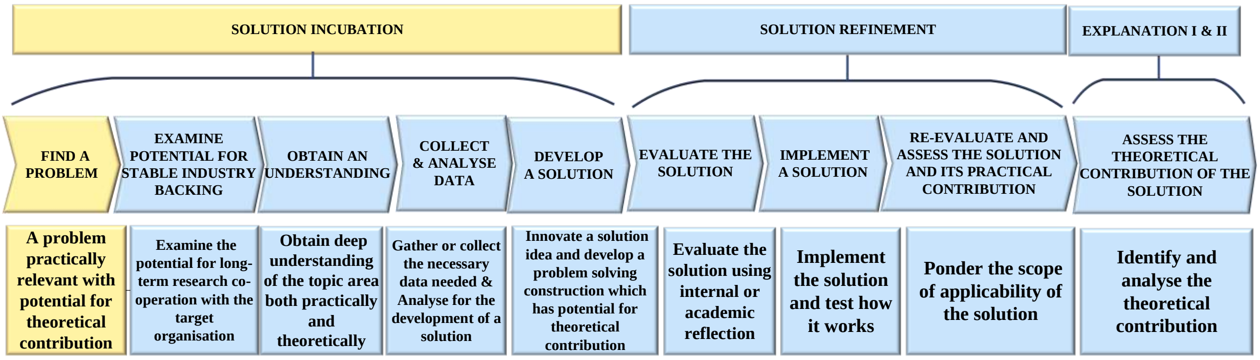
List of Abbreviations

AGM	- Assistant General Manager
AIA	- American Institute of Architects
AR	- Action Research
BM	- Benchmark
BOQ	- Bill of Quantities
BVP	- Best Value Procurement
CAPEX	- Capital Expenditure
CAM-I	- International Consortium for Advanced Management
CAQDAS	- Computer-Aided Qualitative Data Analysis Software
CBA	- Choosing by Advantage
CELT	- Centre for the Enhancement of Learning and Teaching
CIA	- Central Intelligence Agency
DB	- Design and Build
DBB	- Design-bid and Build
DBW	- Designing Buildings Wiki
DPR	- Department of Petroleum Regulations
DSR	- Design Science Research
EDT	- Executive Director Technical
F&LVM	- First and Last Value Model
FA	- Framework Agreements
FFITVD	- Framework for Implementing Target Value Delivery
FGN	- Federal Government of Nigeria
GDP	- Gross Domestic Product
BIM	- Building Information Modelling
IFOA	- Integrated Form of Agreement
IGI	- General Importance Index
IGLC	- International Group for Lean Construction
ILPD	- Integrated Lean Project Delivery
IPD	- Integrated Project Delivery
IPR	- Interview Protocol Refinement
ISO	- International Standard Organisation
IVM	- Institute of Value Management
LC	- Lean Construction
LCI	- Lean Construction Institute
NBS	- National Bureau of Statistics
NCI	- Nigerian Construction Industry
NG	- Nigeria
NIEEE	- Nigerian Institution of Electrical and Electronics Engineers
OGC	- Office of Government Commerce
OPEX	- Operating Expenditure
P2SL	- Project Production Systems Laboratory
PDCS	- Project Delivery and Contract Strategy Selection

PFI	- Private Finance Initiatives
PIF	- People Information Finder
PMBOK	- Project Management Body of Knowledge
PMI	- Project Management Institute
PMO	- Project Management Office
PSD	- Production System Design
QMU	- Quality Monitoring Unit
RII	- Relative Importance Index
SBD	- Set-based Design
SON	- Standard Organisation of Nigeria
TC	- Target Costing
TFV	- Transformation Flow Value
TPS	- Toyota Production System
TVD	- Target Value Design
UAE	- United Arab Emirates
UK	- United Kingdom
USA	- United States of America
VE	- Value Engineering
VM	- Value Management

CHAPTER ONE

INTRODUCTION



1.1 Background

Construction clients globally have placed increasing demands on the industry for continuous improvement (Oke and Ogunsemi 2011). Construction is a vital industry, with significant outputs and outcomes of activities in, for example, infrastructure which allows for goods and services to be distributed within and beyond countries. Construction contributes between 5-10 per cent of gross domestic product (GDP) in most countries and employs up to 10% of the working population (Ofori 2012). Low output in such an important industry can adversely affect the national economy.

Previous research has established that stakeholder fulfilment and successful outcomes have been realised in the construction industry through value creation (Salvatierra-Garrido et al., 2009). Emmitt et al., (2005) agreed by affirming that client/user fulfilment has been accredited to the identification and delivery of value parameters as value creation is the end-goal of all construction projects. Of late, researchers have stated that in construction projects, if the value is not decided upon initially, then it will be challenging to realise it at a later point (Drevland and Lohne 2015).

The literature reviewed assert that the success of many projects is linked to the initial agreement of value propositions and that the achievement of value creation for stakeholders is the fundamental purpose of projects. Despite the importance of value creation in construction and the industry's significant contribution to any national economy, the construction industry has been viewed as being highly inefficient, and value realisation has not been firmly established in the industry, regardless of past initiatives to improve value creation. Mostly, disappointments are encountered due to a lack of collaborative practices between designers, subcontractors and other specialist groups, who choose to work in isolation in their respective disciplines, the unpredictability regarding cost, time, and quality standards, with reports of the design phase usually sequential to the construction phase; This results in rework, change-orders, and re-pricing, thus making it unaffordable and off-target for clients (Oliva et al., 2016; Oke and Ogunsemi2011; Macomber et al., 2007; De Melo et al., 2014). The NCI is privy to all these problems (Oke and Ogunsemi 2011).

Literature reports that the failure of many construction projects in Nigeria can be attributed to various technical and financial pressures of cost limitations; quality and value optimization; diversion of project funds (especially in government projects) into individual purses (corruption); and lack of adequate management inputs in project administration (Anyanwu, 2013; Ugochukwu and Onyekwena, 2014 and Adeagobo, 2014). The NCI is also faced with various challenges such as cost and time overrun, corruption, lack of expertise, lack of funding/finance, excessive waste, and failure to adopt modern techniques (Ahiakwo 2014; Adamu et al., 2012; Adeagbo 2014; Olusegun and Michael 2011; Ameh et al., 2010; Oyewobi et al., 2011; Oke and Ogunsemi 2011; Odediran et al., 2012; Ugochukwu and Onyekwena 2014; Anyanwu, 2013; Adeyemo and Amade 2016). With the ongoing and future projections towards improving the NCI, there is a need to investigate effective techniques that could be adapted to deliver project completion as projected (Obi and Arif 2015). The general view of most construction challenges points towards an inability to deliver value. As value means different things to different people, the literature has tried to reflect this in a range of definitions. It is very important to mitigate the challenges in the construction industry as they may hinder value realisation. There is a general belief that value is not being created well enough; it also seems to be missing from contracts or designs. Value identification, value planning and value delivery do not currently appear in the industry setup, which is evident by the lack of conversation the subject is generating among professionals in the construction industry. There is a concern that the notion of creating value is absent in the industry in any real tangible way. This study developed a structured framework that makes value creation tangible.

According to Emmitt et al., (2005), there has been an increased emphasis in current lean construction literature on understanding the management of value. Some researchers have argued that LC and VM have the potential to improve value creation and make projects a success as the ultimate purpose of a project is to create value (Emmitt et al., 2005; Munthe-kaas et al., 2015). There is an improved focus on value creation and management, which is reflected in VM (Kelly et al., 2004), as well as LC (Ballard et al., 2007). The extensive progression and application of the value concept in construction can be attributed to disciplines like value management through practices like value engineering (VE), as well as Lean Construction (LC) through practices like TVD.

Value creation, which comprises value identification, proposition, and delivery (Cell 2004), is a fundamental concept in LC that contributes significantly to successful projects. Literature review highlights the importance of practices that promote value creation, such as target value design which has roots in both lean construction and value management and notes their weaknesses, considering the inefficiencies and challenges faced by the construction industry, while encompassing their strengths. This review has established that TVD serves as a platform for value identification (what is needed), value proposition (planning what is needed) and value delivery (achieving what is needed) by generally addressing construction challenges to eventually create value. Furthermore, current challenges can be mitigated by the adoption of innovative approaches like TVD, based on the significant benefits recorded in its implementation in various projects.

Additionally, Miron et al., (2015) have identified target value design (a lean approach), which supports project environments with favourable characteristics, to generate value. TVD could also serve as a strategic pathway for achieving more collaboration by adopting value perceived by the client (specific design criteria, cost, schedule) as a driver of design, seeking to eliminate waste and satisfying, or even exceeding, the client's expectations (Obi and Arif 2015; Oliva et al., 2016; Kim and Lee 2010). TVD is the term given to the adaptation of target costing to construction projects by Macomber et al., (2007). In practice, TVD has been reported to be good at maintaining predictable project cost and controlling cost overruns; delivering projects up 20% below their market prices without affecting time or compromising quality; ensuring early involvement of key stakeholders; and enabling collaboration (Do et al., 2014).

1.2 The Research Problem

The literature reveals cases where TVD has been successfully adopted/implemented in the past decade in various countries. These cases have reported significant benefits, support for high collaboration, cost reductions/certainty, and the delivery of products with higher added value in design and construction within a set target cost below the market price (Ballard and Reiser

2004; Ballard 2011; Denerolle 2013; Do et al., 2014; Macomber et al., 2007; Oliva et al., 2016; Rybkowski et al., 2012; Zimina et al., 2012).

Additionally, TVD has been associated with a better selection of integrated teams, learning & education, encouraging the production of innovative ideas in solving problems through a teamwork approach, and better identification of stakeholder value (Antti, 2017 and Chan et al., 2012). Impact on Cost is the most common factor reported on across the various literature reviewed. For example, Do et al., (2015b) reported that out of the 40 completed lean IPD and TVD projects by Sutter Health, Inc., all have typically been completed 10% to 30% below market price.

Over 150 cases of TVD implementation has been recorded in the USA alone (Koskela 2015), with varying levels of success, along with other cases being reported in countries such as Finland, Brasil and the UK, among others. However, the application of TVD in the NCI has not been fully explored; Previous studies have concentrated on assessing the possibility of applying TVD; i.e. awareness of TVD in the construction industry rather than its implementation (Obi and Arif 2015). It is not clear how the current design management practices in the NCI align with the underlying benchmarks and practices of TVD. It can be concluded that empirical studies examining construction practices across major sectors in the industry are lacking. For example, a case of target value design was investigated in a residential project in the NCI with findings from a questionnaire survey and literature-based case studies showing low frequency of use of TVD in the achievement of effective delivery of projects (Obi and Arif 2015). It is difficult to develop an appropriate approach that advances current practice largely due to a lack of empirical supportive data. Clearly, the more advanced and critical elements of TVD are not being implemented in current construction practice within Nigeria. The challenge in the current situation is that the intended benefits of TVD implementation are not being fully realised, neither at the organisational nor project levels. Failing to fully implement TVD clearly has adverse consequences on the flow of construction activities from the resource input needed for construction to the products getting produced and delivered.

Moreover, the challenges and how fragmented TVD Implementation is has also been reported in other construction industry's other than Nigeria such as Oliva et al., (2016), who found evidence based on an exploratory case study in Brazil which supports the claim that the benefits of TVD in traditional cases, i.e. where clients built for personal use, are inadequate in motivating property developers to modify their traditional practices. Issues of adapting collaborative practices have been observed to be a prominent challenge in TVD projects. There is difficulty in developing trust within the project environment due to uncommon collaborative practices, lack of early involvement of subcontractor/main suppliers, and lack of interaction among estimation and design teams (Do, et al., 2015b; Oliva et al., 2016; Morêda Neto et al., 2016). The literature reveals limited attempts to measure the levels of collaboration on TVD projects with a case reported by Oliva et al., (2016) where three levels of collaboration were measured, while this study examines five levels of collaboration. The different levels of collaboration can easily be confused and wrongly used interchangeably, but they have key differences. With collaboration being one of the backbones of the successful implementation of TVD, there is a need to examine the interrelationship and distinct requirements of networking, cooperation, coordination, coalition and collaboration.

Other issues reported are that the basic principles of TVD require extensive training and take time to comprehend; hence, they can seem discouraging when implemented for the first time on actual projects (Rybkowski et al., 2016), though this doesn't justify the current practices in the NCI, it clearly identifies the necessity to develop and test a framework that could be a supporting tool for construction stakeholders in the industry both in Nigeria and globally. Previous researchers worldwide have presented TVD approaches and processes which focus more on the pre-design and design stage of projects, which is not all-inclusive (Ballard 2012; Lee 2012).

To develop an all-inclusive framework to produce such needed support covering all stages in construction for enhanced value creation in the industry, empirical evidence on current practice is vital. Considering these challenges, this study focuses on: exploring the current design management practices in relation to TVD; the awareness of TVD, the feasibility of TVD; identifying the benefits, success factors, barriers, supports and impacts of implementing TVD benchmarks/practices; as well as measuring the five levels of collaboration during TVD across major sectors (buildings, infrastructure and public) in the NCI, using the underlying theories of TVD. Findings from the study are vital as they direct the development, evaluation, testing and re-evaluation of a framework that can support construction stakeholders in the implementation of TVD for enhancing value creation.

Other studies conducted on TVD in the NCI focused less on projects with practical application, which is not comprehensive, Literature asserts that numerous researchers have presented findings without considering the practical application, hence producing evidence that is not comprehensive (Smith 2015). Research that relies on the findings of both practical and theoretical sources is vital as its findings bridge the gap between theory and practice. The design science research approach was chosen for this research since the aim of this study is consistent with the aim of the DSR approach as it attempts to fill the gap between theory and practice. It solves a problem with practical relevance. (Smith 2015). The need for DSR cannot be overemphasised; Smith (2015) and Rocha et al., (2012) assert that it is a good fit for research in lean construction and more specifically in construction management. By extension, DSR is suitable for TVD research work as it is a Lean construction practice.

1.3 Motivation and Justification

This research is driven by the need for a comprehensive approach in the form of a framework to adequately support construction stakeholders when implementing TVD for enhancing value creation. The research is also driven by the lack of conclusive studies that have examined TVD application in different procurement routes and across sectors of the Nigerian Construction Industry.

The literature clearly recognises the importance of supporting the application of new techniques and practices using either a set of guidelines, roadmaps, benchmarks, frameworks or critical success factors (Sacks et al., 2010; Nanda et al., 2016; Nesensohn et al., 2014; Ogunbiyi 2014). Industry-wide benchmarking is paramount in accurately assessing project value (Nanda et al., 2016). To ensure the successful application of TVD, P2SL Labs of the University of Berkeley, California compiled a set of 17 benchmark practices. These have been updated two times, although the benchmarks are tailored more to the US Construction Industry equipped with IPD and multiparty collaborative contracts such as IFOA (Kaushik et al., 2014). They focus more on the project definition and design stages of projects.

However, in Nigeria, very limited studies have been conducted on the application of TVD. No study has explored and tested the application of TVD practice across major sectors of the NCI with the view to developing, evaluating, testing and re-evaluating a framework to support construction stakeholders in its implementation. In Nigeria, previous research by Obi and Arif (2015) only reported on “the efficacy and applicability of TVD in the context of low-cost housing project delivery cost management in the south-east zone of Nigeria”. Thus, their research has limitations as there was no evidence of TVD implementation or development of a support structure for TVD implementation for enhancing value creation. Thus, this is another knowledge gap that this study seeks to bridge.

The research reported in this thesis focused on the current design management practices in relation to TVD, the awareness of TVD, the feasibility of TVD. It identified the benefits, success factors, drivers, barriers, support, and impacts of applying TVD across major sectors (buildings, infrastructure and public) in the NCI, thus presenting a wider view of the current practice. The results are directed towards the development, evaluation, testing, and re-evaluation of a framework to support construction stakeholders in the implementation of TVD for enhancing value creation which is an expansion on previous frameworks.

Some researchers in the UK have investigated “the minimum required setting for TVD implementation in any non-IPD environment” (Kaushik et al., 2014). Applying the full potential of the TVD benchmarks has been reported to be challenging, especially in the public sector and traditional procurement route projects, mostly due to the lack of early involvement of stakeholders and government policies. Meaning that the need to apply TVD on other procurement routes apart from IPD is advocated. Furthermore, Oliva et al., (2016) argue that the characteristics of certain construction markets and procurement practices could challenge the successful adoption of the current TVD benchmarks in countries other than the US. According to De Melo et al (2016), only a negligible amount of research has been conducted on TVD; there are very few reports on the application of TVD in real-world projects or, indeed, the practice of TVD in projects that did not adopt IPD.

Literature suggests more research on TVD is needed on wider applications in various project types for evidence-based decisions regarding its adoption/adaptation in the construction industry, especially in developing countries (Emuze and Mathinya 2016). Morêda Neto et al., (2016) argue that literature on target costing and TVD reveals a critical gap on knowledge as TVD has been mainly examined in a narrow and specific context. There is a limited focus on the impact of TVD on quality and stakeholder value in TVD literature. TVD literature has focussed more on cost and time savings, while achievements in value-generation remains poorly documented (Miron et al., 2015). There is a need to document how TVD implementation can improve the quality of construction products and ensure compliance with initial design intent stated in the stakeholders’ value identification.

At the Global level, previous approaches developed to implement TVD emphasises the use of TVD to organise and oversee construction projects during the project definition and design phases. For instance, Ballard and Morris (2010), Lee (2012) and Kaushik et al., (2014) have developed a TVD framework with guidelines for pre-project planning, project definition and design stage, but no detailed steps for the construction and closing stages. Ballard (2012) also produced a TVD process diagram that shows detailed steps during the pre-design phase but none for the design, construction and closing phases of a project, while Orihuela et al., (2015) have produced a communication protocol for the implementation of target value design (TVD) in building projects. Furthermore, Jacomit and Granja (2011) have developed target costing integrated into the product development process. However, all the above-listed studies have presented details of TVD processes at the design stage, while some only mentioned the construction stage without providing any detail steps. This confirms a significant knowledge gap; therefore, the study reported in this thesis fills this gap by developing a comprehensive framework that encompasses the complete project life cycle, including project initiation, planning/design, execution, monitoring, and the control and closing stage which is an expansion of previous frameworks to be known as the Framework for Implementing Target Value Delivery (FFITVD).

This framework is not intended for a one-off improvement as reported by Pevez and Alarcon (2006), who states that tools have been developed in the past for one-off improvement, as is common with lean methodologies and tools. Rather, the framework developed in this study is aiming for more long term and far reaching improvements. Hence, it supports embedding the process in organisations through its steps and its continuous improvement of the process cycle. The FFITVD has been developed from findings from across the NCI and UK; it identifies organisational, cultural and background issues connected to it which are not addressed by other TVD frameworks developed elsewhere. Thus, it collaborates with reports of the significance of the understanding of the cultural background for successful implementation of lean tools in the way that previous lean implementations have influenced organisational behaviour (Ballard and Howell, 1998; Johansen et al., 2004; Johansen and Porter 2003; and Seymour 1998). The proposed framework is not limited to the NCI alone as the external evaluation findings of DSR justify that it could be adopted elsewhere.

1.4 Research Question

This research is focused on answering the following questions:

I. How does the current application and understanding of target value design in the Nigerian Construction industry align with the theories of TVD?
II. How can construction stakeholders be supported using a framework for the successful implementation of TVD for enhancing value creation?

1.5 Research Aim and Objectives

The aims and objectives of this study are presented below.

1.5.1 Research Aim

The aim of this research is to develop and test the framework for implementing TVD for enhancing value creation in the construction industry.

1.5.2 Research Objectives

The following objectives were set to achieve the aim of the study:

i. To understand the need for value creation in the construction industry within the existing literature.
ii. To review the literature on the current theoretical understanding and application of target value design in construction.
iii. To explore the current design management practices in relation to TVD, the awareness of TVD, the feasibility of TVD and value creation in the NCI.
iv. To identify the benefits, drivers, barriers, impacts, support and success factors of implementing TVD at all stages in the NCI.
v. To develop, evaluate, test and re-evaluate an approach to support the application of TVD for enhancing value creation in NCI.

1.6 Scope and Limitation of the study

This study focuses on the NCI. Although the results of this study can be applied in other countries, no case study was selected from any other country. Only top companies participated in this research, meaning that stakeholders who are not part of this project were omitted. All the respondents used for evaluation and analysis were drawn from the NCI and UK. Of the numerous lean construction tools that exist, the research focuses on exploring and testing TVD for value creation. The research first explored the current design management practices in relation to TVD, the awareness of TVD, the feasibility of TVD. It further identified the benefits, success factors, drivers, barriers, support, and impacts of applying TVD across major sectors in the NCI by examining all project stages from initiation, planning/design, execution, monitoring and controlling, and the closing of projects. The framework for implementing TVD was developed and tested based on the existing body of literature and the findings from case studies. The studies focused on traditional and design and build procurement routes and did not include other procurement routes.

1.7 Overview of Work Done

This section gives a summary of all the work carried out in the course of this research

1.7.1 Summary of Research Methodology

Selecting a specific philosophical standpoint, appropriate method(s) and a suitable methodology from the beginning of the research are vital. This study relies on the ontology of constructivism, the epistemology of interpretivism and the axiological applied school of thought to answer the research questions, develop and test a framework that will engender positive change in the NCI. This mirrors reports by Durant-Law (2005) who states the axiological applied school of thought, stating it creates value knowledge as a means of informing, transforming or enabling positive change.

Both qualitative and quantitative data were gathered to complement each other, to ensure an original contribution to knowledge and to establish the accuracy of data and results; all using different methods such as surveys, structured observations, interviews, document analysis and case studies. DSR was adopted for this study because the aim of the research is consistent with the aims of a DSR approach, which is to develop a solution that solves real-life problems while providing a theoretical contribution to knowledge (Ahiakwo 2014).

1.7.2 Summary of Research Process and Phasing

This study has been conducted through seven major phases which are related to the thesis structure. The phases are briefly discussed below:

Phase 1: Literature Review

The literature review considered the literature on the study background country of Nigeria, the need for value creation in the construction industry, target value design, collaborative working in construction, procurement routes, project management processes, and selective and competitive tendering. The review helped identify the knowledge gap and direction for the study. Databases such as the Emeralds, Elsevier, Google Scholar, the International Group for Lean Construction (IGLC), among others were used to access the journals, theses and publications that were reviewed.

Phase 2: Semi-Structured Interviews

Subsequent to the literature review, semi-structured interview questions were developed to determine the current design management practices in relation to TVD, awareness of TVD, cost-related practices, the feasibility of TVD and value creation in the NCI. This research used the purposive sampling method to select the participants for the research. A total of 26 interviews were conducted with industry experts who all had more than five years' experience. The respondents included: project managers, clients, contractors, consultants, architects, civil engineers, mechanical engineers, and quantity surveyors.

Phase 3: Survey

In addition to the interviews, a semi-structured questionnaire was adopted to provide more support by also determining the current design management practices in relation to TVD, awareness of TVD, cost-related practices, the feasibility of TVD and value creation in the NCI. A total of 208 questionnaires were distributed to professionals in the industry and 112 were completed, representing a total response rate of 53%.

Phase 4: Observation

Further exploration was done at the end of the survey to obtain objective data on the level of implementation (as observed) of the individual benchmarks in all the projects and the overall application of all TVD benchmarks observed in the individual projects. The current design management practices in relation to TVD and awareness of TVD in the NCI were also observed. Thirteen (13) public and private projects were observed through evidence from the physical condition and documentary analysis of their design management practices in relation to TVD practices and benchmarks. This was done using a guide developed for that purpose without necessarily interacting with the project participants. The levels of implementation of the benchmarks were assessed for individual benchmarks on all projects observed, and the overall application of all TVD benchmarks observed on the individual projects was reported.

Phase 5: Multiple Case Studies

The need for comprehensive deliberation and dealings with the physical project setting which could not be addressed extensively during the interviews, questionnaire survey and observations prompted the use of three case studies. This was done to determine the drivers, support, tools and techniques, project mindset and the success factor required for the successful implementation of TVD, as well as to ascertain the likely barriers and expected benefits of its implementation. Evidence was obtained through interviews, document analysis, observations and surveys on each of the projects. The cross-case study analysis was done for the three case studies. This was carried out in order to triangulate the results of the study and to understand the topic area, both practically and theoretically, as stated in step 3 of the DSR process of this study.

Phase 6: Development, Evaluation, Testing and Re-evaluation of the Framework for Implementing Target Value Delivery (FFITVD)

The activities in Phases 1 to 5 led to the development of a framework to support construction stakeholders in the implementation of TVD to enhance value creation in the NCI. The framework developed was named the framework for implementing target value delivery (FFITVD), and it contains sequential step by step procedures for implementing TVD and the drivers, support, tools and techniques, project mindset and the success factor required for the successful implementation of TVD, as well as to ascertain the likely barriers and expected benefits of its implementation. The framework highlights the points at which the different stakeholders participate in the project. Following the internal evaluation carried out, the framework was refined to Version 2. To determine its functionality, FFITVD was introduced to construction industry practitioners who went on to implement and test the framework on a project (case study 4). Evaluation and validation (internal validity) were carried out by 15 of the participants using interviews and surveys.

FFITVD was also introduced to seven academics and construction industry practitioners that did not participate in the implementation of the framework to evaluate and validate it (i.e.

external validity). Both the findings from the implementation as well as the feedback from the evaluation were used to further refine the FFITVD. A guide explaining the FFITVD meant to assist stakeholders in the construction industry when using it was created.

Phase 7: Research Conclusion, Contributions and Recommendations

The main contribution of this study is the framework that has been developed and expanded over and beyond what has been done before, with the additional embedded processes and strategy enhancing its contribution. It supports embedding the process in organisations in steps and through the resulting continuous improvement of the process cycle. It has identified organisational, cultural and background issues which have not been addressed by other frameworks. The framework developed is a contribution in terms of how it was designed and how it serves as a solution to unsolved problems. The most significant conclusion is that value creation can be improved using a more structured process. Most of the waste in the construction process can be moderated because value creation can be improved; only a different approach is required and that is what this research has developed. This study concludes that problems associated with value creation can be overcome by the developed framework, which expands on previous frameworks. Value can be created by appropriately structured techniques, approaches and training and by the creation of the right mindset.

Having completed the research, it should be noted that the framework has been well-received by industry stakeholders. Changes in the industry have come about because of this research. The study has improved other work beyond the research and is continuing to develop and influence practice in Nigeria, research in the US and academics in the UK. The framework is being used by practitioners in the NCI and professional bodies in Nigeria, researchers in other countries. For example, Texas A&M University in the USA is interested in the research and have inquired about possible collaborative work in the future on how TVD is used in the bidding process. A senior lecturer at Nottingham Trent University has requested a copy of the card game used in my thesis, which he intends to make use of in his lectures.

Following the framework evaluation, an overview of research aims, and objectives were revisited. The summary of the empirical findings from the literature review, interviews, survey, observation and case studies from phases 1 to 6 are presented (see Table 8.1). How the five research objectives of the study were achieved as well as the conclusions reached on each research objective was discussed. This phase stated the two research questions and how they were answered and presented the conclusions on both research questions. Contribution to the existing body of knowledge categorised into the practical and theoretical contributions of the study and framework was demonstrated (see table 8.2 and table 8.3). Following the contributions, the research publication including the plan for publication, limitations of the research, research recommendations for construction industry practitioners as well as recommendation for further research was assessed and documented (see chapter 8).

1.7.3 Overview of Contribution to Knowledge

This study has contributed to the existing knowledge in TVD, construction project management, value creation, lean construction and the NCI; and were categorised into theoretical and practical contributions. Some of which include: Initial results from the exploratory studies revealed the identification of the misalignment between the current design management practices in the NCI and the underlying TVD theories; a limited awareness of TVD; a few benchmarks appear to be applied to an extent, while some are not applied at all. Furthermore, the implementation of existing TVD benchmarks on three case studies uncovered that the level of implementation of individual TVD benchmarks ranged up to 81%. This is the first recorded case of TVD implementation in NCI, with findings that support the existing literature's evidence of a positive impact; however, the challenges faced have a negative impact on projects which, if not mitigated, can impede their successful implementation.

TVD has been successfully applied in both design and build and traditional procurement routes especially at the construction stage of a public and private sector projects concerning provisional and prime cost sums. Additionally, early participation of selected tenderers competing during the tender bid process due to the inclusion of TVD practices in tender criteria has been reported as beneficial with this research (TVD in bid process) gaining attention in Texas A&M University, USA.

The collaboration shortfalls when applying TVD in the NCI has been exposed. TVD flourishes with collaborative co-location, although the findings suggest virtual collaboration is also useful with non-colocated teams. whereby the findings led to the development of a comprehensive framework for implementing Target Value Delivery (FFITVD) categorised into project stages from initiation to closing and expanding on previous frameworks, which focused more on the pre-design and design stages of projects.

Extant literature shows no record of a comprehensive framework for the implementation of TVD covering all stages of construction in the NCI this study filled the knowledge gap. The successful testing and evaluation of the FFITVD in a live construction project established that it is comprehensive enough to be understood by stakeholders and has the capability of sustaining the implementation of TVD by making the construction industry more efficient by adding value, reducing waste, and reducing cost and time overrun.

1.7.4 Thesis Structure

An overview of the nine chapters discussed below presents the structure of the thesis.

Chapter One: Introduction

This chapter discusses the background to the study and reveals the existing knowledge gap. It shows the research questions, aim and objectives. It also mentions the motivation and justification for the study. The chapter also provides a thesis structure, an overview of work done, a summary of the study's practical and theoretical contribution to knowledge. Figure 1.1 shows the thesis structure relating the chapters to the phases.

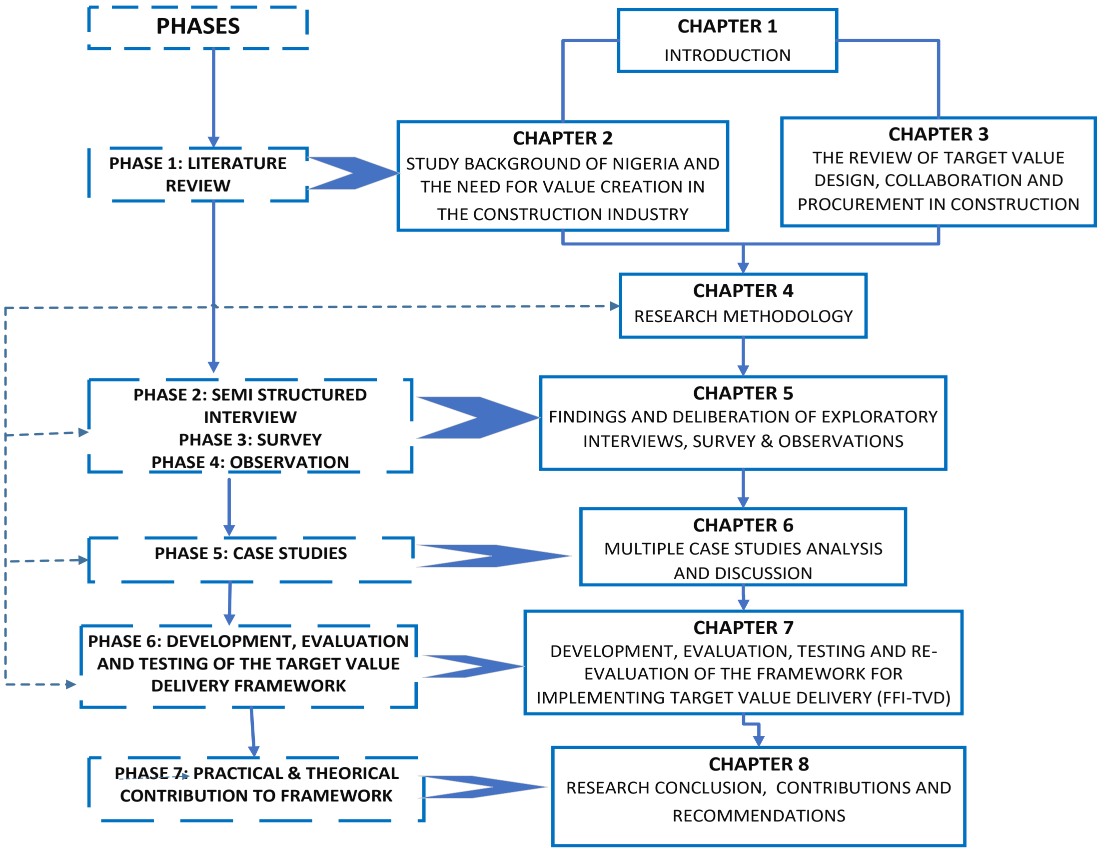


Figure 1.1 Thesis structure relating chapters to phases.

Chapter Two: The Study background of Nigeria and The Need for Value Creation in the Construction Industry.

This chapter investigates the NCI, its current performance, and all the challenges it faces. It then points out the need for innovative ideas for the growth of the industry. This chapter explores the need for enhancing value creation in the construction industry globally. It highlights the demand for, the importance and the challenges of the concept of value, and analyses various thoughts on value creation. The chapter states the knowledge gap about the need for enhancing value creation revealed by this study and goes on to understand value within the context of LC and VM. The chapter concludes by highlighting the importance of practices that promote value creation in a discussion of value in the context of TVD.

Chapter Three: Review of Target Value Design, Collaboration and Procurement in the Construction Industry.

This chapter focuses on the origin, history, and evolution of target value design. It explores target costing and its principles in the construction industry. It presents all the practices involved, and the principles guiding TVD practice. The chapter also investigates previous countries where TVD has been implemented to note successes or failures, and to explore reported challenges, benefits, success factors, support, tools and techniques, project mindset and the impact associated with the implementation of TVD.

Chapter Four: Research Methodology

A comprehensive account of the research methodology and method used in conducting the research is captured in this chapter. The results used in answering the objectives proposed in the first chapter is also presented in detail here. The chapter defends the reasons for the adoption of the research methods, then discusses in detail the DSR approach employed. It also presents the research design and deliberates on the phases of the research.

Chapter Five: Findings and Deliberations on Exploratory Interviews, Surveys and Observations

This chapter reports and discusses the analysis of the findings from the surveys, semi-structured interviews and structured observations of the current design management practices in relation to TVD and value creation in the NCI, the awareness of TVD, the feasibility of TVD and TVD benchmarks implementation.

Chapter Six: Multiple Case Studies Analysis and Discussion

TVD benchmarks were implemented in three case studies in this chapter. The analysis, presentation and discussion of the findings from the three case studies used in this study are presented in this chapter. Cross-Case study analysis and discussion were also presented.

Chapter Seven: Development, Evaluation, Testing and Re-Evaluation of the Framework for Implementing Target Value Delivery (FFITVD).

This chapter discusses the development of the FFITVD using result from the phases one to five of the study. It shows the design, development and iterative refinement of the framework based on comments and criticism arising from the internal and external evaluation of the framework. The chapter also discusses the findings from the implementation of the developed framework.

Chapter Eight: Research Conclusion, Contribution and Recommendations

The main conclusions and recommendations from this study are presented in this chapter. It discusses the conclusions on all the research objectives and the research questions, then lists the study's original contributions to knowledge, both theoretical and practical. It also identifies the study limitations and makes general recommendations and recommendations for further research.

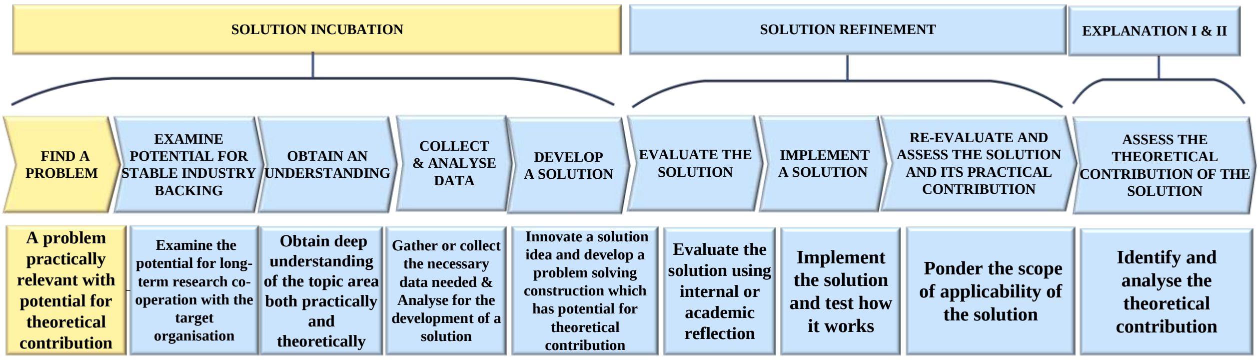
1.8 Chapter Summary

This chapter has introduced the research by identifying the research problem, stating the research aim, objectives and questions, and identifying the research scope, limitations and justification. The chapter concludes with a summary of the work carried out in the thesis.

The next chapter (Chapter Two) presents the background of the study area, the concept of value and the need for value creation in the construction industry. It also compares LC and VM regarding the concept of value. It identifies TVD as a practice which has principles rooted in both disciplines. The chapter further discusses value in the context of TVD, the recent global trends in value management and the recent technologies employed to improve value during the design process.

CHAPTER TWO

THE STUDY BACKGROUND OF NIGERIA AND THE NEED FOR VALUE CREATION IN THE CONSTRUCTION INDUSTRY.



2.1 Introduction

The preceding chapter has offered an introduction to the entire study. It has discussed the problem statement, aims and objectives and given an overview of all the components of the thesis. This chapter provides a general overview of the study background: Nigeria. This chapter explores the need for globally enhancing value creation in the construction industry.

It presents the successful outcomes realised in the construction industry through value creation, then highlights the demand for, importance, and challenges of, the concept of value and analyses various discussions on the issue, the chapter defines the knowledge gap regarding the need for enhancing value creation uncovered by this study, it goes on to understand value within the context of LC and VM. LC and VM are considered as practices that improve value creation for clients and stakeholders in construction. TVD is identified as the practise whose principles not only have roots in both disciplines, but also that which encompasses the strengths of LC and VM. The chapter further discusses value in the context of TVD, therefore establishing the foundation needed to develop and test the framework for implementing TVD for enhancing value creation in the construction industry. This chapter also discusses the recent global trends in value management and the recent technologies that have become available to improve value during design.

2.2 Nigerian Construction Industry and its Performance

Across the African continent, Nigeria is considered as having one of the fastest growing and best-established economies, with its construction industry being a significant contributor to its economic prosperity. The social and economic progress of any nation is associated with the building and construction sector. Nigeria is no exception; it has enjoyed positive impacts on the economy and general living conditions from its construction industry. These contributions range from facilitating the procurement of goods and services to the provision of housing and infrastructure, thus providing employment opportunities for the labour force.

An empirical survey done by the NBS in 2006 found that approximately 20% of the Nigerian workforce was employed in the NCI (Kolo and Ibrahim 2010), hence it contributes immensely to the country's GDP. Adeagbo (2014) further states that the sector not only has potential with respect to providing employment but also the activities within the sector promote effective linkages across all sectors, therefore enhancing and sustaining economic development.

According to Ogbebor (2002), the NCI mainly comprises non-indigenous companies, while Oseni (2002) states that only about 4% of the industry is not dominated by foreign contractors. He asserts that this is due to the belief that foreign contractors are more capable of handling complex projects. While Dantata (2007) agrees with this view, he further categorises the NCI into two major sectors, the organised 'formal' and the unorganised 'informal' sectors. Others have argued that small and medium-sized local contractors who mainly cater for private residential projects dominate the industry (Bashir et al., 2010)

Ahiakwo (2014) reports that since 1990 there have been failed attempts to develop other industries and sectors in Nigeria such as construction. Oluwakiyesi (2011) points out the long-term opportunities for growth and development in the NCI with a view to addressing its huge physical infrastructure and building gap especially in areas like road, rail, airport and seaports which can contribute significantly to the economy. The Nigerian government have made efforts to develop the NCI, such as encouraging partnerships between the public and private sectors for the development of roads, agriculture and power, and putting forth strategies to increase transparency, diversification of the economy and the improvement of fiscal management. Despite these efforts, the industry still faces challenges that impede its effectiveness and efficiency. However, the lack of infrastructure and the inefficient application of these improvements have served as major barriers to the development of the economy.

Regardless of the huge possibilities for the NCI to contribute to economic growth, it has been identified that little consideration is given to its real importance towards the prospect of contributing to the economy compared to other countries. The relationship between the construction industry and strong economic growth is evident in countries such as the UAE and

China, with the construction boom over the last decade due to the oil-fuelled growth for the former and industrial/export-driven growth for the latter (Oluwakiyesi 2011). The performance of the NCI, when compared to those of the countries mentioned above, is well below its potential in terms of contribution to the GDP of Nigeria. Adeagobo (2014) asserts that the NCI's performance in terms of its contribution to GPD is well below its potential, although improvements have been made.

Past studies identified some of the general challenges faced by local contractors, these include technical and financial pressures of cost limitations, lacking management input in project administration, and the diversion of project funds, especially government projects into personal pockets, need for working capital management not prioritised, amongst others (Ugochukwu and Onyekwena, 2014; Adeagobo, 2014 and Anyanwu, 2013). Despite the significant contribution of the construction industry to any nation's economy, it can adversely affect the economy if there is low output; this has informed the need to investigate effective techniques that could be adopted to deliver the expected performances of projects towards improving the NCI.

It can be easily be concluded that the NCI is weighed down by various challenges that have impeded its growth and ability to compete internationally. According to Adamu et al., (2012), adopting the modern techniques that are needed for improving value and eliminating waste is the main problem of the NCI; for example there is no record of the implementation of TVD in the NCI, while Adaegbo (2014) further states some of the challenges peculiar to the industry include the lack of vital building materials and technical expertise, constrained access to funding and the challenging business environment. Odediran et al., (2012) have found that there is a predominance of time and cost overruns of construction projects. Ahiakwo (2014) agrees by stating that the NCI is known for its poor performance due to cost overruns, failure to meet project completion times, poor project planning and control, and a high level of reworks and defects. According to Ahiakwo (2014), various researchers have identified these problems but solutions needed to tackle the problems are lacking.

Furthermore, another huge challenge faced by the NCI is corruption; the country was ranked 147 out of 179 countries under review in the 2007 Transparency International Corruption Perception Index (Arowolo 2008). Ayodele (2010) argued that up to 40% of project funds are illegally used in bribery and corruption to high government officials during contract award, execution and payment. Olusegun et al., (2011) assert that corruption is mainly caused by poverty, unethical behaviour of professionals, profit maximisation by contractors, greed, ‘god-fatherism’ in contract awards and societal corruption.

These challenges serve as a pointer to the fact that there is a need for improved construction processes for project delivery and to enhance value creation in the industry. The major challenges as identified from the literature are presented in Table 2.1. The fundamental ills of the construction industry which TVD aims at correcting to ensure that value is created are under the following categories:

Table 2.1 Major challenges of NCI.

S/N	CATEGORY	AUTHORS
1	Cost overrun & waste reduction	Ahiakwo (2014); Ameh et al., (2010); Oyewobi et al., (2011); Oke and Ogunsemi (2011); Odediran et al., (2012)
2	Time overruns	Ahiakwo (2014); Oyewobi et al., (2011); Ameh et al., (2010); Odediran et al., (2012)
3	Corruption	Ugochukwu and Onyekwena 2014; Anyanwu 2013; Adeyemo and Amade 2016
4	Poor management & expertise	Ahiakwo 2014; Adamu et al., 2012; Adeagbo 2014; Olusegun and Michael 2011
5	Lack of finance/funding	Adeagbo 2014; Ugochukwu and Onyekwena 2014;
6	Rework	Ahiakwo 2014

2.3 Value Creation in Construction

The literature reviewed assert that the success of many projects is linked to the initial agreement of value propositions and that the achievement of creating value for stakeholders is the fundamental purpose of projects. Previous research has established that stakeholder fulfilment and successful outcomes have been realised in the construction industry through value creation (Salvatierra-Garrido et al., 2009). Emmitt et al., (2005) agreed by affirming that client/user fulfilment has been accredited to the identification and delivery of value parameters as value creation is the end-goal of all construction projects. Of late, researchers have stated that in construction projects, if the value is not decided upon initially, then it will be challenging to realise it at a later point (Drevland and Lohne 2015).

Despite the importance of value creation, the construction industry globally has been viewed as highly inefficient and value realisation has not been fully established in the industry regardless of past initiatives to improve value creation. This has resulted in construction clients placing increased demands on the industry. This is due to disappointments in terms of whole-lifecycle costs, and the unpredictability of cost, time and quality standards. Reports telling of the design phase usually being sequential to the construction phase and collaborative practices being uncommon, with designers, subcontractors and other specialist groups working in isolation in their respective disciplines. This results in rework, change orders and re-pricing, thus making projects unaffordable and off-target for clients (Oliva et al., 2016; Oke and Ogunsemi 2011; Macomber et al., 2007; De Melo et al., 2014), with the NCI also being privy to these problems (Oke and Ogunsemi 2011). This is corroborated by Abdullateef (2011) who asserted that stakeholders in the NCI are not pleased with their investment outcomes. A lack of capacity to deliver value for the NCI has also been stated by Kolo and Ibrahim (2010).

The discussion on value dates to the Greek times of Aristotle in the 4th century BC (Martinez 2003). A lot of research has been conducted on the transactional context of value but insufficient on value creation and value delivery, which are still unclear concepts (Grönroos 1997; Bower and Garda 1985; Orrechia and Howell 1999; Jorgensen 2006). Salvatierra-Garrido et al., (2012) state that the term value is debatable, due to its many definitions. Intense deliberations, as well as the contributions of theories and management approaches such as lean thinking and VM etc., have led to a disjointed individual perceptual representation of creating value in construction. Therefore, value creation continues to be an important field to explore (Salvatierra-Garrido et al., 2009).

The general view of most construction challenges points towards its inability to deliver value. As value means different things to different people, the literature has tried to reflect this in a range of definitions. It is very important to mitigate the challenges in the construction industry as they may hinder value realisation. There is a general belief that value is not being created well enough; it also seems to be missing contracts or designs. Value identification, value planning and value delivery do not currently appear in the industry setup, which is evident by the lack of conservation the subject is generating among professionals in the construction industry. There is a concern that the notion of creating value is absent in the industry in any real tangible way.

This study developed a framework that makes value creation tangible. Munthe-kaas et al. (2015) have further argued that in construction, managing value is difficult and unpredictable due to the range of viewpoints, and human nature. Value creation has been reported as being comprised of value identification, proposition and delivery; also, it is described as the integration of knowledge from different transactions within a group because of human actions (Cell 2004; Normand and Ramirez 1993; Hjelmbrekke and Klakegg 2013). Lepak (2007) further argues that value creation in any project setting is based on the relative amount of value subjectively realised by the client (an individual, society or an organization), who is the focus of value creation. Haddadia et al., (2016) assert that value can be said to be generated when a client's needs are met, and planned goals have been achieved.

It is widely agreed that a strong connection exists between quality and value, with a higher level of quality having a positive impact on the value of products/services and client satisfaction. Having information on what clients want plays a very important role in attaining client satisfaction, which can be achieved if the intricate equation of performance and cost is considered by the construction industry. *"When conceptualizing value creation and asking what value is, along with where, how, by whom, and when it is created, the complexity of the value concept becomes clearly evident"* (Voima et al., 2010). The absence of a fixed understanding of "value" in construction has led to confusion and the setting of unclear boundaries with other construction value-related disciplines.

It is safe to say that value can be different things to different people; it does not have a perfect definition and what may be considered value by one may not be value to another. Value, to a large extent, depends on who requires it. Some view it in terms of quantity while others in terms of quality.

In agreement, researchers have established that deliberations on value raise inconsistencies that impede a general understanding of the concept, one which could find synergy in current thinking throughout several disciplines (Emuze and Saurin 2015). Mossman (2013) reported that value in construction is a concept that needs frequent updating and adjustment. In view of the complex nature of the concept, it needs integration and iteration; in this way, research into different approaches in construction may unlock new prospects of delivering value in the future (Salvatierra-Garrido et al., 2009; Kevin and Fadason 2012).

In the quest to improve stakeholder satisfaction, construction stakeholders are seeking innovative approaches to better deliver value. There is an improved focus on value creation and management, which is reflected in VM (Kelly et al., 2004), as well as LC (Ballard et al., 2007). The extensive progression and application of the concept of creating value in construction can be accredited to disciplines like LC through practices like target value design (TVD), and value management through practices like value engineering (VE).

Some researchers have argued that LC and VM have the potential to improve value creation and make projects a success as the ultimate purpose of a project is to create value (Emmitt et al., 2005; Munthe-kaas et al., 2015). Salvatierra-Garrido and Pasquire (2011) also concur on managing value being the desirable outcome of all construction projects; they also put forth the observation that recent lean construction literature shows an improved effort concerning understanding the management of value.

The need to know about value in VM and other value-related disciplines has been clearly stressed in the literature (Seni 2007). Wandahl (2015) established that it is imperative for value to be explored in concepts such as partnering, VM, and other disciplines, like lean construction, as it has been discovered that the application of value is a significant feature of these concepts. A review of the literature only identified a small number of interdisciplinary comparisons of LC and lean manufacturing with VM/value engineering (VE). There have been various efforts to develop a clear understanding of the theoretical and empirical views of value in the IGLC community. A predominant awareness of value as something fixed as opposed to an evolving and dynamic phenomenon has had a changing and limiting outcome on construction.

This review concludes by considering LC and VM as ways of improving value creation to clients and stakeholders in construction. In view of the extensive literature review carried out in this study, it is imperative to understand value in the context of LC and VM through the lens of the construction sector as it has been reported by Nayak (2006) and IVM (2015b). Both have recognised that lean and VM are established disciplines with complementary advantages and disadvantages, along with tools, techniques and practices used to improve each other's processes aimed at attaining value creation.

2.4 The Lean Construction Approach to Value Creation

Value is considered a vital part of the construction industry by the lean community; various theories, innovations and concepts have been developed and improved upon, all with the view of creating and improving value for the stakeholders. The lean construction literature has provided its own views on the concept of value; however, the concept is still unclear as it has no single definition.

The concept of value generation in TVD context will be best understood when viewed from the lean construction perspective. According to LCI (2016), providing value by achieving both customer and stakeholders' value throughout the project life cycle is a key vision and goal of the LC Institute. Lean scholars, like Ballard and Howell (1998), maintain that value is created through a process of concession between the customer's ends and means. Koskela, who is another recognised scholar of LC, developed a transformation flow value-generation (TFV) model, as reported in Koskela (2000). Each of these three concepts (last model, flow and value) concentrates on certain parts of the production phenomenon: value-adding transformation operates on the transformation concept; non-value-adding activities on the flow concept; and control of production from the customer point of view on the value-generation concept. These concepts, which reflect the value-generation view by Koskela, have strongly influenced the LC view of value (Salvatierra-Garrido et al., 2012). Salvatierra-Garrido et al., (2012) resolved that research has shown that the discussion on the delivery of value is concentrated more at the project level, with the subjective part of value given more significance, but their overall conclusion is that value is still unclear as it has no single definition.

Some researchers consider the reduction of waste as a significant way in which value can be added, while others consider the profit that is generated from a project as value. The literature review has identified several explanations and expressions of the concept of value in the LC community. For example, in the construction sector, value has been widely visualised through the first and last value model (F&LVM), developed by Salvatierra-Garrido and Pasquire (2011). Other models proposed have been a three-phase model (value/process/operation) and the identification of six value parameters (Emmitt et al., 2005). Additionally, according to Macomber and Howell (2004), a basic precondition to understanding value is to properly understand waste. Meanwhile, Lindfors (2000) stated that value is the product/service that adds profit, reduces time and cost, improves quality for the company, and produces profit/value for the customer.

Value-based management has since been established, aimed at improving effectiveness and efficiency in the construction industry by looking at different values (Wandahl and Bejder 2003). Value has been grouped according to owners, users and society, who represent different

interests and who value different things at different times throughout the construction lifecycle (Bertelsen and Emmitt 2005). Others have grouped value according to internal and external values (Emmitt et al., 2005), while Brimson and Antos (1999) are of the opinion that value relies on supply chain synchronisation.
It can be concluded that there have been established and extensive contributions to the progression of value over the years from the LC community through a multitude of relevant studies and researches.

2.5 The Value Management Approach to Value Creation

An extensive review of the literature identified that in the VM approach, value is usually stated as a ratio of function to cost, and the most agreed upon expression is that value is presented in the context of units of function which may be obtained for a unit of cost. In agreement with previous researchers, the terms influence, benefits, purpose, and user requirements have been related to value discussions by VM experts globally. The leading scholars of VM report that the concept of value defined in the literature by VM researchers confirms a reasonably fixed approach to its meaning (Kelly et al., 2015). By some, value has been presented as 'the most cost-effective way to reliably accomplish a function that will meet the user's needs, desires, and expectation' (Dell'Isola 1997). Gui Wen et al., (2006) argued that decisions, expectations, and views for cost paid, that have been used to determine user requirement satisfaction, are considered when dealing with value. The understanding of value is influenced by a selected mixture of benefits compared with acquisition costs.

Current researchers have established that VM has focused on the relationship between the user-required functions and cost, but have also recognised other concepts, such as benefit-realisation, value-based thinking style of management, etc. There is a misperception of the image of VM with other value-related techniques. VM is noted for being a one-off intervention, focusing mostly at or around the concept and sketch design stages with key challenges recorded at the implementation stage of projects (Kelly et al., 2015).

2.6 Comparison of LC and VM Regarding the Concept of Value Creation

The concept of value creation considered from the view of both lean construction and value management has been compared, mainly to identify a tool or practice common to both disciplines which encompasses their strengths and could possibly be an avenue for enhancing value creation. A range of similarities and differences between LC and VM were identified, with target value design identified as a practice whose principles are rooted in both disciplines, while encompassing their strengths. The report by Cell and Arratia (2003) strongly argued that both LC and VM approaches have potential and that combining them could offer great synergy in terms of the concept of value creation.

This review established a range of similarities between the two disciplines that suggest LC and VM are interchangeable, having the same objective of delivering value when considering their shared misapplication as cost reduction techniques. However, studies have also discovered a range of differences in philosophy and scope in various areas, including practitioners' duties, areas of practice, project timing and application, and practitioners' areas, amongst others. There has been an ongoing trend of linking VM and lean processes, evident in discussions at conferences both in the UK and US, (IVM 2014; LCI UK 2015; SAVE International 2015a; SAVE International 2015b).

Historically, both disciplines have shared origins and methods from the manufacturing sector (IVM 2015a). According to Womack et al., (1990), in the manufacturing industry value analysis and value engineering, which are known subsets of VM, have been used in target costing to achieve additional cost reductions. Both VE and LC have been found to systematically apply methods to processes/services to enhance the outcome that not only fulfil customers' needs in a cost-effective way but also in a timely manner, with the main objective of maximising value and minimising waste. Lehman and Reiser (2004) assert that LC practices more complement, rather than compete with, VE practices. However, LC is clearly a broader philosophy, encompassing more aspects compared to value management, with more advancements on the concepts of value over the years through relying less on other construction value-related disciplines, such as VM, VE and partnering. Despite the advances in the research on value within the LC literature, the concept of value is still a confusing one, with different interpretations forming the basis of its understanding.

Furthermore, it is agreed that no single approach between the two disciplines is greater than the other; however, some argue that there may be methodologies, techniques and theories from the two disciplines that can support the other when integrated (Nayak 2006), adding value for delivering satisfactory solutions. Some findings of this study suggest that target value design, which is a lean term given to the adaptation of target costing by Macomber et al., (2007), is a practice whose principles not only have roots in both disciplines but also encompass the strengths of LC and VM. In practice, TVD has been reported to be good at maintaining a predictable project cost and controlling cost overruns; delivering projects up 20% below their market prices without affecting time or compromising quality; ensuring the early involvement of key stakeholders; and enabling collaboration (Do et al., 2014).

Previous researchers have concurred with the findings. Novak (2012) has documented that TVD includes practices that enhance value from various disciplines, such as the use of value engineering for construction projects and value management for the client business case while adopting a value methodology throughout the design process. Male et al. (2007) stated that TVD also fits the description of value management as being a “team-based, process-driven methodology”. It has been argued that TVD generally improves the project environment with favourable features that generate value (Miron et al., 2015). In one sense, TVD could be a platform that fosters improved collaboration by adopting value perceived by the client (specific design criteria, cost, schedule) as a driver of design, while attempting to eliminate waste and achieve or exceed client’s expectations (Oliva et al., 2016; Obi and Arif 2015; Kim and Lee 2010).

Globally, the construction industry has been viewed as inefficient and lacking in the delivery of value, resulting in clients placing increasing demands on it. Therefore, this study aims at exploring TVD as a vehicle with the potential to create value and address some of the challenges faced in the NCI. TVD attempts to ensure maximum value for the customers, with minimum waste in the delivery process (Reiser 2003); thus, it has been found to engender a range of social, cost and quality benefits in projects.

2.7 Recent Global Trends in Value Management

The advocates of value management view the concept of value as being based on the relationship between fulfilling clients’ needs and expectations and the resources required for fulfilling those needs, which also involves reconciliation between determining those stakeholders needs and how to fulfil them with the best balance. Generally, stakeholders in the industry all over the world are beginning to broaden their perceptions and interpretation of value, while appreciating its unique nature by adding the apprehensions about the environment held by society (Olawumi et al., 2016; Thomson et al., 2003). The definition of VM over the years has been characterised by five key terms: Systematic process, Multi-disciplinary effort, Functions, Value and Life-cycle costs (Olawumi et al., 2016; Rangelova and Traykova, 2014).

The Value Management process has evolved over time into a more structured methodology. The process involves determining the needs and wants of the client, then setting target ratios and target cost, after which the excess requirements are identified and eliminated; function analysis is performed and alternative options are then generated/evaluated. The process is also a multi-disciplinary effort, where a group of professionals from diverse disciplines work together to analyse all aspects of the project; hence, it is not a “one-man-show”. Function analysis is one of the important aspects of VM; it is the element of VM which distinguishes it from other cost reduction exercises. In VM, questions such as: What does it do? and What is the function that the project seeks to achieve? are usually asked. These questions must be answered without compromising quality, safety, reliability, or the aesthetic attributes that the client demands. The overall objective of VM is not just cost reduction but the improvement of value, which involves balancing the cost, time, function and quality of projects. Life-cycle costs, which include the initial capital, the constructions cost, the operating cost, the maintenance cost and the disposal cost of the project, amount to the current value of the project over its entire operating life.

VM has been suggested as an effective approach to mitigate the problem of cost overrun in construction projects. However, it is significantly different from other cost reduction exercises which, Olawumi et al. (2016) noted, are normally unstructured and conducted informally. The VM process generally involves a sequence of steps that guide the project team through the problem-solving process. VM is, unsurprisingly, becoming one of the major methodologies of construction management for the development of high-performance and large-scale construction projects (Ru-jiang and Wung, 2016). The application of VM has become widespread, accepted and adopted in many countries, resulting in positive outcomes. Mahinkanda and Sandanayake, (2019) have observed that VM is usually applied to complex and repetitive projects that have constrained budgets.

In Malaysia today, after being made compulsory by the Economic Planning Unit, all public projects above 50 million Malaysian Ringgit must adopt VM (Aghimien et al., 2018). The US government also requires the use of VM for all projects that cost USD2 million and above, whereas the US Department for Transport has mandated the use of VM for projects costing as little as USD100 thousand (Olawumi et al., 2016). The driving factor behind the push for the use of VM, as noted by Ru-jiang and Wung, (2016), is to guarantee that clients can reliably follow through investment ideas, and successfully achieve their investment aims and the full life-cycle value of their projects. Despite being proposed as an approach that has the potential to deliver sustainable construction projects in some countries, in developing countries like Nigeria, VM has not been fully accepted nor widely applied. Some researchers attribute this trend to the low level of knowledge among professionals in the construction industry regarding VM and its potential benefits.

2.8 Current Efforts to Use Technologies to Improve Value During Design

Despite value in construction being elusive from a broader perspective, various efforts have been made to improve value during design using technology. Its adoption during design ensures increased productivity, stimulates better collaboration and ensures timely delivery of projects under budget, which eventually creates value for the project. Yates (1988) noted that over the years, technology has exerted diverse effects on the construction industry, although these effects depend on the types of construction undertaken. Nevertheless, they have always been evolutionary.

The design process in construction is becoming more efficient with the introduction of technologies such as building information modelling (BIM), the internet, immersive and mobile technologies; these technologies have the potential to widen and open the possibilities of assessing the impacts of early-design options in the industry. It is evident from the literature that construction firms are embracing various technologies that enhance the process of value creation during the design stage of construction projects. Various cases have been reported where technology has been adopted to improve value during design (Eastman et al., 2011). Building Information Modelling (BIM) is at the forefront of construction technologies that increase value realisation. Gerber et al. (2010) view BIM as an evolving technology that can enable the construction industry to achieve lean construction principles.

Eastman et al. (2008) itemised four categories of benefits derived from using BIM in construction projects, which include: pre-construction benefits, design benefits, construction and fabrication benefits and post-construction benefits. In the design stage, BIM aids design visualization and supports auto-correction of changes and 3-D plan generation. BIM also enables the performance of clash detection and automatic cost data generation. Ilozor and Kelly (2011) asserted that "*BIM provides a platform for collaboration throughout the project's design*". BIM enables the frequent updating and sharing of design data/information among project team members (Lin, 2015). Rowlinson et al., (2010) noted that BIM enables the identification and reduction of errors and design conflicts during design. The coordination that is associated with BIM bridges the communication gap in construction projects, thereby creating value.

Other technologies that support the increase of value during design include virtual teams, emails, video conferencing, cloud computing, instant messaging (WhatsApp), and others. The use of virtual teams for designs in the construction industry has become more widespread (Wilczynski and Jennings, 2003) and is now an important source of value creation in the industry (Santos, 2013). Working in virtual teams in construction involves various internet-based design activities. Various terms have been used to describe internet-based design activities. These include non-collocated teams, Internet-based teams, geographically and temporally dispersed teams, collaborative learning groups, globally distributed teams, distributed design, computer-mediated groups, e-design, geographically dispersed collaboration, and e-teams (Wilczynski and Jennings, 2003).

The main significance of using a virtual team is the capacity to access information and knowledge from diverse locations. The members of a virtual team are expected to work as a group, even without physically being together, to create value that otherwise would not be possible. According to Santos (2013), the most common definition of a virtual team is a team whose members are spread across different geographic locations and who use technology to facilitate communication. Technology, such as emails, video conferencing, cloud computing, mobile technology, virtual reality, 3D printing, artificial intelligence, etc., can increase the value of virtual teams.

Web-based collaboration tools also help to increase value during design. Wilczynski and Jennings, (2003) enumerated web-based tools that can increase value for virtual design teams to include:

a. Project discussion forums

b. Project file depositories

c. Real-time data exchange

d. Instant messaging (augmented with voice and e-mail)

e. Training and project management documentation

Although many innovative solutions are already being applied on a small scale or in a few countries, for increased value during the design stage, the industry still needs large-scale application or better adaptation of current technological developments.

2.9 TVD Literature Highlighting Various Explanations of Value Creation

This review establishes that target value design is about delivering the desired value to a client/end-user. Several scholars of TVD stress that in order to achieve success in projects it is imperative to identify, plan during design and achieve during construction stakeholders' value. From the review of literature value is still uncertain and how to create it is still confusing as it lacks a structured approach or process of achieving it. According to Rybkowski et al., (2012), before customers can achieve their aims, value is required. Value is an estimation made in relation to a set of issues that need to be addressed (Macomber et al., 2012). Novak (2012) stated that explicit values are to be defined in projects and tried to explain the practices that help create and align value with project goals in a TVD context. However, the same researcher mentioned the gaps created in the value creation dialogue (Novak 2012). The findings of Miron et al., (2015) report that the definition of what is value in a TVD context is still unclear: values, which are meant to be principles and guidelines for living, are being used as value, as in what customers need, thereby bringing about confusion in lean theory as well as in solving practical problems for knowledge management in the built environment. Values and value are agreed upon between project stakeholders, and these processes (conversations) are implied in the basic formulation of the value theory during the practical implementation of benefits realisation (Rooke et al., 2010).

As mentioned in Miron et al. (2015), several TVD papers stress the need to develop a relationship with the client, as well as the need to outline the client values, stakeholders values and values of the team, in order to deliver these so-called value(s) as a result of the project (Ballard and Reiser, 2004; Pennanen and Ballard 2008; Lee et al., 2010). To determine customer value in a TVD context, a card game developed by Kowaltowski et al., (2006) has been successfully adopted by some researchers: De Melo (2015) and Oliva et al., (2016) in their target costing and target value design research, respectively. Five categories of value attribute are defined in the card game, which includes: financial aspects, cultural values, indoor, socio-cultural and spatial qualities. Studies have recorded support for strategic decision-making by stakeholders as well as improved understanding of perceived value through the hierarchical perspective detailed through marketing techniques (Bonatto, Miron and Formoso 2011; Brito and Formoso 2014; Hentschke et al., 2014).

2.10 Chapter Summary

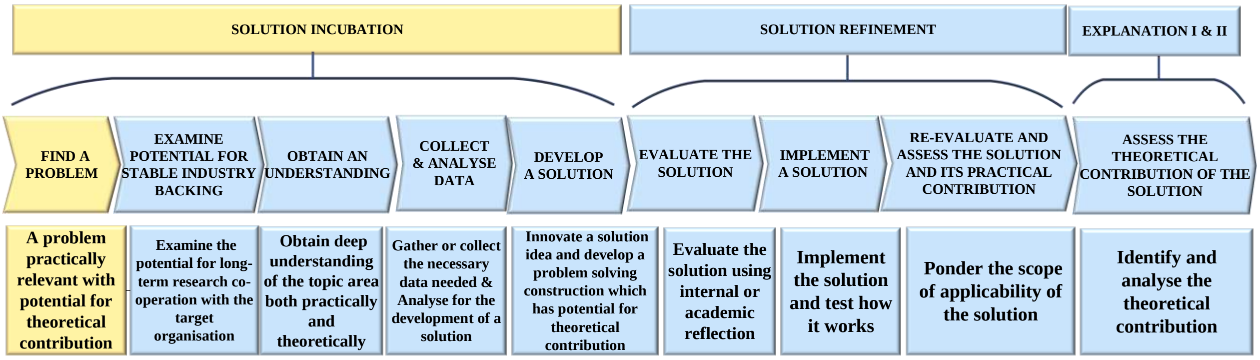
This chapter has investigated the study background of Nigeria, as well as the NCI, its current performance and all the challenges faced within this industry. Following the extensive review of literature in this chapter, the notable gaps which have become obvious in the NCI include the challenges of cost and time overruns, corruption, poor management and expertise, lack of funding and a difficult business environment. The general outcome of most construction challenges points towards a lack of value delivery. From the review of literature, value is still uncertain and how to create it is still confusing as it lacks a structured approach or process of achieving it. Literature has identified that there is a concern that value creation is absent in the industry in any real tangible way; it also seems not to appear in contracts or designs. This study developed a framework that makes value creation tangible.

Despite value in construction being elusive from a broader perspective, various efforts have been made to improve value during design using technology, such as building information modelling (BIM), the internet, and immersive and mobile technologies. These technologies have the potential to widen and open up the possibilities of assessing the impacts of early-design options in the construction industry. It is evident from the literature that construction firms are embracing various technologies that enhance the process of value creation during the design stage of projects. The use of virtual teams for the purpose of design has become more widespread and is now an important source of value creation in the industry. The Value Management process has evolved into a more structured methodology over time and has become widespread, accepted and adopted in many countries, resulting in positive outcomes. Generally, stakeholders in the industry all over the world are beginning to broaden their perception and interpretation of value, while appreciating the unique nature of it by adding society's apprehensions about the environment. However, in developing countries like Nigeria, VM has not been fully accepted and widely applied. Some researchers attribute this trend to the low level of knowledge among professionals in the construction industry regarding VM and its potential benefits.

Regardless of the importance of value creation, the construction industry globally has been viewed as highly inefficient and value realisation has not been established enough, despite past initiatives to improve it. This has resulted in construction clients placing increased demands on the industry. The next chapter explores Target Value Design, highlighting its origin, its benchmarks and principles. It discusses the recorded benefits, challenges, support, tools, techniques and the impact of implementing TVD. It also investigates the concepts of collaboration, procurement, project management, the Lean Project Delivery System (LPDS) and integrated project delivery (IPD). It further reviews TVD and current design practices in the NCI; the role of the client within TVD implementation; a comparison of TVD with traditional design practices; the advantages and disadvantages of the TVD approach; and a comparison of TVD with the latest developments in IPD and BIM.

CHAPTER THREE

A REVIEW OF TARGET VALUE DESIGN, COLLABORATION AND PROCUREMENT IN CONSTRUCTION



3.1 Introduction

The previous chapter discussed the study area, value, value management and the need for value creation in the construction industry. This chapter presents an extensive literature review on target value design (TVD) with the goal of achieving the second objective of the research. It aims to describe the current theoretical understanding and application of TVD in construction. This chapter is divided into sections; the first section starts with a discussion on target costing and its procedures. It then goes on to discuss the meaning of TVD, the benchmarks and the principles, while highlighting the benefits, barriers, tools and techniques, impact, support and success factors for TVD implementation. This section further reviews TVD and current design practices in the NCI; the role of the client within TVD implementation; a comparison of TVD with traditional design practices; the advantages and disadvantages of the TVD approach; and a comparison of TVD with the latest developments in IPD and BIM.

The next section focuses on collaborations and collaborative working in construction. It emphasises the need for collaboration and the interrelationship between collaboration, cooperation, and coordination. The last section examines procurement and the various procurement routes available for the construction industry.

3.2 History of Target Value Design

To discuss TVD, one must first look at its origins which lie in target costing. TVD is an adaptation of target costing from manufacturing (Kaushik et al., 2014; Namadi et al., 2017; Tillmann et al., 2017; Cooper and Kaplan 1999; Ballard et al., 2015; Morêda Neto et al., 2016; Cooper and Slagmulder 1997; Do et al., 2015). Target value design (TVD) emerged from target costing from the manufacturing industry by modifying its principles, processes and practices. It is an improved version of target costing with an addition of stakeholder's value creation as a driver of design and construction. The idea of target costing focus mainly on setting "cost" target while target value design broadens the concept to include time, quality, value targets etc. It has become more and more frequently used and accepted by the construction industry in the United States since its introduction in 2002 (Do et al., 2014).

Tillmann et al., (2017) described target costing (TC), as a practice used in the development of new products, especially in the car manufacturing industry. It originated in the Japanese automotive industry in the early 1960s as a cost reduction and value management strategy (Cooper and Slagmulder 1997; Liker 2004; Jacomit and Granja 2011) and was known to the Japanese as Genka Kikaku (Kato 1993; Tillmann et al., 2017; Nicolini et al., 2000; Jacomit et al., 2008; Miron et al., 2015). Target costing systems recognise the cost at which the product must be manufactured first if it is to attain its profit objective and then creates an environment that is controlled to help guarantee that the target cost is met (Cooper and Slagmulder 1997).

This is corroborated by Tillmann et al., 2017 who emphasised that an essential principle of the target costing method is to look at the cost as a contribution to the product development process, rather than a product of the process. Target costing ensures that the product is designed to satisfy the customers' needs with a strategically determined cost in mind. Ansari et al., (1997) cleverly refer to target costing as a "system of profit planning and cost management that is price-led, customer-focused, design-centred, and cross-functional".

3.2.1 Target Costing Procedures

Cooper and Slagmulder (1997) broke down the target costing procedure into three major steps; market-driven costing, product-level target costing and component-level target costing.

Lee (2012) defined these three steps as:

i. Market-driven costing, which is establishing the product's allowable cost by deducting the target profit margin from the target selling price.
ii. Product-level target costing, which has to do with setting the product-level target cost less than the allowable cost, encouraging designers' creativity to design to target cost.

iii. Component-level target costing, which involves the establishing component-level target cost based on the firm's willingness to pay for each of the components that suppliers provide.

While De Melo (2015) proceeded to further break down the target costing procedure:

- Market-driven costing (five steps)
  - i. set long-term sales and profit objectives
  - ii. structure the product lines
  - iii. set the target selling price
  - iv. establish a target profit margin and
  - v. Compute allowable cost.
- Product-level target (three steps):
  - a. set Product Level Target Cost
  - b. discipline the target costing process and
  - c. Achieve the target cost.
- Component-level target (three steps):
  - i. set the target costs of components
  - ii. select key suppliers and involve them in order to achieve targets and pursue innovation; and
  - iii. Identify cost reduction ideas by means of value analysis.

The International Consortium for Advanced Management (CAM-I) developed six principles of target costing: price-led costing; focus on customers; focus on design; cross-functional involvement; value-chain involvement; and a life-cycle orientation. (Ansari et al., 2006; Lin et al., 2005; Sharafoddin 2015; Swenson et al., 2003; Jacomit et al., 2008). The principles are referred to as the main principle of target costing by the lean construction community. Swenson et al., (2003) described target costing as cost management and profit planning done methodically.

Ballard (2008) defined target costing in relation to allowable cost and expected cost thus

$$\textbf{Allowable Cost} \geq \textbf{Expected Cost} \geq \textbf{Target Cost} \quad \textbf{… Equation 1}$$

3.3 Target Value Design

TVD is an innovation that aims to create value for the stakeholders by reducing waste and ensuring all aspects of the construction process are carried out with the stakeholder's agreed targets (cost, quality, standards, time and stakeholders value) in mind. It ensures that the client gets the best possible quality within an affordable and realistic budget. TVD leverages all resources and skills collaboratively. Many researchers have come up with different definitions of target value design (TVD): Kim and Lee (2010) defined it as a management strategy that is designed to eliminate waste and deliver value by using a 'design-to-cost' method, while Morêda Neto et al., (2016) described it as a management approach that utilizes features of target costing, and adapts them to the construction industry. They went further to say that the focus of TVD is to make the client's value a primary driver of design by improving the project definition during programming, thus optimizing the design phase.

From the literature review, we recognise that TVD:

i. is a management tool, strategy, approach, or practice
ii. focuses on targets comprising cost, time, quality and stakeholders value as the main criteria for design; and
iii. Requires collaboration both face to face and virtual to succeed.

"TVD is a management practice rather than a type of contract or simply a cost control technique" (Zimina et al., 2012). Essential to TVD is the practice of designing to targets rather than designing, then checking whether budgets, schedules, etc. have been exceeded. Rybkowski et al., (2016) argue that although it is increasingly being used for lean-integrated project delivery processes, predominantly in the healthcare facility sector, the basic principles of TVD take time to comprehend and can seem discouraging when implemented for the first time on actual projects.

Oliva et al. (2016) advise that TVD can benefit from the early involvement of key stakeholders using IPD processes. They are supported by Morêda Neto et al., (2016) when they said financial incentives, the formation of partnerships, and other contract methods can engender results regarding collaboration necessary for the TVD approach. De Melo (2015) said TVD can be executed in various project delivery methods; nevertheless, it is best suited to integrated project delivery (IPD), as close collaboration between the stakeholders (designer, the builder, and the owner) is vital.

3.3.1 Target Cost

Zimina et al., 2012 defined the target cost for a project as the figure the design team are going to work towards as it is a product of the feasibility study; they referred to it as the goal set to be the ultimate construction cost. Ballard (2008) and Ballard (2009) support this definition saying, "The target cost is what the team commits to deliver, sometimes contractually and sometimes 'only' morally, and is typically set below the expected cost in order to spur innovation beyond current best practice."

However, Emuze and Mathinya (2016) argue that it is extremely difficult to get working accuracy of the target cost, Do et al. (2015b) explained that the target cost is arrived at by deducting the product's anticipated profit from the expected selling price. This has been substantiated by numerous researchers (Ansari et al., 2006; Dekker and Smidt 2003; Ellram 2006; Okano & Suzuki 2007) quoted in Tang (2015), saying that the variance between the expected selling price (based on the price level of existing products/services or competitors' offerings) and the profit margin expected (which stems from an organization's strategic profit plan) determines the target cost.

3.3.2 Allowable cost

The TVD method starts with an allowable cost determined by the owner's business plan (Novak, 2012). Ballard (2008) defines the allowable cost as the cost a client is able and willing to spend to get what they need to achieve their purposes for a project. He listed capital availability and ability to repay/recover as determinants of the allowable cost.

Rybkowski (2009) believes that the allowable cost signifies the maximum cost that must not be surpassed; if the project team is unable to design to allowable cost, the project must be cancelled because it would become financially unachievable. Granja et al., (2005) argued that in logical terms the allowable cost is often far less than the current estimated cost. Ballard (2008) suggests that if the estimated cost is more than the allowable, there is room for the business case to be revised or the project abandoned. Granja et al., (2005) views allowable cost as the goal of managing cost activities from a broad company's perspective.

3.3.3 Expected cost

The expected cost is a term used in TVD to refer to the cost that is projected for a project based on the most effective professional practices. Rybkowski (2009), who takes a straightforward approach to define the cost terminologies in TVD, defines expected cost as the estimated cost of the project in its existing state through the TVD process, saying that it is recalculated repeatedly with every iteration of the design. Ballard (2008) corroborates this definition and further explains that similar facilities or some type of cost model could be the basis of the expected cost forecast.

According to Zimina et al., (2012), in practising TVD the project team compares the expected cost with the allowable cost and if the allowable cost is less than the former the team begins a search for an adjustment between what is wanted, how much it costs and what can be done to get what is wanted. Ballard (2008) substantiates this by saying, "*If the expected cost is greater than the allowable cost, the project does not meet the client's business case and the project should either be abandoned or the business case revised*." One of the major focuses of the project team is to ensure that the expected cost is not more than what the client is willing to pay, else proceeding with the project is a confirmed risk. The estimated cost is only accepted after collective and collaborative work is done over time by critical stakeholders who iteratively design and redesign the project to meet the pre-determined allowable cost (Nanda et al., 2014).

3.3.4 Market Cost

Market cost is a benchmark cost: it encompasses the cost per square foot that would be expected for comparable construction projects, and it is sometimes referred to as the benchmark estimate (Rybkowski 2009). This definition was supported by Tommelein and Ballard (2016), who say that market cost is the original expected cost determined through benchmarking to a market of the owner's desires. They emphasise that its comparison to allowable cost governs the decision to proceed or not with validation.

3.3.5 Actual Cost

Tommelein and Ballard (2016) defined actual cost as the recorded amount of money spent to perform work (an activity, block of work, or an entire project) based on the agreed definitions of cost, overhead, and profit. The various costs used in TVD (target, allowable, expected, market and actual cost) guide the project team during design. They are also used when planning and setting realistic targets.

3.3.6 Whole-Life Target Value Design

Whole life target value design is a relatively new concept that extends the boundaries of TVD beyond just designing and constructing projects to target but also to operating and maintaining them while assessing the whole life costs and benefits of the asset. It aims to reduce the restrictions on value generation. Ballard and Morris (2010) and Ballard (2012) reported that research efforts aimed at improving the effectiveness of TVD practice by extending it to whole life costs and benefits of the constructed projects are currently ongoing; and this has given rise to the concept of “whole life TVD”, initially developed for the UK’s National Health Service. This was inspired by a yearning to allow better investment of cost savings (Ballard and Morris 2010). As early as the year 1988, the concept of life-cycle cost had been documented in Berliner and Brimson (1988).

Ballard (2012) stated that the cost of construction constitutes the following: the cost for designing, the cost of constructing, the cost to operate and maintain the physical facility, and finally the costs and benefits of asset use. The cost of construction does not end at designing and constructing but goes further to include the operational/maintenance cost and the benefits derived from the use of the constructed asset. Ballard (2012) suggests that as a result of these, the design should be focused on the life cycle and whole life costs, and to whole life benefits, which must be sufficiently large to pay for all the costs and allow for profits. “Whole life TVD”, is used to specify the addition of costs and benefits from the use of facilities, in addition to facilities management costs (Ballard and Morris 2010).

The current research efforts on whole life TVD aims to develop and validate methods for:

i. modelling whole life costs (operations cost models) that can be used to determine allowable costs;
ii. benchmarking market costs that are more accurate than current methods and
iii. linking product models to operations cost models to forecast the impact of design alternatives on whole life costs and benefits.

Whole life TVD research has the goal of reducing the restrictions on value generation. According to Ballard (2012), this can be achieved by:

a. allowing project budgets, allowable costs, to change during design in response to the forecast impact of design alternatives on whole life costs and benefits; and
b. developing the means for financing these investment opportunities.

3.3.7 Relationship Between Targets (Cost, Quality, Schedule and Stakeholders' Value)

One of the key aspects of TVD is the setting of targets and striving to achieve them, which is done with the input of key team members. This aligns the thinking of team members and serves as a motivating factor to spur innovation with the aim of achieving the desired scope, schedule and cost targets. Targets in TVD are very critical to the success of projects; the strategic process of setting the project targets provides direction in projects and aids in establishing performance goals. Booth (1995) observed that "target analysis" is comprised of target cost and target quality components; in TVD projects, target cost and quality are carefully scrutinised in order to achieve the purpose of the project. This is corroborated by the recommendation of Ballard (2012), where he maintained that the cost, schedule and quality implications of design alternatives are discussed by team members (and external stakeholders, when appropriate) prior to major investments of design time. Even though the design team does not participate in setting the target cost, (Zimina et al., 2012), the design team members work collaboratively to find innovative ways of achieving the target cost without compromising scope, schedule, or quality (De-Melo et al., 2016).

Pease (2017) highlighted five principles to consider when setting targets for a successful TVD process. These include:

a. Not setting targets arbitrarily; there should be some logic to support the targets.
b. Involving the team in setting targets; not setting them in a vacuum.
c. Making the targets achievable; not setting something so aggressive that it seems impossible.
d. Focusing on optimizing the whole, not any one piece.
e. Focusing on the process, not just the numbers.

Pease (2017) claimed setting cost targets for a team can align thinking and motivate members to innovate. How those targets are set and who is involved in setting them is just as important as what targets are set on the project. Through a focused strategy, projects can achieve the desired scope, schedule, and cost. De-Melo (2015) and Ballard (2008) believed that the target cost should be set below the expected cost to spur design innovation; however, Pennanen and Ballard (2008) maintained that the expected cost and the target cost should not be too low in order, to prevent unrealistic targets, and not too high, in order to create real pressure on the design team to innovate solutions.

The fifth TVD benchmark stipulates the production of a detailed budget and schedule aligned with scope and quality requirements through the feasibility study (Ballard 2011; De-Melo

2015; De-Melo et al., 2016; Neto et al., 2016). As the success of TVD has a high dependence on the setting and achievement of targets, the cost and schedule targets cannot be exceeded. This is further supported by one of the cardinal rules of TVD, that must be agreed upon by the project team members, which is that only the customer has the power to change the scope, quality, cost or schedule targets.

3.3.8 TVD Benchmarks and Principles

The literature revealed that research into and practices of TVD have been directed within the lean philosophy context and depend on the benchmarks and practices described below. The TVD benchmarks were published by the University of California, Berkeley's Project Production Systems Laboratory and updated twice. The current TVD benchmark, which is a revision of the original published in November 2005 indicates that the benchmark dwells more on the project predesign and design stages with little provision for the construction and closing stages of projects.

The TVD process benchmarks published by Ballard (2011) were derived from theory and empirical studies of TVD projects; they reflect practices that have been found to bring about positive outcomes on TVD projects (Do et al., 2015). There are 17 benchmarks, and they are presented in Table 3.1 These benchmarks are tailored more to the US Construction Industry, which is equipped with IPD and multiparty collaborative contracts, such as IFOA (Kaushik et al., 2014). Furthermore, the benchmarks are more focused on project definition, planning and the design stages of projects.

Table 3.1 TVD benchmarks

BENCHMARK	DESCRIPTION
Benchmark 1	With the help of key service providers, the customer develops and evaluates the project business case and decides whether to fund a feasibility study; in part based on the gap between the project's allowable and market cost.
Benchmark 2	The business case is based on a forecast of facility life-cycle costs and benefits, preferably derived from an operations model; and includes specification of an allowable cost—what the customer is able and willing to pay to get life cycle benefits. Financing constraints are specified in the business case; limitations on the customer's ability to fund the investment required to obtain life cycle benefits.
Benchmark 3	The feasibility study involves all key members (designers, constructors, and customer stakeholders) of the team that will deliver the project if the study findings are positive.
Benchmark 4	Feasibility is assessed through aligning ends (what's wanted), means (conceptual design), and constraints (cost, time, location, …). The project proceeds to fund only if the alignment is achieved or is judged achievable during the course of the project.
Benchmark 5	The feasibility study produces a detailed budget and schedule aligned with scope and quality requirements.
Benchmark 6	The customer is an active and permanent member of the project delivery team.
Benchmark 7	All team members understand the business case and stakeholder values.
Benchmark 8	Some form of relational contract is used to align the interests of project team members with project objectives.
Benchmark 9	A cardinal rule is agreed upon by project team members – cost and schedule targets cannot be exceeded, and only the customer can change the target scope, quality, cost or schedule.
Benchmark 10	The cost, schedule and quality implications of design alternatives are discussed by team members (and external stakeholders when appropriate) prior to major investments of design time.
Benchmark 11	Cost estimating and budgeting is done continuously through intimate collaboration between members of the project team— 'over the shoulder estimating'.
Benchmark 12	The Last Planner®4 system is used to coordinate the actions of team members.
Benchmark 13	Targets are set as stretch goals to spur innovation.
Benchmark 14	Target scope and cost are allocated to cross-functional TVD teams, typically by facility system e.g., structural, mechanical, electrical, exterior, interiors, …
Benchmark 15	TVD teams update their cost estimates and basis of estimate (scope) frequently. Example from a major hospital project during the period when TVD teams were heavily in design: estimate updates at most every three weeks.
Benchmark 16	The project cost estimate is updated frequently to reflect TVD team updates. This could be a plus/minus report with consolidated reports at greater intervals. Often project cost estimates are updated and reviewed in weekly meetings of TVD team coordinators and discipline leads, open to all project team members.
Benchmark 17	Co-location is strongly advised, at least when teams are newly formed. Co-location need not be permanent; team meetings can be held weekly or more frequently.

(Source Ballard 2011)

Martin (2015) recognises three TVD principles: 1) The Cardinal Rule - the total target cost of the facility must not be exceeded; 2) The Corresponding Rule - the buyer's satisfaction with the result is equally important; and 3) The Fundamental Challenge - anything unnecessary to the delivery of value is considered waste. These principles are paramount in guiding a TVD project team: the whole essence of having a set of targets is defeated if the target set for a project is always exceeded.

Zimina et al., (2012) recognise two principles fundamental to TVD. These are:

i. money must be helped to flow across organisational and contractual margins in search of the greatest project-level investment, and
ii. all relevant design conditions to the generation, evaluation and selection from product and process design alternatives must be applied concurrently.

The foundational principles of TVD include concurrently designing the product and process in design sets; collaborating in small and diverse groups and meeting regularly in a “big room” setting of co-location to facilitate communication and develop creative interactions (Suhr 1999). The principle of TVD is to collaborate and work together in the same place or as a virtual team while designing to predetermined targets supported by innovative ideas that allow you to maintain the targets without reducing scope, or compromising the quality of standards and the stakeholders’ value.

The widely accepted practices of TVD are those outlined by Macomber et al., (2007) and Kaushik et al., (2014), which they called the fundamental practices of TVD. They are:

i. engage deeply with the client to establish the target-value
ii. lead the design effort for learning and innovation
iii. design to a detailed estimate
iv. collaboratively plan and re-plan the project
v. concurrently design the product and the process in design sets
vi. design and detail in the sequence of the customer who will use it
vii. work in small and diverse groups
viii. work in a Big Room; and
ix. conduct retrospectives throughout the process.

They went further to list six other practices, calling them the TVD advanced practices. They are:

a) engage the client as a key performer
b) design in small batches
c) use one-page improvement reports to capture and share learning
d) model the space-in-use prior to design

e) use A3 Learning for concurrent set-based design and
f) adopt choosing by advantages decision-making.

The implementation of TVD influences not only the construction process but also has an effect on the final product and, most importantly, the mindset of the people involved in the project by exposing the individuals to the different disciplines while improving their awareness of the whole process. Researchers have proposed and developed various frameworks for the implementation of TVD. These frameworks emphasise the use of TVD to organise and supervise construction projects, albeit only during the project definition and design phases; most of the studies discussed in detail the pre-design and design stages with little details on construction stage. Ballard and Morris (2010), Lee (2012) and Kaushik et al., (2014) have developed a TVD framework with guidelines for pre-project planning, project definition and design stage, but no detailed steps for the construction and closing stages. Ballard (2012) also produced a TVD process diagram that shows detailed steps during the pre-design phase but none for the design, construction and closing phases of a project; Orihuela et al., (2015) have produced a communication protocol for the implementation of target value design (TVD) in building projects. Furthermore, Jacomit and Granja (2011) have developed target costing integrated into the product development process. Nevertheless, all above listed studies were terminated at the design stage.

TVD is a relatively new idea and practice that requires a lot of guidance, simulation and training before implementation. The literature reviewed above shows that the available frameworks and TVD benchmarks are lacking in meeting all the knowledge needs of the construction practitioners on how to go about the implementation of TVD.

3.3.9 TVD and Current Design Practices in NCI

In Nigeria, very limited studies have been conducted on the application of TVD. No study has explored and tested the application of TVD practice across major sectors of the NCI with the view to developing, evaluating, testing and re-evaluating a framework to support construction stakeholders in its implementation. The application of TVD in the NCI has not been fully explored; previous studies have concentrated on assessing the possibility of applying TVD i.e. awareness of TVD in the construction industry rather than its implementation. It is not clear how the current design management practices in the NCI align with the underlying benchmarks and practices of TVD. It can be concluded that empirical studies examining construction practices across major sectors in the industry are lacking. For example, a case of target value design was investigated in the NCI by Obi and Arif, (2015) using findings from a questionnaire survey and literature-based case studies showing low frequency of use of TVD for the achievement of effective delivery of projects. It is challenging to develop an appropriate approach that advances current practice largely due to a lack of empirical supportive data. Clearly, the more advanced and critical elements of TVD are not being implemented in current construction practice within Nigeria. The challenge in the current situation is that the intended benefits of TVD implementation cannot be fully realised either at the organisational or the project levels. Failing to fully implement TVD has clear adverse consequences on the flow of construction activities, from the resource input needed for construction to the products getting produced and delivered.

Previous research by Obi and Arif (2015) only reported on “the efficacy and applicability of TVD in the context of low-cost housing project delivery cost management in the south-east zone of Nigeria”. Thus, their research has limitations as there was no evidence of TVD implementation or development of a support structure for TVD implementation for enhancing value creation. Thus, this is another knowledge gap that this study seeks to bridge.

3.4 The Role of the Client within TVD Implementation

The role of the client throughout TVD implementation cannot be emphasized enough. They are involved from the project’s initiation, planning, execution and closing stages. Clients are fully engaged, from the project’s onset as a business case, to determining available funds and cost, to participating in feasibility studies, and to having the final authority on changes to the scope, quality, cost or schedule of the project. The client is an active key member of the team, whose values drive the project design; however, the client also has the potential to cause immeasurable waste for the project team with incorrect or delayed decisions. The TVD process benchmarks published by Ballard (2011) clearly define the roles of the client in a TVD project, with about 10 out of the 17 benchmarks outlining the client’s role. First, according to benchmark 1, the client is expected to develop and evaluate the project business case with the help of the key stakeholders. The client is expected to decide whether to fund a feasibility study based on his allowable cost and the market price.

Then, benchmark 2 stipulates that the client determines the maximum available funds and the allowable cost—what the customer is able and willing to pay to get life-cycle benefits. In TVD, the client is also expected to take part in the feasibility study with other key stakeholders (Benchmark 3). Furthermore, the client’s values drive the design of the project: s/he is expected to be involved in the assessment of the feasibility study through aligning the ends (what is wanted), means (the conceptual design) and constraints (the cost, time, location). Macomber et al. (2007) observed that both the client and the designers are responsible for revealing and refining concerns, for making new assessments of what is value, and for selecting how that value is produced.

The client or their representative participates in discussing cost schedules and the quality implications of all the design alternatives. Macomber et al. (2007) assert that clients play a central role in projects; getting a timely decision can make the difference between staying on schedule or falling behind. According to Benchmark 6, the client is an active and permanent member of the project delivery team and a key performer during the design process. Macomber et al. (2007) noted that, as performers, the clients express their concerns, make value assessments, and eventually make choices. When clients fail to take those actions in a timely way, it leads to immeasurable waste for the project team.

3.5 Benefits of TVD Implementation

Various researchers have documented the benefits of TVD implementation, ranging from cost savings/cost reduction to maximizing value and minimising waste in the project delivery process, amongst others. This research has classified the wide range of benefits into social, cost and quality benefits. TVD emerged as a recognition of the need to rethink processes upstream of construction, in other words, during design (Nanda et al., 2014); they further said it is an adaptation of target costing in the construction industry. There have been numerous studies conducted on TVD over the years and around the world, some of which have documented its benefits. For example, Oliva et al., (2016) observed that the literature reported cases in which TVD has been adopted successfully, promoting high collaborative environments and delivering products with higher added value.

Researchers have identified various benefits of TVD, the most common being recognised by most researchers as cost savings and cost reduction. (Chan et al., 2012 ; Oliva et al., 22016 ; Russell-Smith et al., 2015; Nanda et al., 2014; Do et al., 2014; Miron et al., 2015; Do et al., 2015a; Do et al., 2015b; Rybkowski et al., 2016 ; and Jacomit et al., 2008). While other studies reported positive realisation of cost savings, the study by Ballard et al., (2015) claimed that although there were considerable savings from value engineering innovations (e.g., spending $200K to redesign the pile system to get over $1 million in savings), overall the cost increases exceeded the cost savings in the study reported. From the various studies, it is a given that cost savings must be realised as a result of the implementation of TVD; the problem lies with how the savings are utilised or managed. It is not surprising that Ballard (2006) suggested that project teams should "agree on how to 'spend' cost savings".

Other reoccurring benefits include:

i. minimising waste (Ballard 2008; Ebbs 2015; Oliva et al., 2016; Ballard and Reiser 2004; Nanda et al., 2014; Hassan 2013);
ii. Collaboration (Oliva et al., 2016; Do et al., 2015; Kaushik et al., 2014; Emuze and Mathinya, 2016);
iii. selection of an integrated team (Nanda et al., 2014; Hyun 2012; Fischer et al., 2014);
iv. learning and education (Nanda et al., 2014; Antti 2017);
v. better identification of stakeholder value (Antti 2017; Hassan 2013); and
vi. innovative ideas (Antti 2017; Chan et al., 2012).

Oliva et al., (2016) identifies eight benefits of TVD implementation which are: promoting strong collaborative environments; the delivery of products with higher added value; reduced costs and added value to the design and construction process; profit gained from the early involvement of key stakeholders by the use of IPD processes; continuous improvement and waste reduction; the reliance on IPD principles as they need to be considered in order for a TVD project to succeed; increased cost certainty; and success in meeting the owner's demands for increased value.

Kron and Von der Haar (2016) are of the opinion that TVD emphasises cost savings as its focus. Meanwhile, Ballard (2008) claims that evidence has been presented, both in arguments from generally accepted principles and from the results achieved by the few projects that have been executed with budgets based on allowable cost and reliance on shared savings, to show a reduction of the project cost without any sacrifice of purpose or value. Russell-Smith et al., (2015) assert that "*Ballard demonstrated TVD as an effective method to reduce project cost*". All of which are substantiated by Chan, et al., (2012), who list 10 benefits of implementing TVD.

Do et al., (2014) mention five benefits of TVD, including: they are good at maintaining a predictable project cost and controlling cost overruns; they have generally been completed at 15% to 20% below market price without compromising schedule or quality; they are less likely to go over budget, even though the contingency of TVD projects is less than that on non-TVD projects; they enable more collaboration, early involvement of the contractors, co-location, and building information modelling (BIM). Ballard (2006) hypothesized that implementing target costing reduces the uncertainty of the project ends and means, which will, in turn, reduce the contingency required to absorb variability.

Ballard and Reiser (2004) inferred from Reiser (2003) that TVD ensures maximum value for the customer and minimum waste in the delivery process, with which Oliva et al., (2016) concur. Nanda et al., (2014) also agree with the literature, saying: “Lean Construction removes waste and adds value using continuous improvement in a culture of respect”. Ballard and Morris (2010) state that TVD has consistently yielded two results that appear to be unusual and important: 1) expected cost falls as design becomes more detailed; 2) outcome cost is substantially below market—both achieved without sacrificing scope or quality.

Nanda et al., (2014) also identify eight benefits of TVD. Antti (2017) and Emuze and Mathinya (2016) both recognised four benefits each, both studies noting that TVD improves the collaboration between team members. Emuze and Mathinya (2016) asserted that beyond collaboration and transparency, TVD could engender a range of benefits, going further to list the benefits as: the costs are worked out to be contained within the market price, making the product competitive; there can be no loss upon realisation of the cost goal to achieve within the selling price and more credible financial feasibility can be calculated. An integrated team-building process (selection) and formation based on the process map will help to achieve the project target (Hyun 2012; Fischer et al., 2014; Nanda et al., 2014)

The benefits of implementing TVD in construction projects identified from the literature can be classified into three broad groups. These are social benefits, cost benefits and quality benefits. Table 3.2 shows the various benefits of TVD implementation as found in the literature grouped into 3 categories.

Table 3.2 Benefits of TVD implementation and the authors

S/N	CATEGORY	BENEFITS	AUTHORS
1	Social Benefits	Client engagement and buy-in (User engagement and user buy-in)	Nanda et al., (2014)
		Collaboration and early collaboration	Oliva et al., (2016); Do et al., (2015); Kaushik et al., (2014); Emuze and Mathinya (2016)
		Integrated teams and integrated team selection	Nanda et al., (2014); Hyun (2012) Fischer et al., (2014)

		Co-location improves communication and Facilitates consensus decision- making	Nanda et al., (2014)
		Working towards common understanding (goal)	Nanda et al., (2014)
		It promotes a high collaborative environment	Oliva et al., (2016)
		Better identification of stakeholder value	Antti (2017); Hassan (2013)
		Encourages a teamwork approach to creating innovative ideas in problem-solving	Antti (2017); Chan et al., (2012)
		The benefit of long-term relations with suppliers	Ballard and Reiser (2004)
2	Cost benefits	Allows the design to be steered towards a target cost	Ballard et al., (2015)
		Reduced changes/variations from client and site conditions by using REVIT and clash detection on drawings	Nanda et al., (2014)
		The implementation of TVD reduces the contingency percentage in the project budget	Do et al., (2014); Nanda et al., (2014)
		Achieves cost savings /reduced cost and cost certainty. TVD projects are good at maintaining a predictable project cost and controlling cost overruns	Chan et al., (2012) ; Oliva et al., (2016) ; Russell-Smith et al., (2015) ; Do et al., (2014) ; Miron et al., (2015) ; Do et al., (2015a) ; Do et al., (2015b) ; Rybkowski et al., (2016) ; Jacomit et al., (2008) ; Nanda et al., (2014)
		Outcome cost is substantially below market—both achieved without sacrificing scope or quality	Do et al., (2014)
3	Quality benefits	Delivering product with higher added value	Oliva et al., (2016)
		The application of TVD often results in multiple design alternatives with different product costs, process costs, as well as product features	Nanda et al., (2014)
		Minimum waste in the design process	Ballard (2008); Ebbs (2015)
		Minimum waste in the delivery process	Oliva et al., (2016); Ballard and Reiser (2004); Nanda et al., (2014); Hassan (2013)
		Targets in TVD help avoid scope creep	Oliva et al., (2016,)

3.6 Barriers to TVD Implementation

Various challenges stand in the way of the successful implementation of TVD in the construction industry, and many researchers have investigated these barriers (Oliva et al., 2016; Do et al., 2015; Antti 2017; Miron et al., 2015; Emuze and Mathinya 2016; Kron and Von der Haar 2016; De Melo 2014; Do et al., 2014; Jacomit et al., 2008; Ballard 2006; Nanda et al., 2014; Koladiya 2017; etc.).

For example, about twelve (12) barriers were highlighted in the technical report 'The Application of Target Value Design in the Design and Construction of the UHS Temecula Valley Hospital' by Do et al., (2015b). The barriers included: overcoming the natural tendency to design and make decisions from a silo perspective; it is very easy to slip into old mind-sets; understanding the level of accuracy that is required at a certain time in the design; the team required extensive training to understand the TVD/IPD process; tracking production rates was very challenging; developing trust within the project environment; people outside the risk pool did not want to go to the big room meeting; some people did not collaborate so well and ended up leaving the project; and contractors do not have a lot of experience with design. Additional barriers may include, it takes time and effort to learn other people's workflow; overcoming the history of firms' previous projects with each other and the tradition of "fear" of asking others to improve.

While Oliva et al., (2016) identified some 10 challenges to the implementation of TVD, Do et al., (2015) catalogued 15 potential misalignments of commercial incentives in IPD and TVD. Antti (2017), in the same vein, enumerated 10 barriers of co-design for services, while Miron et al., (2015) and Emuze and Mathinya (2016) identified four and six challenges to TVD implementation, respectively, Nanda et al., (2014) acknowledged five barriers, which are: inaccurate cost estimating; perception of wasted time; perception of imbalance of control/ influence; need for facilitation which represents different points of view; difficulty in adaptation by team members; and finally, current measures of success still relate more to first costs, rather than quality and improved outcomes after occupancy.

It is worth noting that the problems related to cost were the most common challenge to TVD implementation mentioned in almost all the studies. For instance, Nanda et al., (2014) noted that the biggest opportunities for improvement were identified as inaccurate cost estimates. This was elaborated by Orihuela et al., (2015), who reported that the attempt to use TVD as a tool in the United Kingdom failed due to defects concerning some business practices and cost estimations which were very inaccurate. This view concurred with the works of Ballard (2006); Jacomit et al., (2008); Kron and von der Haar (2016); Do et al., (2015); and Emuze and Mathinya (2016). Do et al., (2015b) concluded that understanding the level of accuracy that is required at a certain time in the design is a challenge.

Another major challenge observed in the literature, impeding the implementation of TVD concerns issues with collaboration. Do et al., (2015b) reported that developing trust within the project environment is one of the challenges of TVD implementation. This can be attributed to the highly adversarial and opportunistic behaviour among stakeholders (Oliva et al., 2016). This view agreed with the study of Antti (2017), which stated that prejudices, mistrust and conflicts of interest were some of the barriers of co-design. Do et al., (2015b) reported that some people did not collaborate so well and ended up leaving the project. In addition, Do et al., (2015) and Tillman et al., (2017) assert that there were collaboration issues with consultants not on the risk pool; they reported that people outside the risk pool did not want to go to the big room or coordination meetings. This affects the level of collaboration on the project.

The company's readiness to adopt TVD was another barrier to its implementation (Oliva et al., 2016). Also, differences in organisational culture (Antti 2017) and the tradition of "fear" of asking others to improve (Do et al., 2015b) were problems faced in TVD adoption. This was substantiated by Nanda et al., (2014) having noted that the adaptation of TVD is difficult for team members because of the culture shift needed. Similarly, it takes time and effort to learn other people's workflow. (Do et al., 2015b).

This study categorises the various barriers to TVD implementation identified from the literature into six major groups, as shown in Table 3.3. The major groups include cost issues, collaboration problems, adoption problem, legal barriers, common understanding issues, and structural problems.

Table 3.3 Showing the major categories of barriers to TVD implementation as found in the literature

SN	SIX MAJOR GROUPS OF BARRIERS	BARRIERS OF TVD IMPLEMENTATION AS FOUND IN LITERATURES	AUTHORS
1	Cost Issues	• Unfortunately, the attempt to use this tool in the United Kingdom failed due to defects concerning some business practices and cost estimations, which were very inaccurate.	Orihuela et al., (2015)
		• Inaccurate cost estimating	Nanda et al., (2014)
		• The target cost was set based on price rather than worth and was not shared with the team.	Do et al. (2015)
		• A full-fledged version of target costing in construction derives from the extant commercial practices in the UK construction industry. As we have shown, the industry, and especially large contractors, often operate without a full understanding of the costs through the supply chain.	Ballard (2006)
		• A fully-fledged target costing implementation was not possible, mainly because of the combination of existing commercial practices and industry weakness (particularly related to costing systems).	Jacomit et al., (2008)
		• An inaccurate and undifferentiated derivation of target costs endangers the successful completion of a project.	Kron and von der Haar (2016)
		• It is very difficult to obtain the working accuracy of the target cost.	Emuze and Mathinya (2016)
		• Understanding the level of accuracy that is required at a certain time in the design	Do et al., (2015b)
		• The difficulty of tracking changes in scope during design with the associated impact on costs	Tillman et al., (2017)
		• The cost savings from one cluster group through the TVD process was held tightly within that particular cluster.	Do et al., (2015)
		• The target cost was set based on price rather than worth and was not shared with the team.	Do et al., (2015)
		• Cost of the early involvement of key subcontractors in the design process	De Melo (2015)
		• Contingency set too low	Tillman et al., (2017) and Do et al., (2015b)
		• Uncertainties related to market fluctuations and how escalation will play throughout the years	Tillmann et al., (2017)
		• The difficulty of tracking changes in scope during design with the associated impact on costs	Tillmann et al., (2017)

		• Since the construction phase is not competitively bid, how can owners know that they are getting the best price?	Do et al., (2015).
2	Collaboration Problems	• Developing trust within the project environment • Some people did not collaborate as well and ended up leaving the project.	Do et al., (2015b)
		• Highly adversarial and opportunistic behaviour among stakeholders	Oliva et al., (2016)
		• Prejudices, mistrust and conflicts of interest	Antti (2017)
		• People outside the risk pool did not want to go to the coordination meeting.	Do et al., (2015)
		• Collaboration issues with consultants not on the risk pool • People outside the risk pool did not want to go to the big room meeting.	Tillman et al., (2017)
		• A lack of commitment from some stakeholders not part of the incentive scheme	Antti (2017)
		• However, the owner was not actively involved in many of the decision-making sessions.	Do et al., (2015)
		• The team required extensive training to understand the TVD process.	Do et al., (2015)
		• Collaborative practices are not common.	Oliva et al., (2016)
		• The absence of a systemic approach to partnership affects collaboration.	Bresnen and Marshal (2000) as cited by Zimina et al., (2012)
		• Integrated teams and governance: Team integration currently occurs, but usually with some misalignment. The chief problem is in the timing. Participation occurs at different stages.	Morêda Neto et al., (2016)
		• There is also a lack of interaction between the estimation and design teams.	Morêda Neto et al., (2016)
		• Developing trust within the project environment	Do et al., (2015)
		• Cross-functional teams: the timing is a barrier for this formation since the supplies and the constructor start participating more effectively during the construction phase.	Morêda Neto et al., (2016)
		• Different design teams used to working in isolation or lacking interaction	Macomber et al., (2007)
		• Lack of subcontractor/main suppliers' involvement in the beginning	P2SL (2018)
		• The fact that the architects were part of the integrated team but were not co-located in the same office space.	Tillmann et al., (2017)
3	Adoption Problems	• The company's readiness to adopt TVD	Oliva et al., (2016)
		• Difficulty in the adaptation by team members (cultural/organisational changes and mind shift needed)	Nanda et al., (2014).
4	Lack of Common Understanding	• A lack of clarity about common goals	Antti (2017)
		• Besides, the lack of a unified vision of values, especially sustainability values, created gaps in the	Miron et al., (2015)

		value creation dialogue & the definition of what is 'value' is still unclear.	
		• A lack of clarity about common understanding goals; poor allocation of responsibilities	Antti (2017)
		• The lack of proper identification of stakeholder values as property developers drive product development.	Oliva et al., (2016)
		• Lack of key stakeholders' input in the business case	P2SL (2018); Morêda Neto et al., (2016); and Ballard et al., (2015)
		• There was a lack of common understanding regarding how the decision-making process within TVD should work.	Tillmann et al., (2017)
		• Commercial terms and alignment of interests	Morêda Neto et al., (2016)
5	Legal Issues	• It was not possible to apply all the TVD principles to the project due to regulatory or legal restrictions.	DeMelo et al., (2014)
		• The public sector owners may be limited in their ability to achieve a complete TVD application due to federal or local laws that prevent early collaboration among key project stakeholders.	Miron et al., (2015)
6	Organisational Problems	• Differences in organization culture/policy	Antti (2017).
		• Evidence collected at the company suggests that its current procurement procedures could pose potential barriers to achieve full benefits of the approach.	De Melo (2015)
		• The impediments include rigid hierarchies.	Antti (2017)
		• Low level of organizational integration	De Melo (2015)
7	Time-Related Problems	• As the product design cycle increases in length, the target costing system typically becomes more complex/time-consuming.	Cooper and Slagmulder (1997)
		• Perception of wasted time	Nanda et al., (2014)

Ballard et al., (2015) reported that other problems occurred in their project case study because installers were not involved in the early design stages, which caused constructability and inspection problems that also contributed to delays, rework and increased the project cost. This was in line with the study with Morêda Neto et al., (2016), which noted that suppliers and the constructor started participating more effectively during the construction phase, and not before. They further submitted that stakeholders should also participate, not only in understanding the core goals for the project but also in incorporating their own input and helping with value engineering.

The literature reviewed shows studies on TVD implementation outside of the US are limited; however, the benefits of TVD implementation identified far outweigh the drawbacks. TVD benchmarks and practices applied meticulously have been found to adequately reduce the effects of these drawbacks.

3.7 Tools and Techniques for Implementing TVD

Several scholars have identified various tools, techniques and practices that enhance the implementation of TVD. These tools, techniques and practices include: Last Planner®; Set-Based Design alternatives, A3 problem solving/reports, knowledge gap, Choosing by Advantage (CBA), value engineering/analysis, cost modelling, earned value analysis, Paper Kaizen, value stream mapping, 5S, Production System Design (PSD), target costing, IPD (collaboration), and co-location, etc. (Novak 2012; Koskela and Kaushik 2015; Do et al., 2015b; Kaushik et al., 2014; Swenson et al., 2003; Morêda Neto et al., 2016; Do et al., 2014; Do et al., 2015b, Rybkowski et al., 2016).

Although TVD has been cited as one of the lean construction tools, Do et al., (2014) observed that TVD projects typically use other lean construction tools to facilitate project delivery; they noted that TVD encourages the use of lean tools and practices that drive down the project cost. This argument tends to agree with De Melo (2015) and Ballard (2011), who noted that TVD is often implemented with the support of other managerial concepts, such as set-based-concurrent engineering and the application of Last Planner System principles in the design phase, and tools such as Choosing by Advantages (CBA) to select from design alternatives and A3 format for proposals.

Emuze and Mathinya (2016), Rubrich (2012) and Ballard (2011) all noted that TVD is a lean construction tool that shifts the basic thinking within a project from expected costs to target costs, and as a tool, it can be implemented within an integrated project delivery (IPD) team model. This view was strengthened by De Melo (2015), who opined that TVD can be implemented in various project delivery methods; however, it is best suited to integrated project delivery (IPD) as it requires close collaboration between the designer, the builder, and the owner.

Novak (2012) identified and categorised the components, tools and practices of TVD and integrated lean project delivery (ILPD). These are shown in Figure 3.1

Figure 3.1 Component tools and practices of TVD and ILPD (Adapted from Novak (2012))

Koskela and Kaushik (2015) gave a concise characterisation of some of the Lean construction tools thus:

i. target costing – lean cost control approach.

ii. set-based design - concurrent engineering.

iii. big room co-location – process-based structured co-location.

iv. Choosing by Advantages – decision-making tool.

v. The Last Planner™ System – collaborative pull planning.

vi. A3 - problem-solving and reporting; and

vii. Building Information Modelling (BIM).

For TVD projects to perform optimally, its functional system must involve lean tools and methods of handling design and construction. Zimina et al., (2012) state that these lean tools and methods are borrowed directly from manufacturing or developed by the lean construction community.

Nanda et al., (2014) noted that TVD uses essential lean tools and principles such as set-based design (SBD), production system design (PSD), target costing, integrated project delivery (IPD - collaboration), and co-location. While the IPD approach permits early involvement of contractors and suppliers in the design stage, co-location, on the other hand, advances communication and enables harmonious decision-making. In the same vein, multiple design alternatives can be produced using SBD, while PSD supports integrated product and process design. Target costing is beneficial in closing or reducing the expected-allowable cost gaps (Nanda et al., 2014).

3.8 Success Factors for TVD Implementation

From the literature, researchers have put forth some essential factors that need to be in place for TVD to be successfully implemented. These range from team-related factors to organizational factors to specific project design factors, amongst others. Antti (2017) stated that the following will enable TVD to succeed: equality, trust, common interests and goals, facilitation, accountability and budgeting, managerial support, formalized support structures, and continuity, all of which can promote collaboration. Kron and von der Haar (2016) reported that to guarantee a successful target costing application, realistic and reliable planning and determination of target costs are a core prerequisite. They went further to say that a new approach for an accurate and more realistic determination of drifting costs may be the integration of client requirements and needs by means of a consideration of functions.

Most of the literature lays emphasis on collaboration and cooperation as a success factor in TVD implementation (Pease 2017; Mendes and Machado 2012; Rubrich 2012; Antti 2017; Emuze and Mathinya 2016; Zimina et al., 2012; Oliva et al., 2016; Kaushik et al., 2014; P2SL 2018). Rubrich (2012) claims that TVD tools require the institution of clients' expectations before detailed designs are assembled. Furthermore, it also requires that constant and transparent collaborative information-sharing is stimulated between designers and builders so that the expected cost will be less than the allowable cost of a project. This is corroborated by Zimina et al., (2012) and Do et al., (2015), who said the successful results from IPD/TVD application have been attributed to collaboration and better alignment of incentives.

Other common success factors include:

i. use of financial incentives.
ii. use of value engineering proactively, along with other managerial concepts tools.
iii. concurrent review of multiple design alternatives, with their cost implications and review of work done; and
iv. early involvement of key stakeholders.

Macomber et al., (2007) and Emuze and Mathinya (2016) noted that there are basic elements that must be in place before TVD can become an effective cost control tactic. These elements include:

i. the promotion of extensive consultation with clients to determine the target value.
ii. ensuring the design team constantly leads the way in learning and innovations.
iii. basing the design on a detailed estimate.
iv. ensuring collective planning of execution so that work packages are ascertained.
v. approval of completed work based on design.
vi. ensuring the design follows the sequential order of construction.
vii. working in a small manageable team that allows a range of views.
viii. work in a room big enough to house all the teams; and
ix. constantly reviewing the level of work done and creating an environment advantageous to reviews at random times.

A workflow mapping of each design area will be helpful as a protocol in order to avoid rework, and it will identify the times when information exchange is necessary to maximize value. Additionally, a construction cost structure with a similar pattern will permit economic valuations to be made at early stages, thus ensuring the objective cost and objective value of the project (Orihuela et al., 2015).

Mendes and Machado (2012) suggested that multidisciplinary teams – cooperation between the different departments - are mandatory for TC success. There are several pre-requisites required to ensure the smooth running of the approaches, such as willing participation, management support, an appropriate study team and an experienced facilitator (Perera et al., 2003). A summary of the success factors of TVD implementation is shown in Table 3.4

Table 3.4 Success factors for TVD implementation

S/N	SUCCESS FACTORS	AUTHORS
1	Collaboration and early involvement and input of key stakeholders	Oliva et al., (2016); Kaushik et al., (2014); P2SL (2018)
2	Commitment to TVD Project Success	APM
3	Leadership support, managerial support and formalized support structures	Antti (2017)
4	Improvement of management strategies and contractual approaches to applying TVD	Miron et al., (2015)
5	Adherence to quality standards	APM
6	Adoption of TVD benchmarks and tools	Kaushik et al., (2014)
7	Using financial incentives, the creation of partnerships and generating results regarding collaboration. Shared risk and reward mechanisms	Chan et al., (2012); Kaushik et al., (2014)
8	Use value engineering proactively and other managerial concepts tools	Ballard et al., (2015); Jacomit et al., (2008)
9	Secured funding - the extent of upfront investments relative to the project	APM
10	Co-located, the multidisciplinary cluster organisation	Kaushik et al., (2014); P2SL (2018); Emuze and Mathinya (2016)
11	Hold frequent budg*et al*ignment sessions	Ballard (2008)
12	Involve capable sponsors	APM
13	Concurrent review of multiple design alternatives with their cost implications and review of work done	Emuze and Mathinya (2016); Nanda et al., (2014)
14	Supportive organization/end users, contractors, supply chain alignment, speciality trade partners, client and project team involvement	APM
15	The degree of integrated competent teams and governance - supportive organization.; common interests and goals	Nanda et al., (2014); Antti (2017)
16	Price-led costing with consideration of life-cycle costs: the rate of having multiple design alternatives to choose the best one. Iterative design cycles	Nanda et al., (2014); Kaushik et al., (2014)
17	Improvement of project definition and design approaches helping to achieve target cost	Lee et al., (2010); Miron et al., (2015)

3.9 Supports for TVD Implementation

Researchers have identified various supports required for the successful implementation of TVD. These include support from top management, public authorities (government), the Lean Construction Institute and other professional bodies, regulatory bodies, clients, and contractual support. The most often mentioned support by researchers is the support from the top management of an organisation (Sarhan and Fox 2013; Tang 2015). Their views were supported by those of Perera et al., (2003) when they stated that there were several prerequisites needed to ensure the smooth running of the approaches, such as willing participation, management support, an appropriate study team and an experienced facilitator. Jacomit et al., (2008) goes so far as to claim that, "Most of the companies have a separate department to support target costing".

Ballard and Reiser (2004) report that another critical support tool needed for designing to target cost is an integrated product/cost model. Zimina et al., (2012) argue that *"although there are cases when TVD worked based on transactional multiparty contractual arrangements, it was noticed that relational contracts provided better support for projects of this kind."*

Tang (2015) considered five management tools/techniques to be implicitly connected with the level of completeness of target costing implementation, these include:

a. top management support in the implementation of target costing.
b. cross-functional teams.
c. a structured reporting system.
d. performance rewards based on achievement of target costs and
e. active participation of suppliers and other external stakeholders in the program development.

Antti (2017) noted that the creation of trust through the recognition of mutual value among the actors is another supporting factor of TVD implementation.

3.10 Impact of TVD Implementation

The introduction of new techniques, new technologies or innovations typically comes with an impact, either positive or negative. The implementation of TVD in various projects in the US has had a far-reaching impact on various aspects of such projects. Ballard and Reiser, (2014) asserted that the implementation of the target costing methodology played a substantial role in the success of the Fieldhouse project of Olaf College. They further reported that the project was delivered on time and within budget, more value was provided to the client that would otherwise have been provided, and the provider, Boldt, made a reasonable profit. The statement shows that TVD impacted on project time, budget, value and profits. The impact of TVD implementation will be discussed based on the following major headings:

A. Impact on cost

Impact on cost is the most reported in the literature reviewed. For example, Do et al., (2015b) reported that out of the 40 completed Lean IPD and TVD projects by Sutter Health, Inc., these projects have typically been completed 10% to 30% below market price. According to the project team, the Temecula Valley project was completed for $480 / SF which is 30% less than the average for California hospitals (Do et al., 2015b).

On the other hand, Do et al., (2014) stated that TVD projects, on average, have a lower ratio of spent-budget funds. The study examined about 47 TVD projects and reported that the worst project had a cost of 7.3% over budget, and the best project had a cost 25% below budget. Do et al., (2014) concluded that this suggests that the final cost of TVD projects is more likely to be close to the project budget. With Fairfield Medical Office Building, the project target cost ($18.9 million) was set 14.1% below the benchmark ($22.0 million). The actual cost ($17.9 million) for the original scope underran the target by 5.3% and underran the benchmark by 18.6% (Ballard, 2008).

Kaushik et al., (2014) reported the case of 12 TVD projects in the United States that achieved significant cost savings; he noted that the first six projects had been completed with final cost savings ranging from 5% to 18%, while the other six projects were incomplete, but the expected cost saving ranged from 5% to 33%. This comparison highlights the possible contribution of TVD to project cost savings.

B. Impact on schedule

Evidence from the literature supports the fact that most TVD projects have always beaten the target schedule set for such projects. Do et al., (2015b) reported that the project for UHS Temecula Valley Hospital was completed a month-and-a-half ahead of schedule, despite 82 days of delay due to environmental conditions. This was corroborated by Ballard et al., (2015), who reported that the first 22 lean projects of Sutter Health, involving at least Last Planner and TVD, were all completed within time and budget, averaging 3.4% under budget. Do et al., (2014) stated that TVD projects are always completed below budget, without compromising schedule or quality.

C. **Impact on quality**

Do et al., (2015b) reported that, according to interviews with two owner representatives, UHS was very happy with their project because they had established aggressive targets in terms of cost, quality, and scope, and were able to achieve them. Lastly, Ballard (2008) reported that in a case study project they observed, cost savings were realised and most of the realised funds were used to provide value-adding scope, especially for imaging capability, with the remainder returned to the client.

D. Impact on productivity and process innovations

Ballard et al., (2015) claimed the implementation of TVD had led to significant improvement in project performance. Do et al., (2015b) maintained that productivity was tracked for every trade, and publicly shared with the team. Ballard (2008) said that in addition to product innovations, there were many process innovations/improvements that reduced cost and increased productivity (Do et al., 2015b).

E. Impact on cultural outcomes and working relationships

Miron et al., (2015) reported that TVD implementation enhances the client-supplier relationship. Do et al., (2015b) confirmed this with a survey that showed that, in addition to achieving the aggressive goals of the project, the project team was able to build long-lasting personal and professional relationships. Correspondingly. the TVD process is suitable for inserting the partnering spirit into the relationships among the construction stakeholders, with the unbiased aim of presenting a harmonious and less challenging attitude to projects.

F. Impact on client/stakeholders' values and satisfaction

Ballard (2008) noted that delivering greater value than in the original scope and doing so at a target cost well below industry standard, was the twin story of the Fairfield and Shawano projects. This was because the target cost was achieved, along with a return to the client of unused contingency funds and the funding of client changes without adding to the budget. Do et al., (2015b) also acknowledged that Sutter Health Inc. has not suffered any major problems and are very happy with the outcomes of over 40 completed IPD and TVD projects. Orihuela et al., (2015) declared that TVD is also a method for continuous improvement and waste reduction. They believed that TVD prevents "negative iterations" and consequent reworks, all of which will result in time and cost-saving, as well as in the generation of added value for both project planners and investors.

G. Impact on profitability

Do et al., (2015b) noted that due to the cost savings in both the design and construction phase, the members of the risk pool were able to earn 150% of their negotiated profits, which was the maximum amount of profit that they could earn on the project. Similarly, Ballard and Morris (2010) reported how a project had been completed within the target cost, with no return to the board for additional funding, in a period of extreme materials cost escalation.

In conclusion, the words of Ballard and Morris (2010) appropriately capture the impact of TVD implementation in the construction industry when they stated that TVD projects have consistently underrun market benchmarks, have been completed within budget (cost and schedule), and have funded additional value-adding scope. However, reports on quality, time and stakeholder value in TVD literature are limited, and are always associated with cost through statements like, "TVD was completed under budget without compromising quality and time without properly capturing or measuring impacts on quality, time and stakeholders' value." For example, there is a limited report of how TVD improves construction quality and ensures compliance with initial design intent stated in the stakeholders' value identification. This is reinforced by Miron et al., (2015), who reported that, in the TVD context, achievement on value generation remains poorly documented.

3.11 Comparison of TVD with Traditional Design Practices

It can be concluded that TVD has some fundamental differences from traditional design practices in terms of the management aspect and practical implementation of projects. Various researchers have attempted a comparison between TVD and traditional design practices. Macomber et al. (2007) observed that TVD turns the traditional design practice "upside-down". De Melo (2015) identified six key principles of TVD that differentiates it from traditional design practices. The six key principles are: price-led costing, customer focus, focus on the design of products and process, cross-functional teams, life-cycle cost reduction and value chain involvement. Zimina et al. (2002) concluded that TVD is essentially different in "managerial philosophy and practical implementation" from the current contract and cost management techniques after reviewing the literature and conducting empirical observations of current cost and project management practice.

Zimina et al. (2012) have provided a summarised comparison between TVD and the traditional process as shown in Table 3.5.

Table 3.5 Difference between TVD and traditional design practices

	CONTRACT AND COST MANAGEMENT PRACTICES IN CONSTRUCTION	**TARGET VALUE DESIGN**
The objective of Cost management	Strives to obtain a constructed asset for the lowest possible price while working on keeping the project cost under control with cost-cutting measures.	Strives to obtain a constructed asset for a maximum allowable cost while reducing the price paid through gainsharing.
The function of cost targets	Target is for guessing the tender price.	Target is for final construction cost.
Setting a target	Set by the client with or without a cost adviser, based on cost estimates (historical data and benchmarking).	Set after a feasibility study rooted in the client's business case has been completed.
Cost and target management in design	Set by the client with or without a cost adviser, based on cost estimates (historical data and benchmarking).	Cross-functional clusters manage cost and design to cluster targets. 'Over the shoulder estimating'. Design solutions are developed with cost, schedule and constructability as design criteria and built-in value engineering. Target cost cannot be exceeded; value targets are stretch goals to spur innovation.
Role of client	Involved occasionally as case problems occur.	An active and permanent member of the project delivery team throughout the project's duration.
Project organization	Cost-based selection. Projects are organized as a sequential process. Poor information flow between the parties working at the project; no involvement of the downstream players. No staff continuity.	Value-based selection. IPD team is formed at the business planning stage. Full engagement of all the key players in the design process. Continuity of staff to retain the knowledge.
Operating system	Project management tools.	Co-location, at least weekly team meetings held on at least a weekly basis. Lean set of tools to eliminate process waste.

Commercial terms and the role of contract	A set of transaction contracts. Contracts used as a control tool. Incentives are better fitted for local optimization. Monetary motivation. Pain/gain share does not distinguish between cost, profits and contingencies.	The relational contract covers the key players. The incentives of all team members are aligned with the pursuit of project objectives. Monetary and nonmonetary motivation. Separation of cost from profits and contingencies.
Risk management	Risk shifting down the supply chain. Contract used as risk management tool; the risk is hidden in commercial terms.	All-for-one, one-for-all thinking. Collaborative decision-making. Risk reduction thanks to the lean organization and operating system

Source: Zimina et al, (2012)

In TVD Projects, the target cost is determined collaboratively by the critical stakeholders (the owner, designers, builders), based on the client's allowable cost and quality requirements, market benchmarking, and feasibility study (Ballard, 2012; Pishdad-Bozorgi, 2013). This implies that there is a collective buy-in of all stakeholders involved. Meanwhile, in the traditional approach, the target-price is set by the client alone, without the involvement of designers or builders.

The managerial philosophy of TVD fosters collaboration and innovation where the client/owner, designers and builders collaboratively and collectively make decisions after considering the different alternatives available, while in traditional projects, the client is not usually part of the decision-making process after the initiation stage. Decisions on how the construction process should be designed and kept within budget are done by the designers and builders with minimal input from the client, who only sets the project criteria.

In TVD projects, designs are based on set targets, unlike in the traditional practice, where designs are completed before checking whether targets (budgets, schedules, etc) have been exceeded (Ballard, 2012; Pishdad-Bozorgi, 2013). The reduced cost and rework associated with TVD can be attributed to this practice. In the traditional design approach, attempts are made to control cost and quality after the designs have been completed, while the reverse is the case in TVD, where cost are managed before they are incurred (Cohen, 2012; Ballard, 2012).

3.12 Advantages and Disadvantages of the TVD Approach

Various scholars have outlined the advantages and disadvantages of using TVD. One of the main disadvantages of TVD is that the planning and design of projects get extended significantly as the design team normally requires several design iterations to be able to meet the target cost, schedule and quality. Ballard (2011) observed that in a bid to implement TVD, clients spend more time and money in the project definition phase of projects than they would have normally done. The whole process of setting a target cost can lead to the design team bearing an unrealistic burden, especially when the estimated cost is too low. Emuze and Mathinya (2016) noted that the anxiety to maintain costs within target may lead to compromise over quality and eventually lead to losses. It is quite difficult obtaining a working accuracy of the target cost, where an inaccurate working target cost could affect the projects total budget cost, with failure in that leading to potential losses.

Another disadvantage of TVD observed by Zimina et al. (2012) is that cost savings are not assured until much further into the design phase of the project, which limits the client from investing in value-adding enhancements. Furthermore, due to the numerous design options that could be produced by team members from the iterative design process, there may be difficulties in reaching a consensus on the final designs to adopt if there are uncooperative team members.

The benefits of implementing TVD outweigh the disadvantages. Emuze and Mathinya (2016) argued that the products available are very competitive with TVD since the cost is kept within the market price. The all-round commitment to both process and product innovation helps the products in achieving competitive advantages. Due to the early involvement of key stakeholders, TVD projects are better matched to clients' needs; more importantly, the client remains a permanent and active member of the project team throughout the project life cycle. TVD projects have been associated with a better selection of integrated teams, learning & education, encouraging the production of innovative ideas in solving problems through a teamwork approach, and better identification of stakeholder value (Antti, 2017 and Chan et al. (2012). Oliva et al. (2016) also stated that TVD projects promote strong collaborative working environments, reduce project costs, deliver products with higher added value, while also adding value holistically to the design and construction process.

3.13 Comparison of TVD with the latest developments in IPD and BIM

A comparison of TVD, IPD, and BIM has revealed that IPD is a contractual agreement while TVD and BIM are lean construction tools. IPD is a project delivery process which enables the adoption of TVD and BIM successfully in construction projects. According to Fakhimia et al. (2017), both TVD and BIM can be empowered by IPD, which is because TVD is focused on introducing appropriate processes that are aimed at reducing waste and optimizing efficiency while BIM, on the other hand, provides the technology needed for sharing information between all the stakeholders involved. IPD concentrates on multi-party contracts and encouraging collaboration between all parties. TVD, IPD and BIM are can be used separately and together, but with collaboration, maximum efficiency can be attained.

The integration of BIM and TVD in an IPD environment is a revolutionary process that has the potential to guarantee value generation in the construction industry (Pishdad-Bozorgi, 2013). Eckblad et al. (2007) argue that, although it is possible to adopt IPD without BIM, the use of BIM in IPD is highly essential to achieve the level of collaboration required for IPD. Perez (2018) noted that in order to apply TVD, it is very important that all team members believe in the collaborative culture, just as with IPD. According to Matthews and Howell (2005), IPD is a project management system, while TVD is a management tool or approach. In conclusion, the main concept that connects BIM, TVD and IPD together is that they all promote collaboration to innovatively create value by saving cost and reducing waste without compromising scope, schedule and quality.

3.14 Collaborations and Collaborative Working in Construction

Issues of adapting collaborative practices have been observed to be a prominent challenge in TVD projects. There is difficulty in developing trust within the project environment due to uncommon collaborative practices, lack of early involvement of subcontractor/main suppliers, and lack of interaction among estimation and design teams (Do et al., 2015b; Oliva et al., 2016; Morêda Neto et al., 2016). However, the literature reveals limited attempts to measure the levels of collaboration on TVD projects with a case reported by Oliva et al., (2016), where three levels of collaboration were measured. The following sections discuss collaborations and collaborative working in construction, highlighting the benefits, barriers, needs and levels.

3.14.1 The Concept of Collaboration

Collaboration is considered one of the foundational principles of TVD; face to face and virtual collaboration are not options in the TVD process, they are required for the success of TVD projects. The unifying role and many benefits of collaboration have made its use more prominent in fields such as information technology, organisation development, construction and service delivery. *"One of the most important discussions in the construction industry and research is the shift towards new collaborative project delivery systems"* (Hamid and Pardis 2014).

According to Schrage (1990) collaboration is defined as "*the process of shared creation between two or more individuals with complementary skills interacting to create a shared understanding that none had previously shared or could have come to on their own*". Collaboration is generally based on the principle of interaction between two parties that is beneficial to both. Collaboration suggests that the teams working are properly integrated with the aim of achieving the overall project goals (Daniel, 2017). According to Attaran and Attaran (2007), collaboration is not limited to the joint working of two or more organisations but also includes: having shared common information; ensuring plans are made based on the shared information; and executing the planned task collectively rather than individually. Individual goals and activities become secondary to a shared goal in a collaborative environment.

3.14.2 Collaborative Working in Construction

The relationship between construction professionals has an immense impact on the success of a project (UK Construction online 2018). According to Norberg-Johnson (2015) and Xue et al., (2010), the industry is currently characterized by an adversarial and tense competitive environment in which each member of the construction team is required to contend with the others to earn a realistic income. This is reinforced by DBW (2018b), who describes the construction industry as 'ineffective', 'adversarial', 'fragmented' and 'incapable of delivering for its customers'. It is apparent that the current traditional practice in the construction industry does not support collaboration. The lack of collaborative practices can make stakeholders work at cross-purposes and contrary to the project goals.

UK Construction online (2018) reports that a significant proportion of the industry has the notion that collaboration will be expensive and time-consuming. This is despite the emphasis placed on the need for collaborative working by numerous researchers. (Xue et al., 2010; Scott 2014; Norberg-Johnson 2015). There is no empirical evidence that supports the notion that collaboration can be expensive and time-wasting. Evidence from the literature has supported the assertion that collaborative work practices can save time and the cost of construction projects, thereby increasing value in the construction process and delivering projects with higher added value to stakeholders.

Dim et al., (2015) observed cases where, for example, the mechanical and electrical design and that of the architect collided, resulting in a sewage pipe hitting or passing through a beam only being discovered on-site during construction. Such cases occurred as a result of non-integration between professionals in the NCI. Challenges like this end up causing waste, increased costs and time overruns.

Ejohwomu et al., (2017) state that communication plays a significant role in the quality of the relationship, trust and collaboration among construction project teams. In addition, Shelbourne et al (2012) assert that with collaboration, a group of people or organisation work as a team to achieve the desired product in a shared environment by sharing their skills, information, and knowledge. Physical human interactions, digital and virtual resources could serve as the shared environment in the collaboration process. Innovations in technology have made collaboration so much easier (UK Construction online 2018). A conscious effort must be made by the stakeholders involved to ensure actual collaborative working practices are observed; the sharing of information is not enough as collaboration is beyond just the sharing of information.

3.14.3 Virtual Collaboration

Technological advancements have improved the ease of communication over the years; the advent of telephones, internet and other associated technologies has made communication more convenient and accessible. Communication is a core element of collaboration. Peters and Charles (2007) defined virtual collaboration as a collaboration where the parties involved do not interact physically but communicate entirely via technological channels. This is corroborated by Gall and Burn (2008) who defined virtual collaboration as a combined effort of several actors either internally or externally who work as groups to achieve tasks or projects. They go further to say that, "Collaborations may be asynchronous; not necessarily working together at the same time, or synchronous; collaborative partners working together simultaneously and in communication". Virtual collaboration is basically a collaboration that is conducted without face-to-face interaction using technology. Nemiro et al., (2008) believe that virtual collaboration requires energy and imagination that go beyond the normal working environment.

Anumba and Evbuomwan (1997) outlined some enabling communication technologies that can support collaboration in the construction industry. They are electronic mail, desktop videoconferencing, multimedia, the internet, intranets, virtual reality, mixed reality, virtual meeting rooms, shared 3D project models, people information finder (PIF), broadband communications networks, data exchange protocols, electronic document management systems and mobile communications systems. In view of this, it is important to clearly differentiate the concept of collaboration from other terms such as ‘cooperation’ and ‘coordination’, which are wrongly interchanged with collaboration. In fact, the use of these terms in the place of collaboration has been questioned by previous researchers (Shelbourn et al., 2012; Jamal and Getz 1995). Shelbourn et al., (2012) assert that there are key fundamental differences between these terms.

3.14.4 The Levels and Interrelationship of Collaboration

Different levels of collaboration can be easily confused and wrongly used interchangeably, but they have major differences. With collaboration being one of the backbones of the successful implementation of TVD, the interrelationship and distinct requirements of networking, cooperation, coordination, coalition and collaboration are explored. The term cooperation has been used unknowingly to mean collaboration, which has led to the non-achievement of some so-called collaborative efforts. This is because the organisations or the team are not actually collaborating but attempting to cooperate. The Oxford Advanced Dictionary defines cooperation as the “process or the action of working together to the same end”. This definition does not show the three core elements of collaboration as identified in Attarran and Attaran (2007). According to Mattessich and Monsey (1992), cooperation is based on informal association, and most of the time it clearly lacks a stated mission, a structure, and a defined responsibility for the parties involved. Cooperation could allow information to be shared between organisations, for example the architect giving the working drawing to the main contractor or the main contractor giving out information to the subcontractor, yet each organisation could still be acting independently, without regard for the other. Hence, such a relationship cannot be termed as collaboration since the authority and reward is left in the hands of individual organisations (Shelbourn et al., 2012; Mattessich and Monsey 1992).

Furthermore, since cooperation is an informal arrangement, it also follows that such an arrangement will not make any consideration for risk-sharing, and the organisations will be less committed to the process. However, collaboration requires high commitment and higher risk since each organisation is expected to adhere to the common goal agreed by the team or organisation (Mattessich and Monsey 1992).

Coordination is among the key principles of management**.** It is the act of managing and unifying different activities or agencies on a project with multiple tasks, participants or organisations (O’Brien et al., 1995; Malone and Crowston 1991). The focus of coordination here is to define a formal approach to organising how an operation or activity should be conducted, which suggests that coordination is still based on the command and control philosophy. This implies that the shared mutuality element of collaboration is still absent, even though the approach is formal. Unlike in cooperation, roles and line of communication procedures which must be adhered to are clearly defined in coordination; however, the authority or decision on how work should be done still lies with the individual team or organisation. The importance of coordination cannot be overemphasized in construction projects due to the nature of construction activities both at the project and organisation level. However, Iyer and Jha (2005) argued that researchers have failed to address issues that could help in achieving good coordination on construction projects. This suggests that coordination of activities without having a defined goal to collaborate could still lead to project failure. It is worth noting that there is more risk in this approach compared to cooperation; however, the basic elements of collaboration are still missing in the approach.

The Oxford Advanced Dictionary (2018) defines networking as a group of people who exchange information and contacts for professional or social purposes. Networking is a process that nurtures the exchange of information and ideas among individuals or groups that share a common interest (Investopedia 2017). This is supported by Barringer and Harrision (2000), who reported that "Organizations form alliances, also called networks or constellations, to align their own interests with the interests of stakeholders and also to reduce environmental uncertainty." Page (2018) opined that networking strengthens business connections, ensures fresh ideas, supports the gaining of different perspectives, and develops long-lasting relationships, while Gaida and Koliba (2007) argue that networking is the weakest operational form of relational collaboration.

"Coalition" is defined as "a group of individuals representing diverse organizations, factions or constituencies who agree to work together to achieve a common goal" (Feighery & Rogers 1990). This is substantiated by Lerbinger (2005), who defined coalition as the interrelating group of organizational actors, who:

(a) agree to pursue a common goal.
(b) manage their resources in a bid to accomplish this common goal; and
(c) adopt a mutual strategy in chasing this goal.

According to (Durlak & DuPre 2008), coalitions encourage several practices and processes known to improve application quality, together with collaboration among local agencies, shared decision-making, and communication. Foster-Fishman et al., (2001) are of the opinion that one of the important purposes of a coalition is to produce a collaborative capacity among coalition members through the organizational structure and programs of the coalition. Kochhar (2013) argues that coalition offers strength in numbers, added credibility, networking and partnerships, media attention, and increased access to policymakers. He further argues that the extent to which participants are involved, satisfied, loyal, committed, and contributing to the coalition's work enables coalitions to execute activities. Table 3.6 shows the relationship between the levels of collaboration.

Table 3.6 Relationship between networking, cooperation, coordination, coalition and collaboration

	Networking	Cooperation	Coordination	Coalition	Collaboration
Relationship characteristics	-Aware of Organisation	- Provide information to each other	-Share information and resources	-Shared ideas -Shared resources	-Members belong to one system
	-Loosely defined roles	-Somewhat defined roles	-Defined Roles		
	-Little communication	-Formal communicatio n	-Frequent communication	-Frequent and prioritised communication	-Frequent communication characterized by mutual trust
	- All decisions are made independently	-All decisions are made independently	-Some shared decision making	-All members have a vote in decision-making	-A consensus is reached on all decisions

(Source: Frey et al., 2006)

Following from Table 3.7, and the prior discussion, it can be concluded that an organisation could practice cooperation and coordination without collaborating. In addition to this, cooperation and coordination could be viewed as a process that will naturally occur in the collaboration process. Various definitions of collaboration have been examined, but in this study, collaboration is viewed as an undertaking in which one or more organisations or people come together to deliver a shared task, with all having a common understanding of the goal to be achieved in a shared environment. It is worth noting that collaboration could occur at different levels, ranging from workers within the same organisation to multidisciplinary project team and inter-organisation, among others. Although the concept of collaboration could be easily adopted in other business sectors, this may not be done so willingly in construction due to the nature of the industry. Some researchers have argued that the construction industry is characterised by the traditional hierarchical organisational system which makes it difficult to achieve collaboration (Wilkinson, 2005). According to Shelbourn et al., (2012), collaboration in the construction industry is unique from other fields because of the one-off nature of construction projects and the multidisciplinary nature of construction stakeholders. This was further confirmed in Xue et al., (2010), where they assert that the fragmented nature of the construction industry, in addition to the different stakeholders involved in each section, spending the most time looking after their own interest, contributes immensely to the poor performance and low productivity of the sector.

It has been observed that, generally and naturally, some level of interaction or dependence must occur among the construction project stakeholders before the delivery of construction product; for instance, the contractor needs the design team to produce the working drawing to carry out the actual construction on site. However, such interaction based on the sequential traditional model of project delivery cannot be viewed as a collaboration since each team works independently of each other (Shelbourne et al., 2012; Rahman and Kumaraswamy 2005). According to Wilkinson (2005), collaboration can only occur in a shared environment of trust which is clearly characterised by giving and receiving useful feedback to and from the team involved in the collaboration process.

Defining collaboration from the construction industry point of view, Kalay (1999) defined collaboration as “the agreement among specialists to share their abilities in a particular process to achieve larger objectives of the project as a whole, as defined by the client, community, or society at large”. For this to be realised, the project team that make up the project organisation must focus on their collective ability and expertise to mutually deliver the project goal rather than focusing on their individual or professional ability. The commonly used phrase for collaboration in the construction industry is “collaborative working” (CW).

3.14.5 Need for Collaboration

One of the most important motives for adopting collaborative working practices is the need for projects to be successful. Hamid and Pardis (2014) and Ertel et al., (2001) noted that poor collaboration is the most vital cause of failure in project agreements. This implies that collaboration is indispensable to the success of construction projects. Consequently, project stakeholders are beginning to recognise that the sharing of knowledge and information is one of the critical prerequisites of a productive contractual relationship. Moreover, it has been observed that many problems require the efforts of many different systems working together to be resolved, and that collaboration is the more efficient system (Abdull-Rahman et al., 2014; Kellar-Guenther and Betts 2010).

The primary reason why people go into collaborative working is to achieve synergy by combining resources from collective efforts and, by working together, they can achieve their respective objectives (Wu and Udeaja 2008). As a result, the landscape of the construction development delivery has been changing rapidly, with an emphasis on partnering, joint venture, public/private partnership, and strategic alliances (Akintoye & Main 2007; Abdull-Rahman et al., 2014).

Due to the ever-increasing pace of technological developments and access to new technologies, collaborative relations are becoming a key success factor in many industries (Abdull-Rahman et al., 2014). Stiles (1995), as reported by Abdull-Rahman et al., (2014), identified the following as factors influencing collaboration around the world: the globalization of demand, competition, risk and uncertainty within the business environment.

Wu and Udeaja (2008) stated that the driver for collaborative working might be internal or external. The external environment can produce pressures on organizations which push them to work together more closely to achieve collaborative advantage to face the challenges from the construction market. Through working together more closely, information and resources are shared, and a closer relationship will be formed. Collaborative working can help the contractor respond to the client's requests more quickly and more effectively; at the same time, the client can avoid repeat tendering and save cost and time. Thus, these internal demands can also attract companies to enter into collaborative working to improve efficiency and to lower the transaction cost.

3.14.6 Benefits of Collaborative Working

A review of the literature shows that the benefits of collaborative working are mainly focused on project performance and working relationships. Some have argued that the efficiency and performance of projects are typically improved with collaboration in the construction industry (Hamid and Pardis, 2014). Wu and Udeaja (2008) observed that by strengthening collaborative working, internal efficiency could be improved, transaction cost could be lowered, and a closer business relationship (partnership) could be formed to improve competitive advantage. They further argued that a higher degree of collaborative working, such as partnering, can have positive impacts on project performance, e.g. saving cost and time, increasing quality, decreasing litigation, and promoting greater innovation and improved user satisfaction.

Wu, Greenwood and Steel (2008) corroborate this impression by stating that such collaborative approaches as partnering or alliancing have positive impacts on project performance, such as saving cost, better quality, decreasing litigation, and promoting greater innovation and improved user satisfaction.

3.14.7 Barriers to Collaboration

People are generally unable and unwilling to change from the traditional ways of construction, which makes collaboration difficult in the trade. Some are wary of collaboration due to their fear of biased criticism from other professionals, while others do not want other people taking credit for their works. Furthermore, many practitioners have the misconception that you must be colocated to collaborate, which makes team members unwilling to collaborate when in different locations. This need not be the case as collaboration can be done face to be face or through using virtual technology

Wu et al., (2008) compared collaborative working in the manufacturing industry with that of the construction industry and concluded that, as a result of the adversarial and fragmented nature of the construction industry, it is more difficult to build collaborative relationships and implement collaboration in the construction industry. This is supported by Antti (2017), who stated that in a Swedish study on the obstacles of collaboration, they identified lack of confidence and problems in the way the professionals encounter each other, such as inequality and territorial thinking, as major barriers to collaboration. Hamid and Pardis (2014) noted that the collaborative environment is not always easy to embrace and maintain.

The absence of knowledge of how collaboration works and the absence of a systemic approach to collaboration is another barrier to its adoption (Zimina et al., 2012). Zimina et al., (2012) noted that in a study on partnering carried out with 30 specialist contractors, the knowledge of partnering was limited only to the senior management. This implies that mid-level and lower-level stakeholders have little or no knowledge of partnering and collaboration.

Antti (2017) identified the barriers to collaboration to include: resistance to change and external impacts, need for security or fear, structural inertia, threats to expertise, the power hierarchy and resource allocation, rigid hierarchies, prejudices and mistrust, conflicts of interest, a lack of clarity about common goals, differences in organisational culture, poor allocation of responsibilities, a lack of resources and management, a lack of commitment or incentive, and discontinuity.

Antti (2017) suggested that to mitigate against this, "the management should integrate collaboration into leadership, values and goals, hire people with collaborative tendencies and offer ways for best-practice transfer and for the cross-pollination of ideas".

3.14.8 Factors That Promote Collaboration in TVD

Both face to face and virtual collaboration is not an option in the TVD process, it is a necessity. Hyun (2012) opined that TVD process mandates the collaboration of project participants. Hyun (2012) noted that the "Big Room" was established to enable collaboration, and without co-location, it would have been hard to operate.

Early involvement of stakeholders can promote collaboration: Kaushik et al., (2014) noted that early involvement of major stakeholders in the project is important to guarantee that all required expertise is accessible from the commencement of the project. This, they argue, helps to not only enable the team to set the right targets as per the client's requirements but can also facilitate a collaborative design process to achieve target costs and required design features. Although tools can be beneficial and essential, for collaboration to work, there must be a change in the way work is done, a change in attitude, and in behaviour (Zimina et al., 2012).

De Melo (2015), Neto et al., (2016), Chan et al., (2012) and Do et al., (2015b) identified the factors required to attain the level of collaboration required for TVD implementation to include: contractual relations, the use of some IPD principles, the shared incentives (the gain-share/pain-share mechanism), the best value contractor selection, co-location, big room meetings, shared governance, and key project personnel training. All these foster more positive results in terms of the collaboration necessary for the TVD approach. Engineering a change in people's general mindset from traditional construction is necessary for collaboration to be effective. Collaborative working should be considered a tool for success rather than a tool of rivalry between professionals.

Similarly, Hamid and Pardis (2014) maintained that there are nine traits in an effective team that can result in collaboration, creativity and productivity. These traits include co-location, commitment, multidisciplinary work, decision authority, a productive environment, training, accountability, immediate feedback and consensus leader selection. Kellar-Guenther and Betts (2010) categorised the factors promoting collaboration into structural and interpersonal factors (see Table 3.7).

Table 3.7 Factors promoting collaboration

S/N	STRUCTURAL FACTORS	INTERPERSONAL FACTORS
1	Favourable political and social climate	Open and frequent communication
2	Development of clear roles and policy guidelines	Established and informal relationships and communication links
3	Concrete, attainable goals and objectives	Shared vision
4	Enough funds, staff, materials, and time	Flexibility
5	Commitment and or involvement of high level, visible leaders	Altruism
6	Interim Successes	Adaptability
7		Trust

(Source: Kellar-Guenther and Betts (2010)

Finally, collaborative working needs to be done with the right people in the proper way, and for proper reasons for suitable projects (Wu et al., 2008).

3.15 The Lean Project Delivery System (LPDS) and Integrated Project Delivery (IPD)

An extensive review of the literature has revealed that TVD is always associated with IPD within a lean philosophy context and that to practice it must involve lean tools and methods in design and construction. This is supported by Emuze and Mathinya (2016), Rubrich (2012) and Ballard (2011), all of whom noted that TVD is a Lean Construction tool that shifts the basic thinking within a project from expected costs to target costs, and as a tool it can be implemented within an integrated project delivery (IPD) team model.

Lean Construction evolved as a new management field from the lean manufacturing philosophy which originates from the Toyota production system (TPS) developed after World War II for Toyota in Japan by Engr. Taiichi Ohno (Ahiakwo 2014; Daniel 2017). 'Lean production' as a concept was first created and popularised by Womack et al., (1990) in their book '*The Machine that Changed the World*', where they maintained that the lean philosophy is destined to become the only production system to be adopted globally, after comparing it with mass production.

According to (Koskela 2000), Lean production philosophy has been adopted extensively in many other sectors including the construction industry. Daniel (2017) asserts the goal of lean production is the addition of value while eliminating waste from the design stage to final production of the product.

Lean construction/ lean project delivery as an adaptation of lean production is the application of lean thinking to the design and production (or delivery at large) of capital projects (or projects in general) (P2SL 2016). The lean project delivery system is a system that attempts to produce higher value for customers with fewer resources. According to Ballard (2008), the lean project delivery system was developed in 2000 from theoretical and practical research, and its development is still on-going through experimentation across the globe. The lean project delivery system diagram is shown in Figure 3.2.

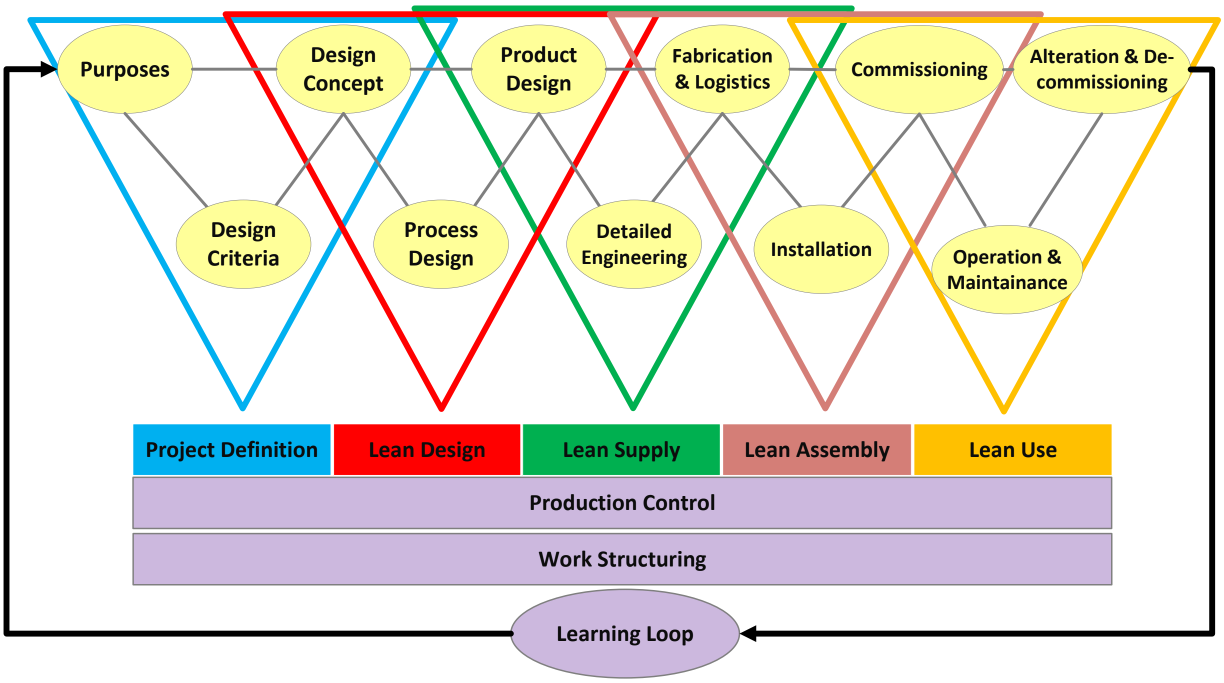


Figure 3.2 Lean Project Delivery System (LPDS)

(Adopted from Ballard 2008)

TVD benchmarks are tailored more towards the US construction industry equipped with IPD (integrated project delivery) and multi-party collaborative contracts in the form of IFOAs (an integrated form of agreement) (Kaushik et al., 2014). The American Institute of Architects (AIA 2007) maintained that IPD is a project delivery method where the individual's success is contingent on collaboration and teamwork among all project participants. This view is supported by Tommelein and Ballard (2016), who noted that IPD is a delivery system that attempts the alignment of the interests, objectives, and practices of all the project stakeholders (including the architect, key technical consultants and key subcontractors) by considering the organization, the operating systems and the commercial terms governing the project. They maintained IPD makes it possible for an organization to be able to apply the principles and practices of the lean project delivery system.

Hassan (2013) maintains that the IPD approach integrates people, systems, business structures and practices into a process that collaboratively exploits all participants' experience and talents to optimize project productivity. IPD thrives on collaboration leverages on lean ideologies to increase value, reduce waste, and maximize efficiency in the project life cycle. However, the minimum required setting for TVD implementation in non-IPD environments have been investigated by other research in the UK (Kaushik et al., 2014). Oliva et al., (2016) also found evidence based on a non-IPD exploratory case study in Brazil which supports the claim that the benefits of TVD in traditional practices are inadequate.

3.15.1 Procurement

Applying the full potentials of TVD benchmarks has been reported to be challenging, especially in the public sector and traditional procurement route projects, mostly due to the lack of early involvement of stakeholders and the standing government policies. The literature suggests more research on TVD is needed on wider applications to various project types for evidence-based decisions regarding its adoption/adaptation in the construction industry, especially in developing countries (Emuze, and Mathinya 2016). Meaning that the need to apply TVD on other procurement routes apart from IPD is advocated. Furthermore, Oliva et al., (2016) argue that the characteristics of certain construction markets and procurement practices could challenge the successful adoption of the current TVD benchmarks in countries other than the US. According to De Melo et al (2016), only a negligible amount of research has been conducted on TVD; there are very few reports on the application of TVD in real-world projects or, indeed, the practice of TVD in projects that did not adopt IPD.

Procurement in property development is a straightforward concept if proper procedures are followed, it is one which requires some thought and planning of placing a contract with a builder. Davis et al., (2008) recommend that the decision as to what procurement system to use should be made as early as possible, and this is reinforced by the client's business case for the project and that the risks and how they can potentially affect the client's business should also be considered. The procurement method must be decided upon at an early stage of a project as this will support the entire development process and create a concrete start point. Laedre et al., (2006) stated that it is widely accepted that a proper selection of procurement route improves the possibility for effective project execution.

ISO (2008) defines procurement as the process that creates, manages and satisfies contracts. Procurement is therefore seen as a series of logically related actions occurring or completed in a defined manner which leads to the completion of a major project or the accomplishment of a milestone. Love et al., (1998) define procurement as an organisational system that allocates specific responsibilities and authorities to people and organisations and defines the relationships between the different elements of construction in a project. The procurement route delivers the procurement strategy (OGC 2003). Laedre et al., (2006) claim that it includes the contract strategy that will best meet the client's needs, adding that the blend of procurement method, contract model and the compensation format constitutes the procurement route. Project procurement is a complicated issue, and success is based on a combination of project conditions and the organisational form the client intended to employ (Oyegoke et al., 2009).

There have been different classifications of procurement routes, a task Oyegoke et al., (2009) report is progressively becoming more complex because of the fragmented method of operations. Various researchers have also categorised procurement routes, based on the way projects are organised, based on financial issues, based on the conditions of contracts and based on management process, relational contracting and integrated working arrangements.

The most widely accepted classifications of procurement route are traditional (separated); design and construct (integrated); management (packaged); and collaborative (relational) (Davis et al., 2008; Oyegoke et al., 2009).

i. **Traditional**: in this procurement route: the client holds design responsibility through the design team; the design process is done in isolation from the construction phase; complete documentation is ready before contractors are invited to tender for the works.
ii. **Design and Build**: here, the contractor is responsible for both the design and construction of the project for a lump sum fixed price.
iii. **Management Contracting**: the client also has the responsibility for design through the design team; the contractor is accountable for defining the work packages and

for managing those works taken on by separate trades or works contracts. The contractor contracts directly with the works contractors.

iv. **Construction Management**: the client is responsible through the design team for the designs in this route too. The contractor joins the design team in order to provide advice regarding the definition of work packages and for managing those work packages. The client contracts directly with the works contractors.

v. **Public/Private Partnerships (PPP)**: A public-private partnership is where the contracting vehicle designs, constructs, and runs a building for a set period, usually 25-40 years, in return for an annual 'unitary payment' from the public sector client.

The nomenclature for procurement route classification may differ from one researcher to another. For example, Oyegoke et al., (2009) classify them as the traditional system, design and build, construction management and partnering. The classification goes further to mention framework agreements (FA), stating that FA and Partnering are based upon the concepts of teamwork, integrated teams and collaborative working arrangements, Laedre et al., (2006) referred to them as Private Finance Initiatives (PFI), Design & Build and Multiple Prime Contracts.

Laedre et al., (2006) mention tools that could be used to select the procurement route. They are:

i. a spreadsheet-based program developed by Construction Industry Institute (2003) called the Owner's Tool for Project Delivery and Contract Strategy Selection (PDCS); and

ii. an internet-based tool developed by a Norwegian research program (Byggherren i Fokus (BiF).

Other procurement routes worthy of note are collaborative procurement and Best Value Procurement (BVP). The term 'collaborative procurement' can mean different things to both individuals and organisations, depending on skills and information gained. Burnand (2009) views it as a market opportunity for the suppliers to join forces to decrease costs and offer enhanced value for money to clients; and with these objectives in mind, the 'sell-side' can, in fact, become the 'buy-side'.

Collaborative procurement can be, and most times is, started as part of either a new or existing collaborative relationship. It is an effective way for more than one client, contractor, consultant or supplier to join together to procure works, services, materials or goods, share expertise, promote efficiency, and deliver value for money savings in the delivery of a project (or series of projects) or service objectives (Burnand 2009). This is supported by Törneman (2015), who said: “long-term collaborative working can be understood as a type of procurement method”.

According to (Snippert et al., 2015), best value procurement (BVP) is a procurement method that focuses its attention on getting the best value for the least cost possible. BVP’s fundamental concept is focused on selecting the supplier with the most advantageous offer to the client, where price and other features are considered (Elyamany an Abdelrahman 2010). Wondimu et al., (2018) observed that BVP is an information-based procurement method that envisages the performance of suppliers based on previous performance information. “Suppliers are ranked and then selected based on past performance, current capability, price, risk management and the quality of key personnel” (Duren et al., 2015).

3.15.2 Impact of Procurement

Kipkemoi (2017) observed that procurement practices can positively affect an organization’s financial performance; this is because the success of a new product depends on procurement and supplier involvement. He further noted that the importance of strategic procurement practices has been recognised by most organizations as they use a considerable sum of their income in procurement.

Eriksson and Westerberg (2011) noted both practitioners and academics argue that many of the problems in construction projects are connected to inaccurate procurement procedures where the focus is on short-term individual sub-optimization rather than on long-term project team performance. Procurement practice is an area that can be improved to further contribute to organizational performance. Organizations often choose procurement procedures that are familiar to them; they should instead choose the ones most appropriate and most beneficial to the organization’s success (Kipkemoi 2017).

3.16 Tendering Process

DBW (2018) maintained that the tendering process generally follows one of several basic procedures, which include: open tendering, negotiated tendering, serial tendering, framework tendering and selective tendering.

3.16.1 Selective Tendering

Selective tendering is a method where only qualified suppliers that are known by their track record to be suitable for a contract of the size, nature and complexity required are invited by the procuring entity to submit a tender (Lewik 2018; DBW 2018). A preferred tenderer is selected based on criteria such as price and quality and negotiations entered from the tenders received (DBW 2018). The goal of selective tendering is to improve the quality of the bids by ensuring that only contractors with the necessary experience and competence are given the opportunity to submit the necessary bids. It also helps to make the tendering procedure more manageable and reduces the drudgery on the parties involved.

This process tends to be faster than open tendering, and less wasteful as there is no pre-qualification process as part of the tender procedure itself, and only contractors that are known to be suitable for the proposed contract are invited to prepare tenders, thereby giving clients greater confidence that their requirements will be satisfied (DBW 2018). Nevertheless, it can eliminate smaller or upcoming contractors who are trying to establish themselves in a new market; it can introduce bias into the tendering process and reduce the potential for innovation by the selected tenderers (DBW 2018).

3.16.2 Competitive Tendering

Laedre et al., (2006) claim that tender competition is a procurement method that does not allow the owner or contractor to negotiate before they have signed the final contract documents, while Namadi et al., (2017) report that it is the basis for the process leading to budget setting and the eventual production stages. Competitive tenders are arrived at from documents that have been prepared to enable several contractors to offer rivalry in designs and in prices (Davis et al., 2008).

Zimina et al., (2012) warn that competitive tenders are better avoided when possible (including tendering for the construction work) to avoid making confidential information available to the public. The Local Government Act, 1988 in the UK stretched competitive tendering to sectors like refuse collection, street cleaning, school catering and parks maintenance (John 1990).

Hasanzadeh et al., (2014) maintain that research in construction procurement methods indicates that there is an exigent need for a change of culture and attitude in the construction industry; a shift from the archaic confrontational relationship into a more cooperative and collaborative relationship. The need for this change stems from the characteristic complexity, uncertainty and time pressure typical of construction projects

3.17 Project Management

Previous researchers worldwide have presented TVD approaches and processes which have focused more on the pre-design and design stage of projects, which is not all-inclusive, and which does not cover in detail the executing and closing stages of construction (Ballard 2012; Lee 2012). This confirms a significant knowledge gap. Therefore, the study reported in this thesis fills this gap by developing a comprehensive framework, grouped according to the Project Management Institute (PMI) process groups, that encompasses the complete project life cycle, including project initiation, planning/design, execution, monitoring and control, and the closing stage.

Various scholars have attempted to define project management. Marcelino-Sadaba et al., (2015) opines that the definition of project management by Project Management Institute (2008) is the most widely accepted definition. The Project Management Institute (2008) defines project management as the application of knowledge, skills, tools and techniques to project activities to meet the project requirements. Marcelino-Sadaba et al., (2015) claim that project management allows current ideas to materialise in the future.

The project management processes ensure the effective flow of a project throughout its life cycle. These processes encompass the tools and techniques involved in applying the skills and capabilities in all areas of a project.

> The PMBOK® Guide grouped project management processes into five categories known as the project management process groups (or process groups): the initiating process group, planning process group, executing process group, monitoring and controlling process group, and closing process group

i. The initiating process group includes those processes done to define a new project or a new phase of an existing project by gaining approval to start the project or phase.

ii. The planning process group includes those processes essential to define the scope of the project, perfect the objectives, and explain the courses of action required to attain the objectives that the project was started to achieve.

iii. The executing process group includes those procedures taken to complete the work defined in the project management plan to ensure that the project stipulations are satisfied.

iv. The monitoring and controlling process group includes those processes essential to trial, review and regulate the progress and performance of the project; recognise areas in which changes to the plan are needed and commence the conforming changes.

v. The closing process group includes those procedures performed to complete all activities across all process groups to officially close the project or phase. This section provides information for project management of a single project organised as a system of interwoven processes and details the project management processes.

All the features essential for sustainable management emerge in the management areas defined by project management standards: stakeholders, processes, products/services and learning (Maletic et al., 2014). This makes project management process an effective method for implementing TVD on construction projects. This is further supported by the PMBOK® Guide, which says that project management processes apply globally and cut across industry groups. Project management includes the management of all knowledge areas (integration, scope, time, cost, quality, human resources, communications, risk, and procurement) (PMI 1996), all of which are critical factors to be considered in the implementation of TVD.

3.18 Chapter Summary

This chapter has explored the origin of TVD, which is target costing, and its principles in the construction industry. It focuses on target value design and presents all the practices involved and principles guiding its practice. It also explored the success stories of TVD implementation in various countries, and at the same time highlights the benefits, challenges, success factors, supports, tools and techniques, project mindset, impacts of TVD implementation and the role of the client throughout the TVD implementation. It was noted that the TVD benchmarks were developed by the University of California at Berkeley's Project Production Systems Laboratory and have been revised by Ballard (2012). Although these benchmarks guide the application of TVD, they focus mainly on project definition, planning and the design stages of projects.

This review has observed that while cost savings and cost reduction are the most common benefits of TVD implementation, inaccurate cost estimating is the most common challenge mentioned in almost all the studies reviewed. An attempt to practice TVD in the UK failed due to some business practices and inaccurate cost estimations. The review has also noted that TVD implementation has had a significant positive impact on cost, time/schedule, quality, client satisfaction and working relationships. The gaps identified from the literature review which this study has attempted to address are as follows: one of the shortfalls of TVD implementation is that its basic principles take time to comprehend and can seem discouraging when implemented for the first time on actual projects; issues of adopting collaborative practices have been observed to be a prominent challenge in TVD projects, with the literature revealing limited attempts to measure the levels of collaboration on such projects; there is a need for the teaching of TVD practices through TVD simulation, which is a more practical method of understanding collaboration and TVD practices than formal training and workshops. The different levels of collaboration can be easily confused and wrongly used interchangeably, however, there are key differences. With collaboration being one of the backbones of successful TVD implementation, there is a need to examine the interrelationship and distinct requirements of networking, cooperation, coordination, coalition and collaboration.

The application of TVD in the NCI has not been fully explored; previous research has only reported on “the efficacy and applicability of TVD in the context of low-cost housing project delivery cost management in the south-east zone of Nigeria”. The research has limitations as there was no evidence of TVD implementation or the development of a support structure for TVD implementation to enhance value creation. It is not clear how the current design management practices in the NCI align with the underlying benchmarks and practices of TVD. It can be concluded that empirical studies examining construction practices across major sectors in the industry are lacking. Thus, this is another knowledge gap that this study seeks to bridge. Clearly, the more advanced and critical elements of TVD are not being implemented in current construction practices within Nigeria. The challenge with the current situation is that the intended benefits of TVD implementation may not be fully realised at the organisational and project levels.

Another critical gap in knowledge identified by the literature is that most TVD research has mainly focused on a narrow and specific context; the focus has always been more on cost and time saving, while achievements in value-generation have been neglected. There is a limited focus on the impact of TVD on quality and stakeholder value in TVD literature. There is a need to document how TVD implementation can improve the quality of construction products and ensure compliance with initial design intent stated in the stakeholders' value identification. The review noted that the need for projects to be successful is one of the most important reasons for collaborative working and that poor collaboration is the most vital cause of failure in project agreements. Furthermore, the adversarial and fragmented nature of the construction industry endangers collaborative relationships in the industry.

Applying the full potential of TVD benchmarks has been reported as being challenging, especially in the public sector and traditional procurement route projects, mostly due to the lack of early involvement of stakeholders and the standing government policies. This means that although the need to apply TVD on other procurement routes apart from IPD is advocated, some procurement practices and characteristics of certain construction markets might yet confront the implementation of TVD benchmarks in some countries. To counter this, there is a call for further research on TVD within several project types to guide the adoption of TVD based on evidence from practice, especially in developing countries.

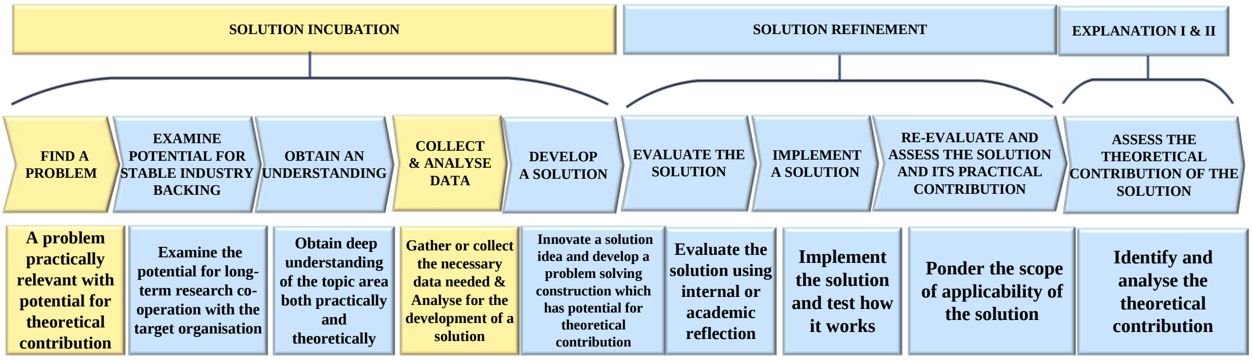
This chapter has also explained the various types of procurement routes available for the construction industry; these include traditional, design and build, management contracting, construction management, and public/private partnerships. It can be concluded that the advantages of TVD far outweigh the disadvantages and that TVD has a number of fundamental differences from traditional design practices in terms of management and the practical implementation of projects. A comparison between TVD, IPD, and BIM shows that while IPD is a contractual arrangement, TVD and BIM are lean construction tools. IPD is a project delivery process that can enable the use of TVD and BIM successfully in construction projects.

As mentioned earlier, researchers' presentation of TVD approaches and frameworks are usually centred on the pre-design and design stages of the project, which does not encompass the entirety of a project. It is essential that an all-inclusive framework is developed to ensure the necessary support covering all stages in construction exists in order to achieve enhanced value creation in the industry. This study expands on previous frameworks, aiming for long-term and far-reaching improvements. This signifies how empirical evidence on current practice is vital.

Also, the Project Management Institute (PMI) process groups have been reviewed to guide the development of an all-inclusive framework that identifies the life cycle of a project to be categorized into project initiation, planning, execution, monitoring and control, and closing stages. The succeeding chapter concentrates on the research methodology used in the study; elaborating on the research methods and methodology, research philosophy, research paradigms, research strategy, research design and the phases employed. It gives an overview of all the development, evaluation and testing of the framework for implementing target value delivery (FFITVD).

CHAPTER FOUR

RESEARCH METHODOLOGY



4.1 Introduction

The preceding chapters (2 and 3) have presented a detailed literature review on the core concepts and terminologies like value creation, TVD, collaboration, LPDS, IPD, procurement, tendering process and project management. This review forms the foundation for the methodology adopted in the research. This chapter presents a comprehensive explanation of the research philosophies, paradigms, approach and strategies used to achieve the aim and objective of the study. An attempt is further made to validate the paradigm used in the study. This chapter thus describes the methodology and methods used in conducting this research and further justifies the reasons for the adoption of the research methods employed to meet the objectives. This chapter also discusses the data collection, evaluation processes employed, design science research, research design and phases adopted for this research.

4.2 Understanding Research Methods and Methodology

The importance of understanding and differentiating between research methods and methodology cannot be overemphasised as it helps in making an informed choice about the research (Saunders et al., 2009). Various scholars have defined research methods and methodology in order to bring out the difference between the two terms. For example, Saunders et al., (2009) maintained that the term methods "refers to techniques and procedures used to obtain and analyse data" and, in contrast, refers to methodology as the theory of how research should be undertaken. Kothari (2004) agreed with Saunders et al., (2009), adding that research methodology is a way to systematically solve the research problem; in other words, the research methodology is a science of studying how research is done scientifically. Grix (2002) explained that methodology concerns the logic of scientific inquiry, with exploring the potentialities and limitations of techniques or procedures. Methodology relates to the science and study of methods, and the assumptions about the ways in which knowledge is produced.

Saunders et al., (2009) stated that research methods include questionnaires, observation and interviews, as well as both quantitative (statistical) and qualitative (non-statistical) analysis techniques. Research methodology has many aspects, and research methods form a part of the research methodology; thus, the scope of research methodology is broader than that of an individual research method. The discourse on research methodology is not limited to the research methods only, but also involves a critical analysis of the logic behind the methods used in the context of the research study and explains the reasons for selecting a method or technique over others so that the research result can be evaluated by any scholar (Kothari 2004). All the approaches and perceptions adopted in the research process to answer the questions why, what, where, and how the data is collected and analysed constitutes the research methodology (Collis and Hussey 2003).

4.3 Research Philosophy

The disjointed classification of research philosophies such as epistemology, ontology, axiology, doxology, and the quantitative-qualitative dichotomy debates have intensified the difficulty in conducting research today (Mkansi and Acheampong 2012; Grix 2002). This has been compounded by the imperative of defining the philosophical stand of the research from the beginning as this is vital in determining the appropriate methods and methodology to be used in executing the research (Daniel 2017),

Selecting a specific philosophical standpoint from the beginning of the research is very important; this is because the researcher’s specific opinion of the connection between knowledge and the process by which knowledge is developed has a significant influence on the research philosophy (Saunders et al., 2009). Mkansi and Acheampong (2012) noted that various studies have used diverse explanations, categorisations and classifications of research paradigms and philosophies in relation to research methods, with overlapping emphasis and meanings. Damien (2016) observed that the main branches of philosophy are divided according to the nature of the questions asked in each field; nevertheless, the veracity of these divisions cannot be strictly sustained for fields overlap (Damien 2016; Mkansi and Acheampong 2012). The most significant, as illustrated by Durant-Law (2005) and Damien (2016) in Figure 4.1, involves ontology, epistemology, and axiology.

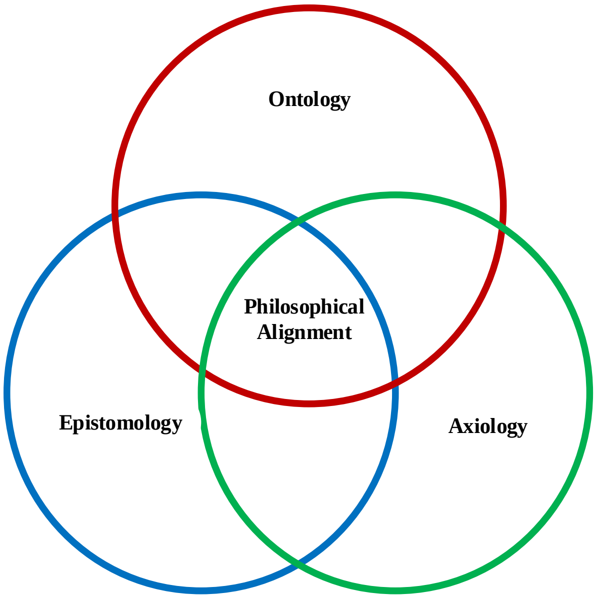


Figure 4.1 The philosophical overlaps (Durant-Law 2005; Damien 2016)

The choice of research philosophy to use is determined by the research question; this is because, according to Saunders et al., (2009), one research philosophy may be more appropriate than another for answering questions.

4.3.1 Ontology

Ontology is the foundation of every research; it usually precedes the researcher's epistemological and methodological standpoint (Grix 2002). Ontology is defined or concerned with the nature of reality (Saunders et al., 2009; Vaishnavi and Kuechler 2004; Damien 2016). While Ritchie and Lewis (2003) noted that understanding the social world and its characteristics is the concern of ontology, the simplest and most complete definition of ontology was the one given by Saunders et al., (2009), who stated that ontology is interested in the assumptions and claims a researcher makes about knowledge, concentrates on how the knowledge exists, its make-up and their interaction. Various ontological views have been identified in the literature. GuhaThakurta (2015) classified ontology into objectivism and subjectivism. Realism, materialism and idealism are the ontological positions recognised by Ritchie and Lewis (2003), Saunders et al., (2009) broadly classified them into objectivism and subjectivism while Easterby-Smith et al., (2012) classified them into realism, internal realism, relativism and nominalism and Grix (2002) into objectivism and constructivism.

Ritchie and Lewis (2003) maintain that in realism, there is an external reality which exists independently of people's beliefs or understanding about it. They further proposed that materialism claims that there is a real-world, but only material features such as economic relations or the physical features of that world hold reality. Finally, idealism asserts that reality is only knowable through the human mind and through socially constructed meanings. Objectivism is an ontological position that asserts that social entities exist in reality external to social actors concerned with their existence (GuhaThakurta 2015; Grix 2002; Saunders 2009). Subjectivism and constructivism are the ontological positions that assert that social phenomena are created from the perceptions and consequent actions of those social actors concerned with their existence (GuhaThakurta 2015; Grix 2002; Saunders 2009).

The ontological position of this study is constructivism. This position was adopted for this study because it is believed that the knowledge and understanding about TVD, value management, value creation and the current design management practices in the NCI exist based on the subjective opinions of industry stakeholders. More so, the study seeks to create an artefact to aid the construction stakeholders in the implementation of TVD, (Simon, 1996) noted that in the ontology of DSR, the artefact must be created before it can be examined.

4.3.2 Epistemology

The word epistemology is gotten from Greek works episteme and logos meaning knowledge and reason respectively. It's generally referred to as the theory of knowledge which focusses on how knowledge about social reality is gained in terms of its methods, validity and scope (Stroll and Martinich 2018; Damien 2016; Grix 2002). It is based on what each field of study regards as satisfactory knowledge (Saunders et al., 2009; Bryman 2012; Henn et al., 2006; GuhaThakurta 2015). Blaikie (2007) substantiates this by stating that epistemology is focused on examining the form of knowledge developed, how the knowledge was produced, and the criteria used in discerning valid from invalid knowledge.

Various epistemological positions have been identified and presented with diverse names in the literature. For example, while Grix (2002) regarded the epistemological positions as positivism and interpretivism; Saunders et al., (2009) added a third, which is realism. Crotty (1998) saw them as objectivism and constructivism. Saunders et al., (2009) noted that positivism adopts the philosophical stand of the natural scientist. Positivists are of the opinion that the application of natural scientific methods is the only way social reality can be known and understood (Saunders et al., 2009). This portrays the position that things exist as meaningful entities independently of consciousness and experience; they have truth and meaning residing in them as objects (Crotty 1998).

The interpretivists, on the contrary, believe that the actors that are involved in the process need to be studied for social reality to be understood, i.e. the actors create the social realities (Saunders et al., 2009). In other words, interpretivism advocates that it is necessary for the researcher to understand and respect the differences between people and the object of natural science, and therefore requires the social scientist to appreciate humans' role as social actors (Grix 2002; Saunders et al., 2009).

This study adopted the interpretivist epistemological position because the process of obtaining information about the practices, challenges, and solution for the NCI involves the interpretivist approaches. This position was adopted for this study because there is a need to study the actors that are involved in the process of value creation in the NCI; Value creation does not exist independently, but it is a consequence of the actions of construction stakeholders. This study understands and appreciates the human role as a social actor of value creation. It is therefore imperative to study the activities of the construction stakeholders and obtain their opinions on the problems and practices in the industry.

This is in line with the popular quote by Manser (2007): "No one knows where the shoe pinches but he who wears it". This implies that nobody can fully understand the suffering or problems faced by the industry stakeholders except they themselves.

4.3.3 Axiology

Axiology is a branch of philosophy that studies judgements about values (Saunders et al., 2009) as well as ethics and aesthetics (Damien 2016; Durant-Law 2005). Saunders et al., (2009) argued that although it may include the judgement about values we possess in the fields of aesthetics and ethics, the process of social enquiry is the paramount concern here. The credibility of the results of any research is dependent on the values of the researcher (Saunders et al., 2009). Heron (1996) as cited by Saunders et al., (2009), argues that the researcher's values are the controlling influence of all human action; researchers demonstrate axiological skill by being able to articulate their values as a foundation for making the decision about what research they are conducting and how they conduct it.

A review of the available literature shows an unclear classification of axiological schools of thought. Nevertheless, Durant-Law (2005) identified two different positions, namely the Aristotelian School and the Applied School. Durant-Law (2005) noted that the Aristotelian School concerns the value of knowledge for its own sake and as an end in itself; in other words, simple understanding is valued above all else. Meanwhile, the Applied School values knowledge as a means of informing, transforming or enabling positive change.

The axiological standpoint of this study is the Applied School of thought; this is because the study aims to go beyond understanding:

a. the current design management practices
b. the need for value creation in the construction industry within literature
c. the application of TVD

to the developing and testing a framework that will engender a positive change through the successful implementation of TVD in the NCI. Going with my research being constructive research, it also complies with the reports of Kasanen et al., (1993) which stated that constructive research is viewed as applied studies since it also focuses on the production of new knowledge in form of normative applications.
From the foregoing, the chosen philosophical position will obviously influence the methodology to be used in the investigation. The various philosophical stances of the study are illustrated in Figure 4.2.

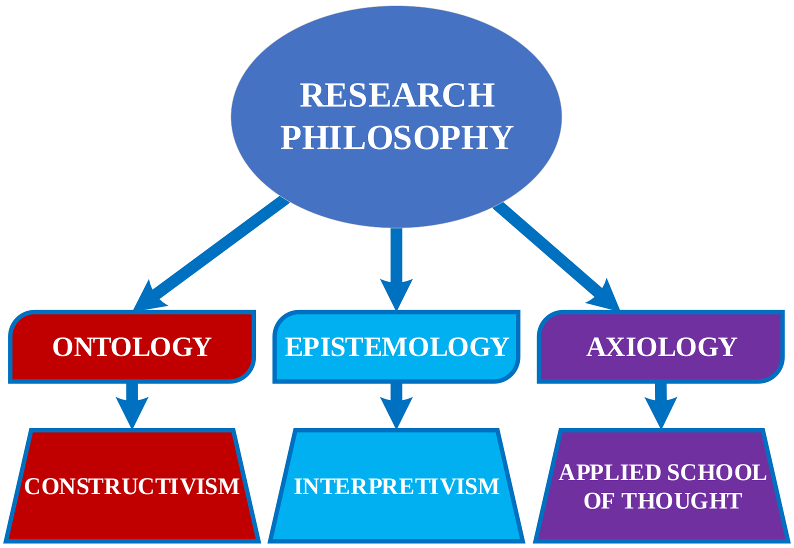


Figure 4.2 Research philosophies adopted for the study

4.3.4 The Relationship between Ontology, Epistemology, Axiology, Methodology and the Research Methods

Saunders et al., (2009) observed that each of the three major ways of thinking about research philosophy (epistemology, ontology and axiology) has important individual differences which will influence the way in which a researcher thinks about the research and the research process.

Grix (2002) noted that by having a clear and transparent knowledge of the link between what a researcher thinks can be researched (the ontological position), connected to what we can know about it (the epistemological position), and what is valuable (the axiological position) and how to go about acquiring it (the methodological approach), a researcher can begin to understand the influence the ontological position can have on what and how we decide to study. Grix (2002) explained that a researcher's methodological approach, supported by and reflecting definite ontological, epistemological and axiological assumptions, signifies a choice of approach and research methods chosen in any given study.

While ontology is frequently wrongly collapsed together with epistemology, methodology, on the other hand, is plausibly linked to, and very often confused with, the research methods (Grix 2002). Although ontology and epistemology are closely related, they need to be kept separate since all research essentially starts from a researcher's view of the world, which itself is shaped by the experience the researcher brings to the research process (Grix 2002).

Durant-law (2005) noted that even when not specified, the researcher's epistemological stance is determined in part by their ontological position. This, he noted, is because a theory of the nature of knowledge or the world is at the same time a theory about knowledge of the world; hence there are large overlaps between epistemology and ontology. From the foregoing, there is a need to allow the ontological, epistemological and axiological position instead of research methods to influence the research process. This is because ontology and epistemology are research building blocks (Saunders et al., 2009; Grix 2002).

4.4 Research Paradigms

Saunders et al., (2009) posited that the term paradigm is often used in the social sciences, and it can lead to confusion because it tends to have multiple meanings. Guba (1990) observed that a paradigm is a set of propositions that explain how the world is perceived; it contains a worldview, a way of breaking down the complexity of the real world, telling researchers and social scientist, in general, 'what is important, what is legitimate, what is reasonable'.

Sarantakos (2012) noted that examples of paradigms are positivism, symbolic interactionism, ethnomethodology, and phenomenology. Saunders et al., (2009) classified paradigms into functionalist, interpretive, radical humanist, and radical structuralist. Daniel (2017), Bryman (2012), and Fellow and Liu (2009) classify paradigms into positivism, interpretivism and the mixed approach.

4.4.1 Positivism

The aim of the positivist research is to offer clarifications leading to control and predictability (Blaxter et al., 2006), and the positivist researcher is often encouraged to use a highly structured and organised methodology in order to enable replication (Saunders et al., 2009; Churchill 1996; Carson et al., 2001). Blaxter et al., (2006) argue for the use of research instruments such as questionnaires and experiments to capture ‘reality’ as this makes it possible for the researcher to be objective and be separate from the objects of research.

Ritchie and Lewis (2003) reported that Rene Descartes, a foremost proponent of positivism, wrote *Discourse on Methodology*, in which he advanced the importance of objectivity and evidence in the search for truth. A vital view of his writing was that researchers ought to distance themselves from any influences that might corrupt their analytical skills. Positivist ontology is of the view that the world is external (Carson et al., 2001), with any research phenomenon or situation having a sole objective reality, irrespective of the researcher’s perceptions or beliefs (Hudson and Ozanne 1988). The researcher can investigate a problem without influencing it using this approach (Guba and Lincoln 2005). The positive research is not adopted in this research. According to Kasanen et al., (1993) positivism focusses on statistical testing and critical interpretation which does not really lead us to the core of knowledge. They argue that emphasis should be put more on design of systems and problem solving (design science). Research reports that constructive research is different from positive research being a directly goal-directed problem-solving activity (Kasanen et al., 1993). According to van Aken, (2004) phases of constructive research are subjective and intersubjective (avoid the word objective). They argue that researches tend to frame problems from their own background expertise.

4.4.2 Interpretivism

Ritchie and Lewis (2003) noted that the early development of interpretivism has been linked to the writings of Immanuel Kant who published his *Critique of Pure Reason* in 1781 in which he proposed that:

a. Perception is not only associated with the human senses, but also with interpretations of what our senses tell us.
b. Our knowledge of the world is based not just simply on having had experiences, but on an 'understanding' which arises from thinking about what has happened to us.
c. Knowing and knowledge exceed basic empirical enquiry.
d. Differences exist between 'practical reason' (based on moral freedom and decision-making and which involves less certainty) and 'scientific reason' (based strictly on causal determinism).

Blaxter et al., (2006) observed that the interpretivist approaches to social research view interpretations of the social world as culturally and historically situated. Ritchie and Lewis (2003) pointed out that people always use other ways other than direct observation to know or investigate the world. Interpretivism has many variations. These include hermeneutics, phenomenology and symbolic interactionism (Blaxter et al., 2006; Ritchie and Lewis 2003) ethnography, ethnomethodology, grounded theory, constructivism, and critical theory (Ritchie and Lewis 2003).

For an interpretivist researcher, it is important to understand motives, meanings, reasons and other subjective experiences which are time-bound and context-bound (Neuman 2000). The knowledge gained in this discipline is socially constructed rather than objectively determined and perceived (Edirisingha 2012)

4.4.3 Justification of the Research Paradigms Chosen

After a logical examination of the various research paradigms, it is imperative at this junction to state the philosophical standpoint that this research has taken. The significance of taking a philosophical stance cannot be overemphasised and this is because many researchers have explicated its place in shaping the research process (Saunders et al., 2012; Grix 2002; Fellow and Liu 2008; Blaikie 2007; Henn, et al., 2006)

Saunders et al., (2012) argues that the most central determining factor of the research philosophy to adopt is the research question, this is because one philosophical stance may be more appropriate than the other for answering a question. He further noted that if the research question does not suggest explicitly that either a positivist or interpretivist philosophy is adopted, then it is perfectly possible to work with variations in the epistemology, ontology and axiology stance. However, when a combination of different philosophical viewpoints is adopted, it is expedient for the researcher to view the philosophical viewpoints adopted as a continuum rather than opposites (Tashakkori and Teddlie 1998).

Interpretivism paradigm was adopted to accomplish the aim and objectives of this study. This paradigm will enable this research to develop an understanding of problem of the NCI through obtaining the views, positions, concerns and the meaning ascribed to the problem by the industry stakeholders (Fellow and Liu 2008), to evaluate and validate the FFITVD developed to support construction stakeholders in the implementation of the TVD in the NCI. The commonly used research strategy with interpretivist views is the qualitative research strategy; while research methods include case study, action research, ethnography, participative enquiry, feminist perspectives and grounded theory (Daniel 2017; Ritchie and Lewis 2003; Blaxter et al., 2006). This study used case studies, observations and interviews for qualitative data collection.

4.5 Research Strategy

The research strategy is the plan of how the researcher intends to answer the research question(s) (Saunders et al., 2009; Naoum 2012). Sarantakos (2012) stated that research strategy is the means through which a researcher makes sense of the object of inquiry. Saunders et al., (2009) observed that the research strategy to be used in any research is usually determined by the following factors: the research question(s) and objectives, the philosophical viewpoint, the amount of current knowledge, the time, and other resources available. They argued that research strategies should not be viewed as being mutually exclusive because no research strategy is intrinsically superior or inferior to another. Therefore, methods can be combined (mixed); for example, a researcher can use the survey strategy as part of a case study. The research strategies used in this study are discussed in the following sections.

4.5.1 Qualitative Approach

Researchers have identified qualitative research using different names at different times. For example, while Neelankavil (2007), Engel and Schutt (2005), Bernard (2006), and Kothari (2004) have referred to it as exploratory research, Saunders et al., (2009), and Engel and Schutt

(2005) have called it inductive research, and Kothari (2004) has referred to it as formulative research.

Qualitative research is an experimental form of research which uses data that are not in the form of numbers (Blaxter et al., 2006; Punch 2005). This view is supported by Kothari (2004), who claims that it is an approach to research that produces results in a form which cannot be exposed to rigorous quantitative scrutiny. In other words, qualitative research is that which seeks to gather, analyse and produce mostly non-numeric forms of information.

Blaxter et al., (2006) proposed that it has a propensity to concentrate on realising 'depth' rather than 'breadth'. Creswell (2014) corroborated by affirming that it is a method for discovering and discerning the meaning people or groups attribute to a social problem. Furthermore, Kothari (2004) upholds that the qualitative approach to research is interested in "subjective assessment of attitudes, opinions and behaviour" which is dependent on the researcher's insights and impressions. He noted that it is concerned with phenomena involving quality or kind.

The most common techniques for this research are focus group interviews, projective techniques, and in-depth interviews (Kothari 2004). From the foregoing, the qualitative research approach is in line with one of the objectives of this research, which is to establish the general understanding of the need for value creation in the construction industry within the literature. This is because the approach allows the researcher to assess the meaning participants make out of the world around them.

4.5.2 Quantitative Approach

Just as in qualitative research, quantitative research has been identified by various terms such as deductive, explanatory (Saunders et al., 2009; Engel and Schutt 2005), and empirical research (Hinchey 2008). Quantitative research is practical research which uses data that are in the form of numbers: it focuses on collecting numerical data and generalizing it across groups of people (Blaxter et al., 2006; Mkansi and Acheampong 2012; Babbie 2010; Kothari 2004). Creswell (2014) stated that quantitative research is an approach for examining unbiased theories by probing the relationship among variables, which can be measured, in order that numeric data can be scrutinised using quantitative processes. While the qualitative approach can be subjective, the quantitative approach tends to be objective in trying to establish a causal relationship between the variables.

Kothari (2004) noted that the quantitative approach includes the sourcing of data in a numerical form which can be subjected to a thorough quantitative analysis in a formal and rigid fashion. Babbie (2010) noted that the goal of conducting quantitative research is to establish the relationship between an independent variable and a dependent or outcome variable within a population. He further observed that quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by the manipulation of pre-existing statistical data using computational techniques.

In this study, both quantitative and qualitative methods have been used to collect both quantitative and qualitative data, integrating the two forms of data to properly understand and provide a solution to the research questions. This is widely known as the mixed-method approach. The ultimate truths of qualitative and quantitative research are that no single methodology serves as a panacea for any given situation, and each methodology has many methods (Durant-Law 2005).

4.5.3. Rationales for Choosing Mixed Method

Saunders et al., (2012) noted that it is possible and highly appropriate to use both qualitative and quantitative approaches within one study. Diriwächter and Valsiner (2006) stated that the combination of both quantitative and qualitative data collection is often termed mixed methods research. Henn et al., (2006) maintained that research findings are made more credible with more depth and breadth by the adoption of different research methods. The mixed-method approach has been used on several occasions in construction management research literature (Fellow and Liu 2008). Constructive research can be both quantitative and qualitative (Kasanen et al., 1993).

A mixed-method approach was used in this research in order to ensure triangulation; sequential research development; credibility; to compliment; obtain fresh insights; for purposes of expansion, i.e. adding breadth to scope; and enhancement, etc. (Bryman 2012). The Texas State Auditor’s Office stated that the collection of data from various data sources engenders triangulation during data analysis. Therefore, this study has combined various data collection techniques, such as exploratory interviews, semi-structured surveys, non-participant observations, and multiple case studies, to aid in validating and improving the quality of the data obtained and to ensure that the FFITVD developed to support TVD implementation is comprehensive.

The mixed-method approach has also ensured the sequential development of the research, as well as adding breadth to the scope of the study. For example, the exploratory interview (phase 2) and survey (phase 3) questions were developed based on findings from the literature review (phase 1); observations (Phase 4) were then performed to confirm the findings from the interviews and survey. The findings from the first four phases of the research were found to support the implementation of TVD in the three case studies shown in the study. Henn et al., (2006) argues that adopting a combination of methods helps to gain from the strength of each method combined, and to reduce the effects of the weaknesses that are characteristic with the use of a single method.

4.6 Research Method choice for study

Daniel (2017) argues that the accomplishment of every research is highly based on choosing the appropriate research methodology and methods to be adopted in the study. However, the choice of research methods and methodology is influenced by the research philosophy (Henn et al., 2006). The method chosen for any research study should be effective in addressing the research problems and help accomplish its aim and objectives. Several research methods relevant to the present study were scrutinised. These included; ethnography evaluation, survey approach evaluations, interviews, case studies, design science and action research.

4.6.1 Ethnography Evaluation

The foundation works of ethnography have been linked to Bronislaw Malinowski's (1922) work among the Trobriand Islanders. This was the earliest research to demonstrate and express the importance of participant observation. Ethnography is the organised study of people and cultures; it is designed to investigate cultural phenomena where the researcher observes society from the viewpoint of the subject of the study. Typically, ethnography is a holistic study (Ember & Ember 2006; Heider 2001). Some researchers assert that it is a qualitative technique used to study the culture, relations and practices of groups of people in their social environment (Saunders et al., (2009), Fellow and Liu (2009)). According to Fellow and Liu (2009), the researcher closely observes the participants in their natural setting; usually, the participants are questioned either formally or informally to obtain empirical data that will enable the researcher to comprehend the problem.

Safadi (2016) opined that there are no time rules for observing ethnography, but the researcher's feelings of full understanding of the concepts of culture under study are key; however, the longer that the study continues, the better, and that depends on the sample size you are observing and the time until they feel "relaxed" enough to be themselves with your presence. Morgan (2015) noted that the standard criterion for an adequate amount of data collection in ethnography is data and theoretical saturation: data saturation involves the point at which the researcher is no longer gaining new insights from the observations, so that they are merely repetitive, while theoretical saturation is a more complex concept that is primarily used in Grounded Theory. He further identified an apparent problem of unpredictability in advance of how long it will take to reach saturation. Mullooly (2012) states that while there is a tremendous value to the long-term approach to research, there are instances when a short-term model can produce accurate and helpful results.

From the foregoing, ethnography was considered a potential approach to be used in the exploratory study in the use of Target Value Design in the Nigeria construction industry with the view to enhancing value creation. This is due to its capacity to network and observe a precise practice in each situation. (Fellow and Liu 2009; Saunders et al., 2009).

4.6.2 Survey Approach Evaluation

A survey can be seen as a research method used for gathering data from a pre-defined group of respondents to gain information and insights on various topics of interest (Bhat 2018) in a structured format (Daniel 2017). The objectives of the study usually determine how the survey will be carried out. Daniel (2017) noted that knowledge gained from the survey process could be generalised especially where efforts were made to select a sample that is a true representation of the population of the study. By this way, the conclusions of the process can be valid.

There are four modes of survey data collection that are commonly used. These include face-to-face surveys, telephone surveys, self-administered computer surveys (typically online, e.g. Survey Monkey), and self-administered paper and pencil surveys (Qualtrics 2018). Henn et al., (2006) observed that the disadvantage of this approach is that it limits the view of the respondents and seldom welcomes new perceptions on the issue or phenomenon under examination from the respondents. This is because the researcher predetermines the factors to be examined. A semi-structured survey questionnaire, which allows respondents to suggest and write down differing opinions from the predetermined factors, attempts to solve this problem. A mixture of structured and semi-structured survey questionnaires was used in this study.

4.6.3 Interview

Castillo-Montoya (2016) noted interviews provide researchers with ample and detailed qualitative data for understanding participants' experiences, how they describe those experiences, and the meaning they make of them. Saunders et al., (2012) echoed the proposal that interviews are suitable for undertaking an exploratory study, and for the purpose of understanding the meaning participants ascribe to the subject being investigated.

Various types of interviews for collecting qualitative data exist, such as open-ended, semi-structured and unstructured interviews. The semi-structured interview is considered the most widely adopted approach in qualitative research because it encourages standardisation when asking questions and documenting the responses of the interviewees (Bryman 2012; Yin 2014). Respondents can provide in-depth data from their experiences during semi-structured interviews. The semi-structured interview process is flexible, unlike questionnaire surveys that restrict respondents with rigid questions. This study considered the interview approach the most suitable as it is an effective means to understand a process in a certain environment. "*It has been observed that no research method can provide a complete understanding that comes from directly listening to and observing people compared to what they have to say at the scene*" (Daniel 2017). Interviews were used at various phases of this research.

4.6.4 Case study

A case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context using multiple sources of evidence" (Noor 2008). The evidence used in a case study focuses on developing an in-depth rather than broad, generalisable understanding. Case studies can be used to explore, describe, or explain phenomena by an exhaustive study within its natural setting (Yin 1984). The main purpose of the case study is to enable the researcher to gain more in-depth insight into the understanding and application of target value design and determine the nature of support that could be provided for its successful and swift implementation in the NCI.

4.6.5 Action Research

Action research (AR) is an approach for applying and assessing an existing solution to a practical problem in its organizational context; then, with the knowledge acquired from the implementation and evaluation, make recommendations for future implementation of any solutions (Khan and Tzortzopoulos 2018; Iivari and Venable 2009), and develop guidelines for best practice (Denscombe 2010). AR has been credited to Kurt Lewin, who portrayed it as a spiral of learning cycles comprised of planning action, acting, evaluating action, and amending any plan based on what has been learned (See Figure 4.3).

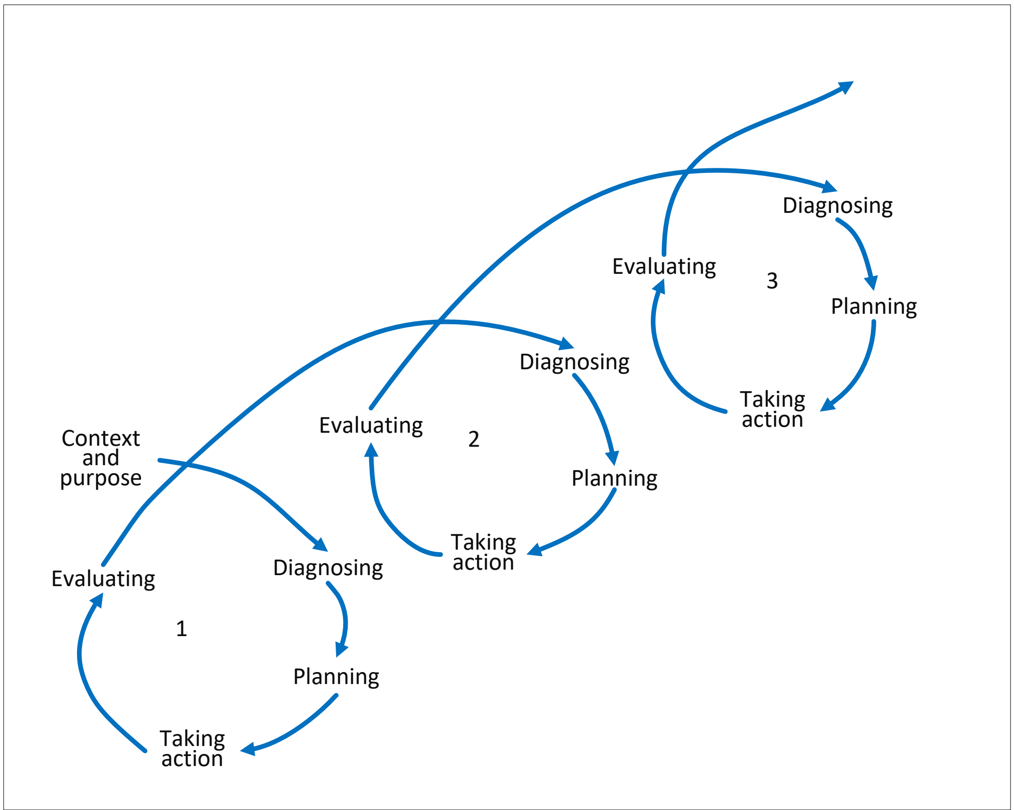


Figure 4.3 Action research spiral (Adopted from Saunders et al., 2012)

Saunders et al., (2012) identified four themes of AR within the literature, which include:

i. Emphasises on the purpose of the research: research in action rather than research about action (Coghlan and Brannick 2005) so that, for example, the research is concerned with the resolution of organisational issues.

ii. The involvement of practitioners in the research and a collaborative democratic partnership between practitioners and researchers.

iii. The iterative nature of the process of diagnosing, planning, acting and evaluating (see Figure 4.3).

iv. Action research should have implications beyond the immediate project; in other words, AR should have generalisability.

From the four themes of AR identified within the literature, AR is similar to DSR in many areas; however, AR focuses on action, while DSR focuses on constructing an artefact; AR takes a problem-solving approach that focuses on applying already existing solutions, while DSR is a problem-solving approach that concentrates on constructing innovative artefacts that solve real-life problems. For these reasons, AR was not considered to be suitable for this research because this study aims at developing an artefact to support the implementation of TVD in the NCI, which is beyond the scope of AR.

4.6.6 Design Science Research

Design science research (DSR) has been presented as a recently developed research approach; nevertheless, it has been in use in accounting and information systems since the 1990s (Lukka 2000; Hevner et al., 2004), and in management research since 2000 (van Aken 2004). It has been referred to as constructive research in accounting literature (Lukka 2003; Smith 2015) and has attracted support and attention in fields such as medicine, business administration, and engineering research (Lukka 2003; Hevner et al., 2004; Smith 2015). Hevner et al., (2004) noted that the key focus of DSR is to achieve knowledge and understanding of a problem domain by the building and application of a designed artefact.

Smith (2015) noted that because of the "applied" nature of DSR, it seems to be a good fit for research in lean construction. By extension, it may be considered a suitable approach for TVD research work as this is a Lean construction approach. Smith (2015) also noted that DSR was strongly recommended by facilitators during the 2012 International Group for Lean Construction Summer School program in San Diego, CA. Other studies conducted on TVD in NCI focused less on projects with practical application, which is not comprehensive, Research that relies on the findings of both practical and theoretical sources is vital as its findings bridge the gap between theory and practice. Researchers have argued that industry stakeholders, namely architects, engineers and urban planners, address issues that can be suitably resolved using DSR; and by adopting a methodology that supports real-world application, researchers might be able to avoid a scenario described by Meredith, et al., (1989), where a researcher has high academic prestige but little exposure to analysing real-life problems (Smith 2015).

It has been established that the objective of DSR is to develop valid and reliable knowledge to be used in designing solutions to problems, and to contribute significantly to the act and theory of the discipline in which it applies; herein lies the justification for selecting design science as a research method (Brady et al., 2013; De Melo 2015; Lukka 2003). March and Smith (1995) maintained that DSR has two main goals which are: the building of artefacts which can solve real-life problems and the evaluation of the effectiveness of the artefact(s) in use. According to Koskela (2008), construction management provides solutions to managerial problems in construction and establishes that the goal of researches in the field is not to describe and explain the world but change it and create something new to it. Thus, advocating for design science research.

DSR was preferred for this research because it involves the development and evaluating of a solution proposed to solve problems faced by the real world that has practical significance and contributes to the theory of the discipline in which is implemented. It is appropriate since FFITVD was developed, tested and evaluated primarily in response to the practical problem of the industry being viewed as inefficient and lacking when delivering value. Mostly, disappointments are due to a lack of collaborative practices, the unpredictability of cost, time and quality standards resulting in reworks, and change orders, thus, making projects unaffordable and off-target. The Nigerian construction industry (NCI) is no exception to this. Lukka (2003) noted that the constructive research approach is a research process for developing innovative constructions with the aim of solving problems faced in the real world and thereby contributing to the theory of the discipline in which it is applied.

4.6.6.1 History of Design science

Iivari (2007) opined that right from the early days of computer science, computer scientists have engaged in DSR without naming it. However, it was probably first used by Buckminster Fuller (1957), who later expanded on the concept in his proposal at the International Union of Architects in 1961 (Fuller and McHale 1964), with it later being adapted by Gregory (1966) in the context of the 1965 conference on ‘The Design Method’, where he distinguished between scientific method and design method. Gregory (1966) was unequivocal in his opinion that design is not a science and that design science is the systematic study of design.

Cross (2001) argues that the Conference on Design Methods, which took place in London on September 1962, is noted as the event which marked the presentation of design methodology as a subject or field of enquiry. The 1960s was acclaimed the ‘design science decade’ by the revolutionary technologist Buckminster Fuller, who called for a ‘design science revolution’ founded on science, technology and rationalism, to surmount the human and environmental problems which he believed could not be solved by politics and economics (Cross 2001)

The term was later used and popularized by Herbert Simon in his submission for the scientific study of the artificial (as opposed to the natural), in the 1968 Karl Taylor lectures (Simon, 1996). Herbert Simon made a case for the development of ‘science of design’ in the universities which he described as ‘*a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process*.’ (Cross 2001).

However, in the 1970s, a criticism against design methodology and a rejection of its fundamental principles arose, led by some of the early pioneers, namely J. Christopher Jones and Christopher Alexander, who had originated a rational method for architecture and planning. Nevertheless, there was a strong continual development of design methodology, particularly in engineering and some branches of industrial design, even though evidence of practical applications and results are unavailable (Cross 2001).

4.6.6.2 Process of Design Science

Various scholars such as Holmstrom et al., (2009); Hevner et al., (2004); Lukka (2003); March and Smith (1995); Smith (2015); Peffers et al., (2006); Vaishnavi and Kuechler (2004); Offermann et al., (2009); Formoso (2012); Ellis and Levy (2010); Rocha (2011); Brady et al., (2013); Novak (2012); and Ahiakwo (2014) have enumerated various stages, sequences, guidelines, phases or steps for conducting DSR with several differences and similarities, as shown in Table 4.1. Two major approaches of the DSR process can be identified from the synthesis of the literature reviewed (see Figure 4.4).

Table 4.1 A comparative review of different DSR process by various researchers

	First Approach											Second Approach	
Steps	Vaishnavi and Kuechler (2004)	Smith (2015)	Offermann et al., (2009)	Ellis and Levy (2010)	Peffers (2006)	Brady et al., (2013)	Ahiakwo (2014)	Formoso (2012)	Lukka (2003)	Rocha (2011)	Novak (2012)	De-Melo (2015)	Holmstrom et al., (2009)
1. Identify the problem	Awareness of a problem	Awareness of a problem	Problem identification	Identify the problem	Problem identification and motivation	Problem identification	Identification of a problem and motivation	Find a practically relevant problem which also has research potential	Find a practically relevant problem, which also has the potential for theoretical contribution	Frame the problem	Identify Practical Problem	solution incubation	Phase 1: Solution Incubation
2. Long-term Research Cooperation									Examine the potential for long-term research co-operation with the target organisation				
3. Understanding	A suggestion of a solution	A suggestion of a solution		Identify objectives	Objectives of a solution	Objectives of a solution	Definition of objectives for the solution	Obtain a general and comprehensive understanding of the topic	Obtain a deep understanding of the topic area both practically and theoretically	obtain a deep understanding of it	Obtain an understanding / prior theory		
4. Collect Data										Collect data	Select and gather data		
5. Design/ Development	Development	Development	Solution design	Design and develop the artefact	Design and development	Design and development	Design and development	Innovate, i.e. construct a solution idea	Innovate a solution idea and develop a problem-solving construction which also has the potential for theoretical contribution	develop and implement a solution	Design and Test Research Solution		
6. Demonstrate / Implement					Demonstration	Demonstration & data analysis	Demonstration	Demonstrate that the solution works	Implement the solution and test how it works			Solution Refinement	Phase 2: Solution Refinement
7. Evaluate	Evaluation	Evaluation	Evaluation	Test and evaluate	Evaluation	Evaluation	Evaluation	Show the theoretical connections and the research contribution of the solution concept	Ponder the scope of applicability of the solution	Test the solution and assess its practical contribution	Practical Outcome:	Explanation	Phase 3: Explanation I — Substantive Theory
8. Theoretical contributions	Conclusion	Conclusion	Summarize results	Communicate results & conclusions	Communication	Communication	Communication	Examine the scope of applicability of the solution	Identify and analyse the theoretical contribution	Assess the theoretical contribution of the solution	Theoretical Contribution		Phase 4: Explanation II - Formal Theory

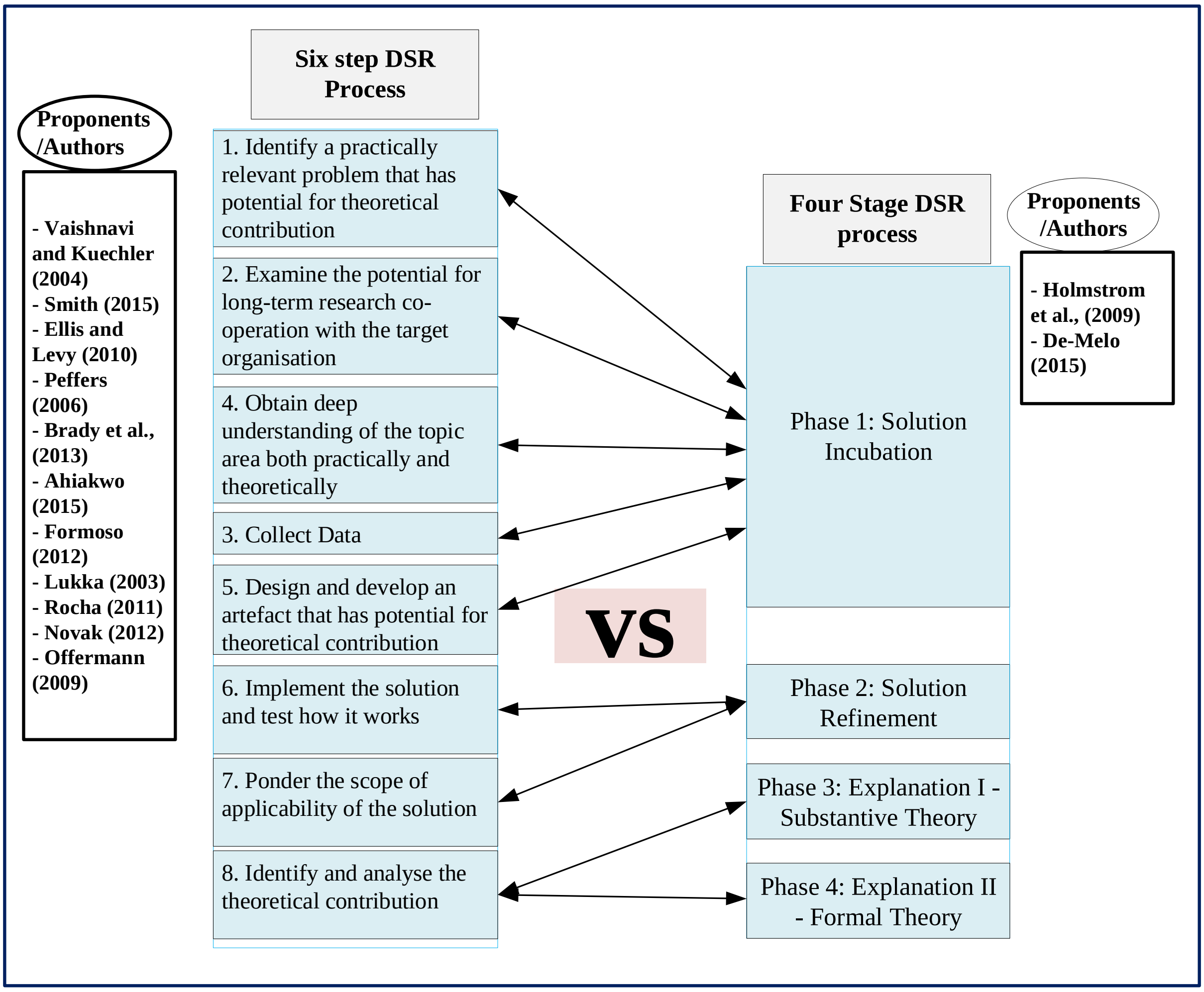


Figure 4.4 A combination of research DSR processes proposed by various authors

The two approaches have been combined to produce the DSR process adopted for this study. The rationale for the synthesis is to obtain a clear understanding of the various approaches to DSR available and to determine the best-suited for enhancing value creation in the NCI. The approach adopted in this study is a modified fusion of the research work by Lukka (2003), Vaishnavi and Kuechler (2004), Holmstrom et al., (2009) and Rocha (2011). This combination will provide a holistic approach to DSR.

The collective eight steps of Figure 4.4, when combined with a step proposed by the researcher, produces a nine steps process used for this study (see figure 4.5).

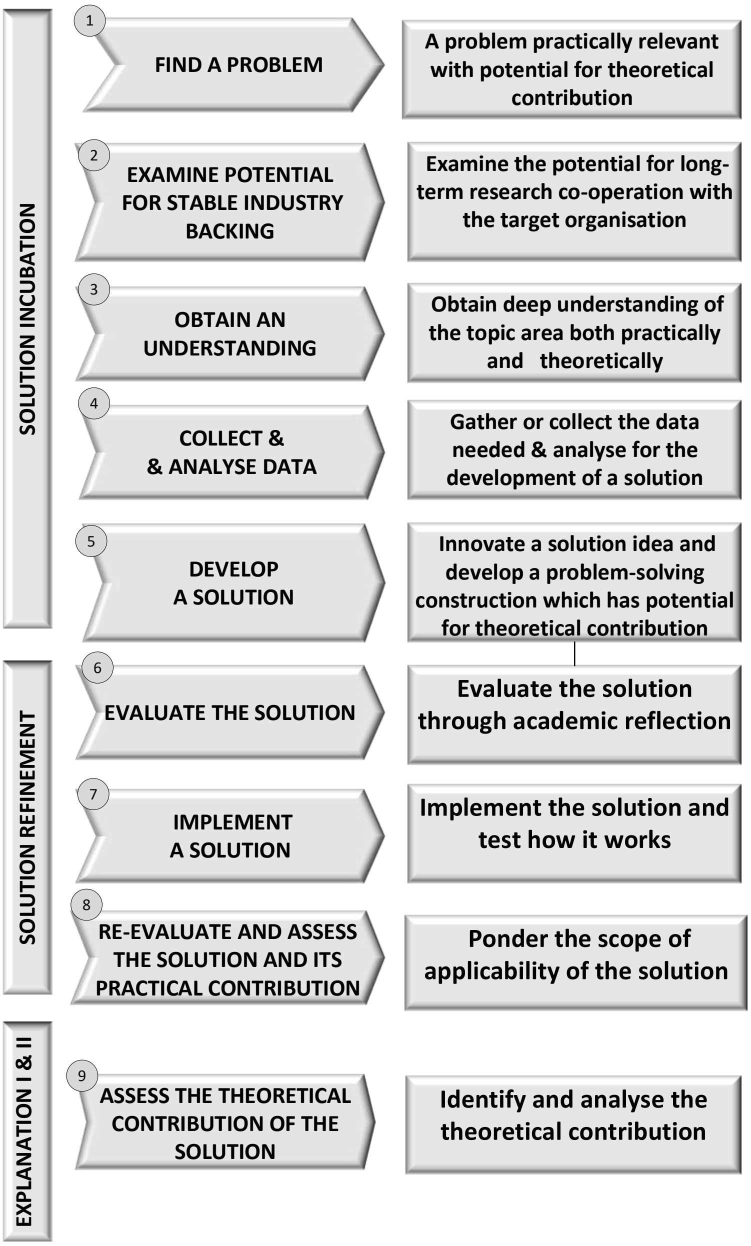


Figure 4.5 The DSR process adopted for the study (produced by the author)

The thesis structure and DSR process of this study are elaborated in Figure 4.6

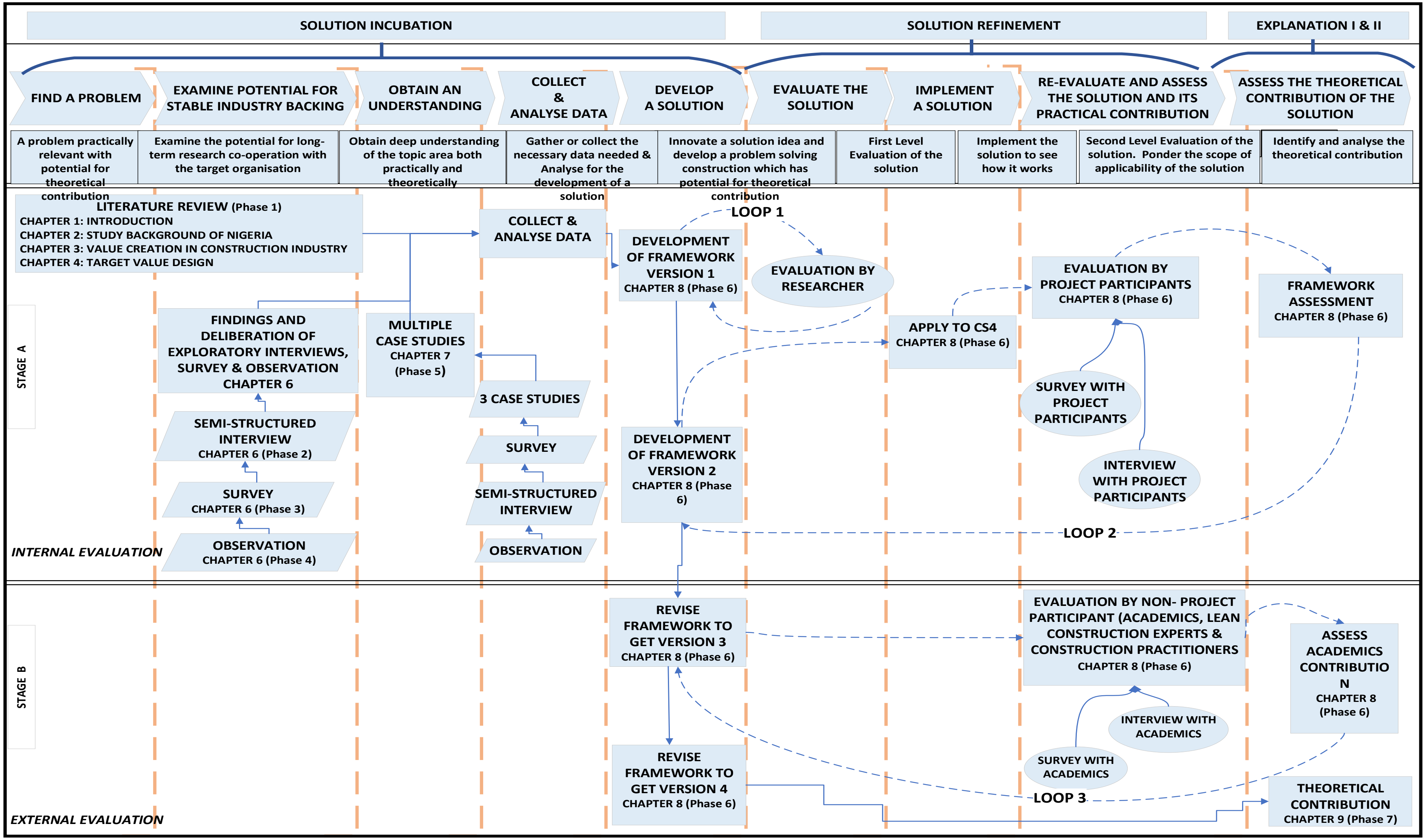


Figure 4.6 The design science and thesis structure

Stage 1: Solution Incubation

From the synthesis of the two approaches in figure 5.4, the solution incubation stage involves the following steps: 1) the identification and framing of the problems; 2) examining the potential for long-term research co-operation with the target organisation; 3) obtaining a deep understanding of the problem; 4) gathering and analysing the necessary data; and 5) the development of the essential elements of a likely solution.

Step 1: Identifying and framing the problem

The first stage of this research is to identify a problem which is practically relevant, and which has the potential for theoretical contribution. Holmstrom et al., (2009) stated that the most challenging part of this stage is the framing of the problem. This is because there are characteristically several ways by which any specified problem can be framed, and this can be subjective, being based on the idiosyncratic background of the researcher, Ellis and Levy (2010) added that not all problems are research-worthy and not all research-worthy problems are appropriate for DSR methods. Additionally, Offermann et al., (2009) also claimed that the problem identified must have practical significance.

The goals of any research effort are captured in the research question that drives the research. This stage provides a firm and vital base for the research process. Therefore, the research question must be clearly related to the problem, and not already have known and/or documented answers: the answers to the research question are the contributions of the research to knowledge (Ellis and Levy 2009). The motivating factor for this research is the desire to align the current understanding and practice of TVD in the NCI with the fundamental theories of TVD. In order to identify and frame the research problem, an extensive literature review was conducted; this is in line with the submission of Offermann et al., (2009) and Lukka (2003), who stated that the literature review can be used to identify the research problem because unsolved problems could arise in scientific publications. This was further corroborated by Lukka (2003), who noted that a topic which has been under-analysed in the existing literature or is seemingly contradictory, is an ideal topic for research.

Step 2: Examining the potential for long-term research co-operation with the target organisation

After the problem has been identified and framed, the researcher needs to explore opportunities for long-standing research collaboration with the target organisation(s). Lukka (2003) noted that the organisation, including its relevant key stakeholders and the researcher, ought to be devoted to committing to significant effort concerning the project. Lukka (2003) advised that it is imperative that the researcher becomes a team member of the organisation, although not necessarily the team leader. It may be noted that this phase gives the researcher insight into whether the research will be a success or failure, and whether the research outcome will be accepted or not for implementation by the organisation (Lukka 2003).

For this research, exploratory interviews, surveys and observations were used to examine the potential for long-term research co-operation with the target organisation. Also, the researcher was the project director of CS-01 and CS04 and a consultant in the CS-02 and CS03 projects. This implies that the potential for long-term research co-operation with the target organisations was valid.

Step 3: Obtaining an understanding

The next step is to obtain a deep understanding of the topic area, both practically and theoretically. Obtaining a deep understanding of the problem can be through typical ethnographic methods like observation, interviews, surveys and the analysis of archives (Lukka 2003; Formoso 2012; Rocha 2011, Peffers et al., 2006). Lukka (2003) stated that the implementation of an existing construction should not be regarded as an application of the constructive research process.

The findings from step 2 informed the researcher that the practitioners were not aware of TVD nor had it been implemented, and practitioners were willing to partake in its implementation. This led to the implementation of TVD

In this step, three case studies were conducted where observations, interviews, surveys, and a literature review were conducted to obtain a deeper understanding of the problem. Offermann et al., (2009) concurred that interviews and surveys with stakeholders and experts in the field are vital to identifying and understanding relevant problems. For this stage, a total of 26 interviews was conducted with professionals from the NCI, all of whom have over five years industry experience, and a total of 208 questionnaires was distributed to professionals in the NCI, 112 of which were completed, representing a total response rate of 53%. The literature covers areas such as a review of Nigeria, the Nigerian economy and construction industry, value creation, target value design, collaboration, and procurement, among others. The review was exhaustive enough to reveal the explicit and implicit problems of the NCI as it relates to value creation and delivery.

Three exploratory case study projects were conducted to gain further insight into the problem. Yin (2014) noted that case study research seeks to create answers to questions such as ‘what’, ‘why’, and ‘how’. All of these are discussed in detail in chapters 2, 3, 4, 6 and 7 of this research.

Step 4: Collecting and Analysing Data

Step four of the DSR is gathering and analysing the necessary data needed for the design and development of the solution. The various processes used for collecting the needed data are shown in Figure 4.7.

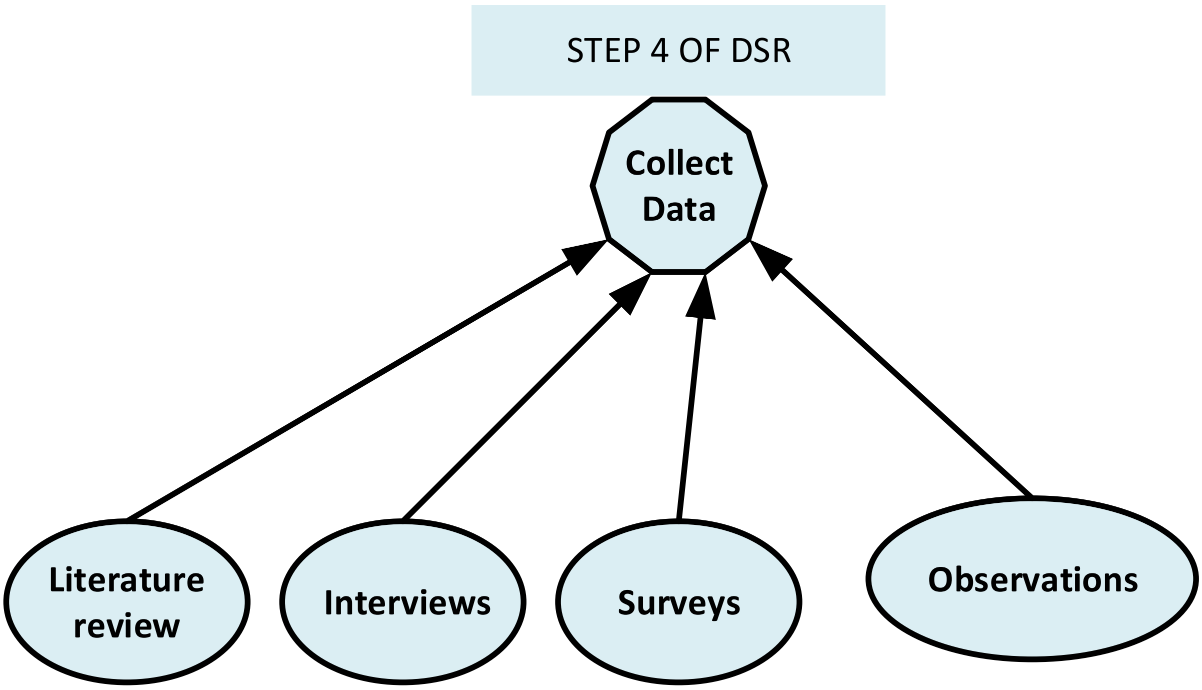


Figure 4.7 Methods used for collecting data for DSR

Figure 4.7 shows that the findings from the literature review, observations, surveys, and interviews were used in conjunction with exploratory case studies as the source of data for the development of the solution. The data collected were analysed with the appropriate techniques, such as coding, content analysis and statistical analysis.

Step 5: **The design and development of the solution.**

Lukka (2003) noted that this step of the research is crucial because if an innovative or novel artefact cannot be developed, then there is no point in continuing with the project; therefore, this phase should be creative and empirical. The development of the artefact should be the collaborative efforts of both the researcher and the practitioners, relying on findings of both practical and theoretical sources (Lukka 2003).

The artefact (framework) development was anchored on the findings from the literature review, observations, surveys, interviews and the exploratory case studies. This agrees with Ellis and Levy (2010), who claimed that the process of designing and developing the artefact should be supported by the literature review (see Figure 4.8).

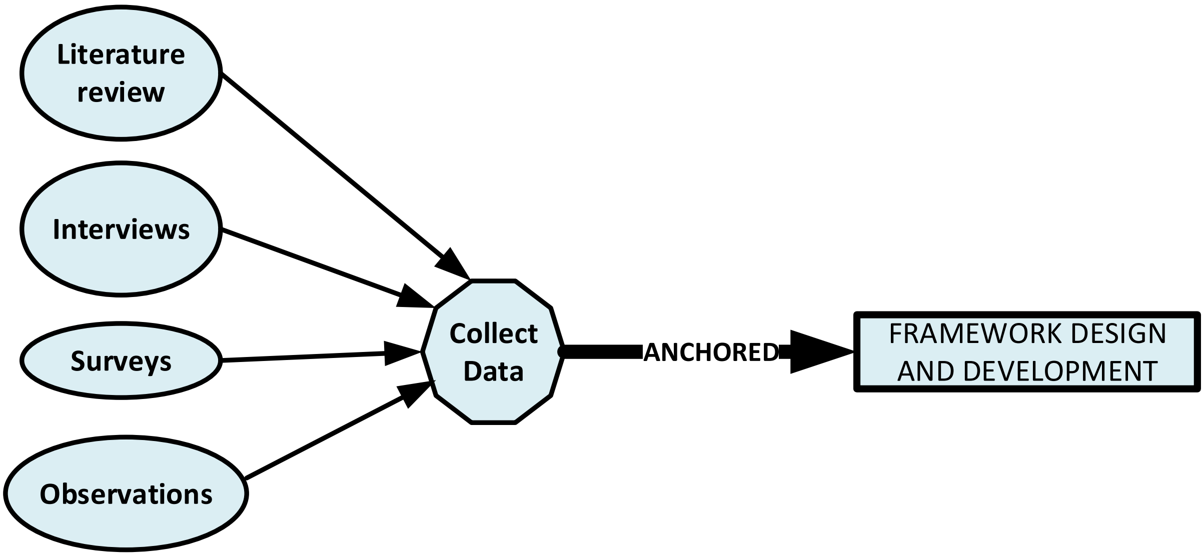


Figure 4.8 Framework development anchored on the findings of the literature review and ethnographic methods

Figure 4.8 shows that the development of the framework was based on the input information of both practical and theoretical origin, hence it was a time-consuming, iterative process; this agrees with Lukka (2003). The detailed process of the design and development of the framework is discussed in chapter 7.

Stage 2: Solution refinement

Solution refinement involves the implementation of the solution and testing to know how it works. Peffers et al., (2006) observed that this step involves assessing the purpose the artefact will serve, its structure, and the formation of the real artefact. Holmstrom et al., (2009) stated that the process is methodologically similar in principle to a hypothetico–deductive approach to testing, i.e. much more of a trial–and–error type of iterative process. Peffers et al., (2006) noted that this stage is necessary to discover and assess how well the artefact supports a solution to the problem as it involves linking the objectives of a solution to the actual observed results from use of the artefact in its implementation.

The most common methods for testing and evaluating the efficiency of the research outcome (the artefact) are through direct observations, from pilot studies, and indirect indicators from surveys, questionnaires, interviews, and other observations (Hasan 2003; Richey and Klein 2007; Ellis and Levy 2010; Peffers et al., 2006). The solution refinement stage involves the following steps: 6) Evaluation, 7) implementation and testing 8) Re-evaluation.

Step 6: Evaluation

For this study, the first draft framework for implementing target value delivery (FFITVD) was evaluated through reflection by the researcher. The detailed procedure for the evaluation is discussed in section 4.7.6.

Step 7: Implementation and Testing

The framework for implementing target value delivery (FFITVD) that was evaluated by the researcher was then implemented through researcher participation on a case study project (CS-04) to test the framework and see how effective it was. The procedure has been explained in section 4.7.6 and chapter 7 of this work.

Step 8: Re-evaluation

Further to implementing the FFITVD, it was evaluated by the participants of the case study using surveys and interviews; this is referred to as the internal evaluation. Training and TVD manuals were used as suggested by Lukka (2003). The procedure has been explained in section 4.7.6 and chapter 7 of this work. At this stage, the research ponders on the scope of the practical application of the solution that was developed. Participants' comments, criticism and recommendations obtained from the internal evaluation of the framework coupled with the findings from the implementation of the framework were used for its further improvement.

Stage 3: Phase 3: Explanation I - Substantive Theory
Step 9: Assessing the theoretical contribution of the solution

Holmstrom et al., (2009) noted that the theoretical relevance of the solution design must be established through the examination and evaluation of the artefact from the theoretical point of view instead of the pragmatic point of view. The focus of researchers in the Explanation I phase is on the development of the substantive theory of the mid-range variety (Holmstrom et al., 2009). Glaser and Strauss (1967), as quoted by Holmstrom et al., (2009), describe the substantive theory as a theory that is dependent on a context, "which has been developed for a narrowly defined context and an empirical application, where the contextual boundaries of the theoretical argument are important."

For this research, in order to assess the theoretical relevance of the solution leading to substantive theory, the FFITVD was evaluated by participants of the of the study; this is regarded as internal evaluation.

Stage 4: Explanation II - Formal Theory

Step 9: Assessing the theoretical contribution of the solution

This stage involves the development of a formal theory, communication and conclusion. This stage is concerned with the development of a formal theory instead of the substantive theory of stage 3 (Holmstrom et al., 2009). Holmstrom et al. (2009), while citing Glaser and Strauss (1967), refer to formal theory as one whose applicability is not limited to the empirical context under study. Hence, the goal of this stage is to consider the wider implications regarding the artefact, i.e. to determine the various contexts to which the artefact (framework) can be applied. To assess the theoretical relevance of the solution leading to a formal theory, the FFITVD was evaluated again by selected academics and lean construction experts that were not part of the study; this is considered the external evaluation.

Peffers et al., (2006) noted that it is expedient to communicate the research problem, its importance, the artefact, its utility and novelty, the rigour of its design, and its effectiveness to researchers and other relevant audiences, such as practising professionals, when appropriate. Communicating the findings of a research study is very important, especially when the research aims to solve a real-life problem; the essence of the research is defeated if its results are not made known to those who should benefit from them. Lack of communicating construction research findings is another waste in the construction industry.

Vaishnavi and Kuechler (2004) noted that the final stage of a specific research effort is the conclusion. They further noted that the conclusion is the result of attaining the minimum requirements of the design and development of an artefact. This can happen even though there are still deviations in the behaviour of the artefact from the (multiple) revised hypothetical predictions; in this case, the results are adjudged "good enough". Not only are the results of the effort consolidated and "written up" at this phase, but the knowledge gained in the effort is frequently categorized as either “firm” - facts that have been learned and can be applied repeatedly or behaviour that can be invoked repeatedly - or as “loose ends” – anomalous behaviour that defies explanation and may well serve as the subject of further research. The findings of this research have been documented in the form of this thesis, and publications are under consideration to further report them to a wider population.

4.6.6.3 Outcomes of DSR

Various researchers have listed the outcome or outputs of DSR. Vaishnavi and Kuechler (2004) reported five outputs: constructs, which they explained as the conceptual vocabulary of a field; models, which is a group of statements showing associations between constructs; methods, which are the set of steps used to complete a task; instantiations, which are the operationalization of constructs, models and methods; and finally, better theories, which they referred to as an artefact construction analogous to an experiment in natural science, with attached reflections and abstractions. According to Ahiakwo (2014), some of the products of DSR are artefact, better theories, and technological rules. He argues that constructs/ concepts, models, methods and instantiations all fall under artefacts. March and Smith (1995) suggest four outcomes in the information technology arena:

(i) constructs
(ii) models
(iii) method
(iv) instantiations

Hevner et al., (2004) reported three results of design science to be; the design artefact, its construction, and the evaluation processes. Rocha et al., (2012) listed the following as the outcomes of DSR: artefact (construct/concept, model, method & instantiations), better theories, technological rules, substantive theories, and formal theories.

The outcome for this DSR study is in the form of a “Framework for Implementing Target Value Delivery” (FFITVD).

4.6.6.4 Need for DSR

The need for DSR cannot be overemphasised as it serves the following purposes:

i. DSR explores the practical and theoretical significance of the research topic (Lukka 2003).

ii. This means that DSR seeks to investigate and answer the questions arising from the research topic.

iii. It solves a problem with practical relevance. Scholars have noted that numerous studies are carried out, but they have no practical application (Smith 2015).

iv. DSR bridges the gap between practice and theory by the collaborative efforts of the researcher (and other academics), who perform the theoretical aspects, and the practitioners (architects, engineers, etc.), who practice in the field.

v. It validates the potential for multiple users. DSR ensures the development of a solution that can be applied by other researchers. The generalisability of the solution (artefact) is established using design science.

4.6.6.5 Contributions of Design Science

DSR guarantees that a solution (artefact) is developed and evaluated (Ahiakwo 2014). It likewise contributes to both theoretical and practical knowledge to any field of study where it is applied.

Hevner et al., (2004), highlighted the following as contributing to knowledge:

a. The design artefact serves as a contribution to knowledge in terms of how the artefact was designed and how it serves as solutions to unsolved problems.
b. The foundation contributes in terms of the knowledge base in the field of study.
c. The DSR methodology is an innovative research method; hence, it serves as a contribution to knowledge in whatever fields it is applied.
d. DSR aims to produce a solution to solve a real-world problem. However, if an existing solution is used in a new domain, this also serves as a contribution to knowledge.

4.6.6.6 Justification for choosing Design Science research

DSR was adopted for this study because it is a form of research that has both high academic prestige and application to real-life problems: it involves the development, evaluation, testing and re-evaluation of a solution that has practical and theoretical significance. Smith (2015) noted that because of the field's "applied" nature of DSR, it seems to be a good fit for research in lean construction. By extension, DSR is a suitable approach for TVD research work as it is a Lean construction tool. Smith (2015) also noted that DSR was strongly recommended by facilitators during the 2012 International Group for Lean Construction Summer School program in San Diego, CA. Researchers have argued that industry stakeholders, namely architects, engineers and urban planners, address issues that can be suitably resolved using DSR; and by adopting a methodology that supports real-world application, researchers might be able to avoid a scenario described by Meredith, et al., (1989) whereby research may enjoy high academic prestige but have no application to real-life problems (Smith 2015).

DSR was criticised by Iivari (2007), who argued that there is a need for DSR to go beyond just creating innovative artefacts and to be grounded in better theories; however, Hevner (2007) argued that the rigour and relevance of DSR can be demonstrated by using the three closely interrelated cycles of relevance, rigour and design, which may serve as key performance indicators.

This research aims to develop and test the framework for implementing TVD for enhancing value creation in the construction industry. Hence, the DSR approach was chosen, since the aim of the research is consistent with the aims of a DSR approach, which is to develop a solution that solves real-life problems while providing a theoretical contribution to knowledge (Ahiakwo 2014).

4.7 Research design and phases

Kothari (2004) noted that the preparation of the research design is an unnerving problem that trails the task of defining the research problem. While Selltiz (1962) defined research design as “the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure”, Kothari (2004) believes that research involves making decisions regarding what, where, when, how much, and by what means concerning a research study. Similarly, a research design is the reasonable arrangement that links the empirical data of a study to its research questions, the analysis of the data and, finally, to its conclusions (Yin 2014).

The importance of research design cannot be overemphasised as it is the conceptual structure within which research is conducted; it is comprised of the blueprint for the collection, measurement, analysis of data, and the making of meaning out of the data (Kothari 2004). The research design includes the plan that stipulates the sources and kinds of information relevant to the research problem, the strategy that stipulates the approach to be used for collecting and analysing the data, and the time and cost budgets for the research study.

Yin (2014), noted that the reason for having a research design is to be sure that the findings of the study truly address the research question(s). It enables the smooth navigation of the several research processes, thus making the research well-organised in order to yield the maximum information with minimum cost and time (Kothari 2004).

This study comprises of seven phases, which are:

a. Phase 1: The literature review
b. Phase 2: Semi-structured interviews
c. Phase 3: Survey
d. Phase 4: Observations
e. Phase 5: Multiple case studies
f. Phase 6: Developing, evaluating, testing and re-evaluating the framework for implementing Target Value Delivery
g. Phase 7: Research Conclusion, contributions and Recommendations

The phases of the research design are discussed in detail in the following sections.

4.7.1 Phase 1: A literature review

The literature review is a very important process in any research because it is through the process of reviewing existing literature that one can determine the available reality (ontology) and the acceptable knowledge (epistemology) needed to frame the research question and determine the best method and methodology to be used to answer it. Coffta (2018) defined the literature review as a complete summary of earlier research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to an area of research. Koladiya (2017) observed that the literature review is a process of identifying, interpreting and evaluating all the existing research related to specific research questions or ideas.

A good literature review should list, define, recap, critically examine and elucidate previous research. Arlene (2014) expressed that the literature review critically inspects books, scholarly articles, and any other sources related to an issue, area of research, or theory, in a bid to provide a description, summary and critical evaluation of these works in relation to the research problem being investigated. A literature review is performed with the aim of obtaining theoretical knowledge about the subject matter under investigation (De Melo 2015; Arlene 2014). Hart (1998) and Jesson (2011) maintained that the purpose of a literature review is to:

a. place each work in the context of its contribution to understanding the research problem being studied
b. describe the relationship of each work to others under consideration,

c. identify new ways to interpret prior research.
d. reveal any gaps that exist in the literature.
e. resolve conflicts amongst seemingly contradictory previous studies.
f. identify areas of prior scholarship to prevent duplication of effort.
g. point the way to fulfilling a need for additional research; and, very importantly,
h. locate your own research within the context of existing literature.

The literature review played a crucial role in this study in that it helped in the formulation of the research questions and objectives. It also helped to identify the gap which this study intends to fill. Figure 4.9 shows the literature review flowchart.

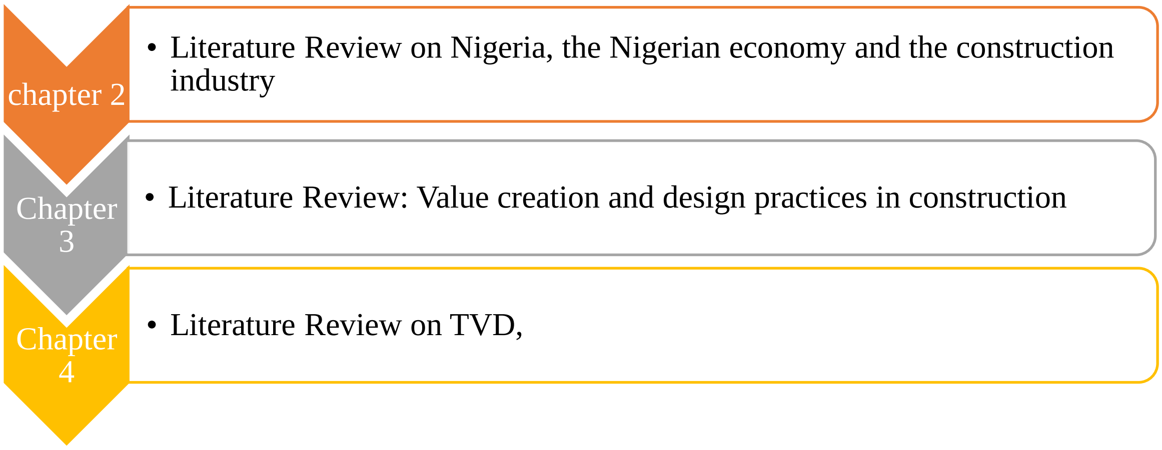


Figure 4.9 Literature review flowchart

The study conducted an extensive literature review on the current practices in the NCI to ascertain the level of awareness and implementation of TVD principles and discovered that TVD practices have not been fully explored, possibly due to lack of knowledge among industry practitioners. In view of this, the study set out to formulate and answer the research questions.

This study reviewed the need for value creation in the construction industry. This was to throw light on value generation in the TVD context, and it is useful to understand how lean construction literature considers the concept of value (Miron et al., 2015). The study further reviewed the concept of target costing (TC) and target value design (TVD), tracing the origin of TC to the Japanese automotive industry in the early 1960s, and establishing the fact that TVD is a tool used by lean construction practitioners envisioned as another attempt to adapt target costing to the construction industry (Macomber et al., 2007). The current theoretical understanding and application of TVD in the construction industry were also considered.

The literature reviewed was chosen from publications based on various factors such as the period of publication, origin and relevance to the study. Publications from databases such as the International Group for Lean Construction (IGLC), Emerald, Elsevier, the Construction Industry Institute, among others, were analyzed. Peer-reviewed publications were given priority consideration. Furthermore, the literature was continuously reviewed and updated all through the research process and all research studies were referenced appropriately.

4.7.2 Phase 2: Semi-structured interviews

Rubin and Rubin (2012) maintain that interviews provide researchers with rich and detailed qualitative data for understanding participants' experiences, how they describe those experiences, and the meaning they make of those experiences. Edwards and Holland (2013) argue that while a structured interview has a rigorous set of questions which does not allow one to divert, a semi-structured interview is open, allowing new ideas to be raised during the interview as a result of what the interviewee says. The interviewer in a semi-structured interview generally has a framework of themes to be explored. Semi-structured interviews are widely used in qualitative research (Edwards and Holland 2013).

Therefore, following on from the literature review, a semi-structured interview guide was developed to determine the current design management practices in relation to TVD and value creation, the awareness and practice of TVD, and its feasibility in the NCI. Exploratory interviews were used as the study seeks to examine the current understanding and application of TVD in the NCI through exploring its social settings and the individuals in it (the Nigerian construction practitioners). Some have argued that exploratory interviews are more suitable in cases where a study try to find and understand the meaning people attribute to a process/event and not the meaning from literature alone (Creswell, 2014), which is line with the aim of this research. According to Taylor and Bogdan, (1984) pioneer researchers are of the opinion that no research method overshadows the detailed understanding derived from observing people directly and listening to their opinions on site.

The interview consists of 31 open and closed-ended questions, which are divided into five themes titled: Respondents Background Information; Current Design Management Practices in the NCI; Awareness and Practice in Target Value Design (TVD) in the NCI; cost-related Practices; and The Feasibility of TVD in the NCI. (See Appendix 1 for a sample of the interview guide).

A total of 26 interviews was conducted with professionals from the NCI who all have over five years of experience in the industry

4.7.2.1 Interview Plan

Interview planning involves the making of decisive and informed decisions on the appropriate process of data collection and analysis that will be followed to ensure that the research questions are satisfactorily answered at the end of the process. In preparing the interview plan, the researcher critically evaluated the aim and objectives of the study in order to be able to draw up a process that would support the achievement of the said aim and objectives.

The researcher and the supervisory team identified and provided all the necessary requirements (such as skills, resources, manpower and training) and equipment needed for the successful conduct of the interviews. Thereafter, the researcher sought and acquired the support and approval from the College Ethical Committee for the conduct of the interview (See Appendix 2 for a copy of the ethical approval letter).

4.7.2.2 Interview Protocol

Interview protocol is a very important part of the interview process. Castillo-Montoya (2016) stated that the interview protocol framework is comprised of four phases, which are:

i. ensuring interview questions align with research questions,
ii. constructing an inquiry-based conversation,
iii. receiving feedback on interview protocols; and
iv. piloting the interview protocol. (see table 4.2)

Table 4.2 Interview Protocol Refinement (IPR) Method

PHASE	PURPOSE OF PHASE
Phase I: Ensuring interview questions align with research questions	To create an interview protocol matrix to map the interview questions against the research questions
Phase 2: Constructing an inquiry-based conversation	To construct an interview protocol that balances inquiry with conversation
Phase 3: Receiving feedback on the interview protocol	To obtain feedback on the interview protocol (possible activities include close reading and think-aloud activities)
Phase 4: Piloting the interview protocol	To pilot the interview protocol with a small sample

Source: Castillo-Montoya (2016)

Each phase aids the researcher to go further towards formulating a research instrument compatible with the aims of the research and appropriate for their participants (Jones et al., 2014)

The protocol for the interviews was established as follows:

a. Establish rapport; note the participant's name; have the interviewee complete the consent form.
b. Remind the participants that the interview is tape-recorded and inform them of the right to ask for the recording to be stopped, or to request that the recording is destroyed.
c. Explain the nature of the research, the aim of the research, and why the participant was selected.
d. Manage expectations of the interview format.
e. Explain that the format will take the form of brief questions/answers, but that the participant is welcome to volunteer more information.
f. At the conclusion, ask again for any questions the participant might have and/or any relevant information the questions might not have covered.

4.7.2.3 Sampling

According to the Encyclopaedia Britannica, sampling is a process or method of drawing a representative group of individuals or cases from a population. Sampling and statistical inference are used in circumstances in which it is impractical to obtain information from every member of the entire population. Saunders et al., (2012) noted that all-inclusive answers to the research questions are determined by the selection of the right sample. Kothari (2004) identified different types of sample designs based on two factors viz.: the representation basis and the element selection technique. Regarding the representation basis, the sample may be a probability or non-probability sampling. Probability sampling is based on the concept of random selection, whereas non-probability sampling is 'non-random' sampling. Regarding element selection basis, the sample may be either unrestricted or restricted. When each sample element is drawn individually from the population at large, then the sample so drawn is known as an 'unrestricted sample', whereas all other forms of sampling are covered under the term 'restricted sampling'. Thus, according to Kothari (2004), sample designs are basically of two types viz.; non-probability sampling and probability sampling (see Figure 6.6).

Purposive sampling is considered desirable when the population happens to be small and a known characteristic of it is to be studied intensively (Kothari 2004). The purposive sampling strategy was identified as the best sampling technique for this study; this is due to the nature of issues to be investigated that required respondents who have knowledge and experience related to design management in the NCI. In order to collect such necessary information, the semi-structured interview was administered purposively to selected project team organisations with direct managerial influence on construction in Nigeria. The project team members comprised of consultancy, contracting and client organisations.

4.7.2.4 Conducting the Interview

In conducting the interview, efforts were made to adhere to the criteria that support quality interviewing as suggested by Kvale (1996). These include:

a) The researcher being conversant in the research area.
b) linking your questions to what has been previously said by the interviewee.
c) the respondent knowing the aim of the interviews.
d) Steering the process using questions and prompt question.
e) enduring the interviewee's responses.
f) A strategy of openness and flexibility towards the interviewees.
g) responding to what is important to the interviewee.
h) being ready to challenge what the interviewee has said, and
i) providing a summary of what has been said.

The interview was recorded using a portable Sony recorder (a digital recording device), and the researcher also took written notes. This was to ensure that the information given by the respondents was properly documented.

4.7.2.5 Interview Transcription

Many authors have discussed the quality of interviews, but little has been said about the quality of transcriptions in the literature. Cook (1990) noted that "it is a truism to note that all transcription is in some sense interpretation". Bryman (2012) observed that recording and transcribing interviews help in no small measure to solve the natural limitation of human memories, and the possibility of forgetting any salient point made by the respondents during the interview.

The researcher ensured that all the interview sessions were transcribed verbatim and word-processed immediately after the interview session (both in the exploratory stage and in the case studies) since they were audio recorded. This was done to ease the work at the data analysis stage (see Appendix 7 for a sample of the interview transcript).

4.7.2.6 Analysis of the Interviews

Henn et al., (2006) argue that in analysing qualitative data, ingenuity and expertise of the researcher takes precedence due to the lack of a strict approach for analysing such data unlike with quantitative research. The two most common approaches used in analysing qualitative data such as interviews are content analysis and coding of themes (Bryman 2012; Sanders et al., 2012). These two methods were used in this study for interview analysis after the transcribed interview were first grouped into data sets.

The analysis of the transcribed interviews focused on thoroughly understanding the main issues and themes highlighted by the respondents while comparing them with facts from the literature. The use of Computer-Aided Qualitative Data Analysis Software (CAQDAS) to analyse the interviews was considered because of its capabilities to manage large datasets (Bryman 2012); however, Marek (2016) noted that software cannot comprehend the “shades” of the meaning of a text. Therefore, because the focus of the analysis was to thoroughly understand the experiences and opinions of the interviewees, the manual analysis method was used; this, according to Marek (2016), is the only way of extracting deep meaning and subtle connotation. Daniel (2017) believed that analysing the data manually offers the researcher further opportunity to interact with the data.

The accuracy of any qualitative research is contingent on the validity of the content analysis and coding undertaken in such research. Strauss (2000) observed that the brilliance of any qualitative research depends, to a large extent, on the excellence of the content analysis and coding. He further noted that researchers who anticipate becoming proficient at qualitative analysis must have a mastery of the art of coding and content analysis. Content analysis is the technique for objectively and methodically creating interpretations from the contents of communication by identifying the definite features of messages (Bryman, 2012). According to Flick (2009), content analysis is a method of scrutinising documentary materials from various sources, especially those from interview data. Bryman (2012) noted that it provides a rigorous framework for the analysis of a wide range of documents.

The importance of performing content analysis and the coding of interview data cannot be overemphasised as interviews are arguably one of the best procedures for undertaking qualitative research. Erlingsson and Brysiewicz (2017) maintained that the overall objective of interview content analysis is to "*systematically transform a large amount of text into a highly organised and concise summary of key results*". It involves the process of reflecting on the data from transcribed interviews and transforming the data into latent meanings; this is achieved through the process of creating codes, themes, categories and subcategories from the transcribed interview data.

The process of content analysis and coding outlined by Erlingsson and Brysiewicz (2017) was adopted in this study; this is because their process gives detailed and straightforward steps for analysing interview data. The interview data gathered from this research was based primarily on human experiences and are, therefore, complex, multifaceted and often carry on multiple levels of meanings. The researcher read the transcribed interviews multiple times to understand what the respondents were striving to say. Based on the ideas gleaned from reading the interviews, the researcher then summarised all the interviews into a smaller text, while retaining the core meanings of the interviews; short codes were formed for these meanings and these codes were grouped into categories. The researcher did all this while focusing on the aims, objectives and the research questions of the study. It should also be noted that the process of content analysis carried out in this research was not a sequential one-time event but rather a continuous process of coding, categorising and then returning to the raw data to reflect on whether the coding and categorisation satisfied the meaning (Figure 4.10 for the Interview Data Analysis Process used in the Study).

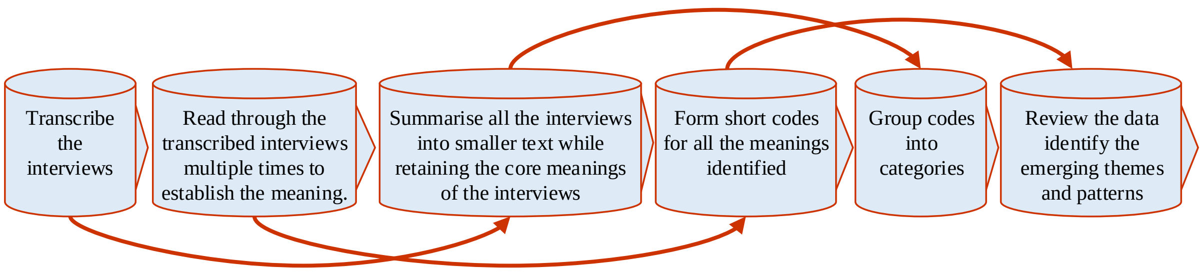


Figure 4.10. Interview Data Analysis Process used in the Study

To identify the links with existing TVD theories and new themes, the researcher examined the main issues and themes from the analysis and presented the findings from the grouping, cluster categorisation and content analysis in chapters 6 and 7 of this thesis. A sample of the groupings and categorisations is shown in Appendix 18.

Various codes were used to categorise the case study projects (viz: CS-01, CS-02, etc.), and the interviewees involved in the study. Efforts were made to differentiate the codes of the various case studies: these codes are shown in the demography data of the respondents in Chapters 6 and 7.

4.7.3 Phase 3: Survey

The third phase of this study is the survey evaluation. Saunders et al., (2012) claimed that surveys are often used for exploratory and descriptive research because they are frequently used to answer the questions of who, what, where, how much and how many. They further noted that it is a popular form of data collection as it enables researchers to collect a large quantity of data from a sizeable population in a highly economical way.

A semi-structured questionnaire was adopted to provide more support by also determining the current design management practices in relation to TVD and value creation in the NCI. The nature of a survey makes it possible to reach a larger number of respondents compared to conducting interviews. The questionnaire was divided into five sections; the respondents' background information; the current design management practices; the awareness and practice of TVD in the NCI; cost-related practices during design and the feasibility of TVD in the NCI (See appendix 4 for a sample of the survey). A total of 208 questionnaires were distributed to professionals in the industry and 112 were completed, representing a total response rate of 53%. The results and analysis of the semi-structured survey questionnaire are presented in section 5.3 of chapter 5.

4.7.3.1 Survey Analysis

Kawulich (2012) noted that the explanation of the process of quantitative data analysis is an area that is often neglected by many researchers. There are several methods of analysing quantitative data gathered through surveys. These include cross-tabulation, trend analysis, MaxDiff analysis, conjoint analysis (Bhat, 2018), descriptive statistics, parametric and non-parametric analysis. A mixture of descriptive statistics, graphs and nonparametric inferential statistics were used in the analysis of the various surveys in this study.

4.7.4 Phase 4: Observation

Kawulich (2005) maintains that observation has been used in a variety of disciplines as a tool for collecting data about people, processes, and cultures in qualitative research. Observations enable the researcher to describe existing situations using the five senses, providing a "written photograph" of the situation under study (Erlandson et al., 1993). Observation methods are useful to researchers in a variety of ways. They provide researchers with ways to check for nonverbal expression of feelings, to determine who interacts with whom, to grasp how participants communicate with each other, and to check for how much time is spent on various activities (Schmuck 1997).

A non-participatory observation was carried out after the second phase of the study (the exploratory interviews), with about 13 different construction projects with the aim of obtaining first-hand information and assessing the current design and construction practices in the Nigeria construction industry, with a view to fulfilling the aim and objectives of the research. The observation took place over a period of 9 months, and the projects observed included housing, infrastructure and ancillary projects (see Table 4.3).

Table 4.3 The list and categories of projects observed.

S/N	**HOUSING PROJECTS**	**INFRASTRUCTURES**	**ANCILLARY PROJECTS**
	Name and Location	Name and Location	Name and Location
1	Guzape 5-bedroom Terrace Abuja Nigeria	Low-Cost Housing and Infrastructure Abuja Nigeria	Low-Cost Housing and Ancillary Abuja Nigeria
2	Housing development Guzape Abuja	Katampe District Infrastructure Abuja Nigeria	
3	Housing Estate Galadimawa Abuja Nigeria		
4	Housing Estate Gwarimpa Abuja Nigeria		
5	Low-Cost Housing Abuja Nigeria		
6	Housing Estate Life Camp2 Abuja		
7	Housing Estate Apo 5 Abuja Nigeria		
8	Housing Estate Apo 3 Abuja Nigeria		
9	Housing Estate Apo 2 Abuja Nigeria		
10	Shopping Complex Abuja Nigeria		

4.7.4.1 Observation Schedule

An observation schedule is a form prepared prior to data collection that delineates the behaviour and situational features to be observed and recorded during an observation (Given 2008). Cooper and Schindler (2008) observed that the observation schedule influences the reliability and validity of the data obtained through structured observation.

4.7.4.2 Observation Checklist

British Council (2008) noted that observation checklists provide an observer with a structure and framework for observation, it also serves as a feedback mechanism to assess the success or otherwise of the observation.

This study carried out a non-participant observation before the implementation of TVD on the project. The Planning Best Practice index checklist of full implementation, partial implementation and no implementation were adopted in order to record the level of the current implementation of TVD in the 13 projects sampled. The researcher observed how the activities on-site were planned and controlled without any actual contact with the participants of the project. as reported by Dolnicar et al., (2011) and Paulhus (1991). Dolnicar et al., (2011) and Paulhus (1991) reported that to minimise response bias a three-point Likert scale be used rather than a 5-7-point Likert scale, this was adhered to in the study.

According to Bryman (2012), if the observation schedule is not followed as intended, reliability and validity of the structured observation could be lost. The researcher checked that the observation schedule was followed stringently for all the 13 projects observed to prevent loss of validity and reliability. The findings and discussion of the analysis are stated in chapter 6 of this thesis.

4.7.4.3 Observation Sampling

A purposive sampling approach was chosen during the structured observation to enable the researcher to detect projects that fulfilled the pre-set criteria before selection. The projects selected for observation had to meet the following criteria:

i. a construction project
ii. ongoing; and
iii. located in Nigeria.

The projects were chosen from building, infrastructure and ancillary works sector construction projects in both the private and public sectors to achieve a broader viewpoint. This was done based on Bryman (2012) and Cooper and Schindler (2008) stating that the observation standards must be consistent across the sampling elements for structured observation data to be valid and reliable. All together 13 public and private projects were observed through a document and physical condition analysis of their design management practices in relation to TVD practices and benchmarks. In addition to the record and physical condition analysis on each of the projects observed, discussions were conducted with professionals (quantity surveyors, construction managers, civil engineers, contractors, and clients) involved in the construction of those projects.

4.7.4.4 Data Analysis of the Observation

The researcher visited the project site in person to collect the data, this enabled the researcher to collect data on ‘physical condition analysis’ and ‘record analysis’. The researcher had access to both the mid-line and top managers of the observed projects.

The data gathered from the projects were categorised into datasets using the three main schedules used in compiling the data. Content analysis was used to analyse the data from the record and physical condition analysis. Berg and Lune’s (2014) procedure for conducting content analysis was adopted for this study. Descriptive statistics like percentages was adopted to analyse the level of TVD implementation and practice in the observed projects. The findings are presented and discussed in chapter 5 of this thesis using tables and charts and are discussed.

4.7.5 Phase 5: Multiple Case Studies

Case study research is an organised process that focuses principally on building theory and uses principles from quantitative research for assessing the value of case study findings.

The following forms of case study research are recognised by Stake (1995):

i. intrinsic (where the case is selected because it is of special interest).
ii. instrumental (where there is special interest in an issue or to redraw a generalisation)’ and
iii. the multiple or collective case study, which is an instrumental case extended to several other cases.

Yin (2014) differentiates between a single case study and multiple case studies, defining the former as critical, extreme/unique or revelatory, and the latter as selected to enable replication and extension. He further argues that a multiple case study can require extensive resources and time. Multiple cases help to clarify if a finding is peculiar to a single case or can be dependably simulated by several studies by comparison between the case studies. The case study research was conducted in this study to ensure that there was adequate interaction with the project site (a physical setting). The study sought to:

a. Support the initial interviews, surveys and observations carried out to establish the existing understanding and practice of TVD in the NCI.
b. To identify the benefits, drivers, barriers, impacts, support and success factors of implementing TVD at all stages in the NCI.
c. Identify the impact of the current practice on TVD on NCI

Multiples case studies where done to ensure the validity and reliability of the findings of the study. These allowed the study to understand the current practices of TVD in the NCI, and the findings helped in the development of an artefact (the framework for the implementation of target value delivery: FFITVD).

4.7.5.1 Case Study Planning

The study considered the factors that could influence the overall case study duration during the case study planning. The factors considered included: access to the site, documentation and the respondent’s willingness to participate. Three case studies were conducted on three different projects that included a private commercial petrol station construction, a private housing development, and public building construction. The case studies covered both traditional procurement routes and the design and build procurement routes.

4.7.5.2 Case Study Selection

The way cases are selected in a study should be guided by the purpose and aims of that study (Dubois and Gadde 2002). Fletcher and Plakoyiannak (2008) observed that the case study approach offers flexibility in terms of the justification of sampling choices, the number of investigated cases, and the sampling techniques. Any sampling involves the initial selection of the case(s) as well as within-case sampling in terms of choosing informants, observations, documents, etc.

The selection of case studies is based on the rationale of maximum variation sampling that seeks “to incorporate as much diversity as possible into the research design” (Lye and Hamilton 2000). The case studies in this study were selected based on the factors suggested by Yin (2014). Consideration was given to the procurement methods chosen in the construction projects; this was done to develop a guide for the implementation of TVD in the NCI. The case studies were selected from ongoing construction projects located in Nigeria that were easily accessible to the researcher. This was done to ensure that the case studies were true representations of the study area.

4.7.5.3 Case Study Data Collection

According to the Texas State Auditor's Office, case study data collection is founded on two central views: robust detail in recording events, interviews, and observations; and the use of various data sources to allow triangulation during data analysis. Therefore, it is imperative to use several techniques when gathering information.

After selecting the cases, the researcher together with the supervisory team established a data collection procedure that was used to collect data from the case studies. Three case studies were selected to enable validation of the findings. The researcher ensured that the data collected were comprehensive enough to ensure that important situations and values were considered, with bias minimized as much as possible. The researcher was part of the construction project team in all the case studies, which enabled him to have access to the documents of the project for analysis, observation, surveys and interviews with participants of the project such as top management, middle management, lower-level managers, subcontractors, suppliers and the project execution team.

Data was collected using project documents, semi-structured interviews, and surveys. These were done to expand and substantiate the results in accordance with the suggestions if Yin (2014).

A. Project Documents

According to Bryman (2012), documentary evidence is reliable it has not been intended for the study. Documents such as a program of work, statutory approvals, weekly work plans, earned value documents, minutes of weekly or bi-weekly site meetings, progress reports, change orders, the project plan and project emails served as the documentary sources for the case studies. Access to these documents was not difficult because of the researcher's involvement in the projects, mentioned earlier.

B. Semi-structured interviews

Introduction and invitation to participate letters were sent to the participants of the studies prior to their various dates of interview, with participants' consent to the interviews being recorded, and later transcribed, then stored for analysis and future documentation

C. Survey

The researcher, in a bid to examine the prospect of applying TVD in the NCI; identify the benefits, success factors, challenges and drivers; and develop a framework for successful TVD implementation in Nigeria, considered survey crucial to the study. The researcher, using the literature and study objects, prepared a questionnaire that was verified by the supervisory committee. The questionnaires were administered to 34 participants.

4.7.5.4 Case Study Data Analysis

Data analysis for case studies is somewhat unusual in that much of the data collected are qualitative. Case studies use the OTTR as the principal data analysis method: OTTR stands for "observe," "think," "test," and "revise." It is essential for analysis to be an iterative process, where the original observations are reflected upon and then shape subsequent data collection. However, care should be taken to avoid improper generalizations. Other tools must be used to confirm or reject hypotheses in a statistical sense.

This study focused on documentary analysis, semi-structured interviews and surveys as the major sources of data for analysis. The data were collected and stored on a system with all the data from each case study given codes to help the researcher keep track of it, and for discretionary reasons. Case study projects 1, 2, and 3 were coded CS-01, CS-02, and CS-03, respectively. The study had 34 participants (17 in CS-01, 12 in CS-02, and 5 in CS-03) for the survey and 31 participants (15 in CS-01, 9 in CS-02, and 7 in CS-03) for interview across the three case studies. The research participants included a client, two contractors, sub-contractors and many senior managers, indicating that key stakeholders were part of the research, and further ensuring the validity and reliability of the study.

The transcribed interviews were compared with the document analysis and the survey analysis. The collected data were analysed using quantitative and qualitative analysis, and basic descriptive statistics. Triangulation was carried out for all the sources to enhance the validity of all the case studies. To achieve a unifying conclusion, individual evidence sources were examined independently and further cross analysed.

4.7.5.5 Cross-case Study Analysis

Cross-case study analysis is a research method that enables the assessment of cohesion and differences in the events, actions, and processes that are the components of analyses in case studies. Researchers have observed that cross-case analysis enhances their capacity to understand how relationships may exist among discrete cases, accumulate knowledge from the original case, refine and develop concepts, and support the generalisation of findings across the case. It offers a better understanding of the phenomenon investigated (Ragin 1997; Miles and Huberman 1994)

The researcher, to enable this study to identify the current TVD practised in the NCI, the challenges faced, and the data required to develop a framework for the implementation of TVD in the NCI, subjected the three case studies to individual analysis, and then subjected them to cross-case analysis, as suggested by Yin (2014). Details of how the data obtained from each case study were compared and analysed to support any generalisation of the findings are reported in chapter 6.

4.7.6 Phase 6: Development, Evaluation, Testing, and Re-Evaluation of the Framework for Implementing Target Value Delivery

March and Smith (1995) stated that the research activities of design science are twofold: to "build" and "evaluate". He noted that while the building is the process of creating an artefact for a specific purpose, evaluation is the process of determining how well the artefact performs. Lukka (2003) corroborated that the perfect result of a constructive research project is that a real-world problem is resolved by implementing a new construction which has both boundless practical and theoretical contribution. The goal is to produce an artefact that solves a problem and contributes to both theoretical and practical knowledge.

In this phase, the study focuses on the creation and evaluation of the framework for implementing target value delivery (FFITVD). The purpose of the FFITVD was to support stakeholders in construction (subcontractors, the main contractors, clients, consultants, suppliers, statutory authorities) to understand the all-inclusive process that is required for successful implementation of target value design.

4.7.6.1 Development of a Framework for Implementing Target Value Delivery

This stage is one of the two research activities of DSR, referred to as "building" by March and Smith (1995), which involves the construction of the artefact, and establishing the fact that such an artefact can be constructed. Smith (2015) observed that the responsibility of DSR is to produce a practicable artefact in the form of a construct, a model, a method, or an instantiation for solving a real-life problem.

This research developed a framework for implementing target value delivery; this has been discussed in detail in chapter eight. The framework highlights the drivers, tools and techniques, support and project mindsets required for the implementation, as well as the likely barriers and the expected benefits from its implementation.

The literature review, interviews, observation, survey and case studies, as well as the existing benchmarks and practices of TVD, served as the sources of the data used to create the framework. They also formed the foundation for the development of the FFITVD. The development process is an iterative one that comprises several development loops; this is in conformity with Markus et al., (2002); Hevner et al., (2004); and Brady et al., (2013), who stated that the build-test-and-evaluate loop is characteristically iterated several times before the final design artefact is produced.

4.7.6.2 Framework Evaluation

Brady et al., (2013) identified two types of evaluation: an internal and external evaluation. They noted that the essence of conducting internal and external evaluation is to establish if and to what extent a real-world problem has been solved by the implementation of a new artefact, and to determine the practical and theoretical contributions of the artefact. According to CELT (1998) the evaluation carried out by one or more members of the project team is referred to as internal evaluation, while the evaluation carried out by individuals who are not directly involved in the development or operation of the artefact being evaluated is tagged as external evaluation. While the internal evaluation prides itself in the fact that the evaluator has the advantage of fully understanding the rationale behind the development and appreciates any problems that may arise as a result of its implementation, the external evaluation produces a more objective assessment of the artefact (Smith 2015; CELT 1998; Joseph 2010).

This study adopted the three levels of evaluation proposed by Rocha (2011), which include: evaluation by the researcher; evaluation by the participants of the study (both of which are internal evaluations); and evaluation by non-participants of the study (external evaluations). This tripartite method aims to engender a more robust evaluation. It is worth noting that the internal and external evaluations were carried out in a process Brady et al., (2013) described as cycles or loops; Vaishnavi and Kuechler (2004) referred to them as "circumscription".

The first level of evaluation took place during the development of the artefact, where the researcher reflected upon and reviewed the framework, leading to a development cycle. This allowed the necessary testing and application of the framework before its completion (March and Smith 1995), even though it was not a rigorous process, as posited by Hevner (2004). The other two levels of the evaluation were conducted after the implementation and testing of the framework, and they were more rigorous than the first level.

Ryan and Brough (2012) posited that academic reflection is a pedagogical pattern that can be applied in diverse discipline areas, especially by researchers engaged in developing professionally-relevant solutions. It is a process in which researchers reveal their thinking around key ideas of a professional discipline. Academic reflection is seen as a disciplined disposition, ranging from relatively low-order skills (such as recounting) to critical, high-order capabilities, such as reasoning (Bain et al., 1999; Carrington & Selva 2010).

Ryan and Ryan (2010) have further refined a scale for academic reflection by characterising just four levels required for evaluating artefacts. They labelled them the resource for academic reflection, the 4Rs scale, comprised of reporting/responding, relating, reasoning, and reconstructing. Following the scale for academic reflection proposed by Ryan and Ryan (2010), the researcher observed the developed framework and compared it to the existing literature and the initial observation, the interviews and the survey on the implementation of the TVD to see if it had the potential to support its implementation. The researcher recorded questions that arose from critical thinking while observing the framework, and refinements to the framework were made based on the recordings from the reflection.

4.7.6.3 Framework Testing on a Case Study

According to Lukka (2003), the implementation stage is a very demanding task; nevertheless, it enables the researcher to verify if the developed solution actually solves the problem it was developed to solve. The testing of the framework is part of the build-evaluate-test-and-re-evaluate iterative cycle. Artefacts, constructs, models, methods, and instantiations are technologies that, once created, must be tested and evaluated scientifically; the goal here is to assess its usability and if any progress has been made, and the basic question is: 'how well does it work?' (March and Smith 1995).

There are various methods for testing and evaluating artefacts depending on the nature of the artefact being developed and the resources available to the researcher. Hasan (2003) identified direct observations from pilot studies, while Richey and Klein (2007) recognised indirect indicators from surveys, questionnaires, interviews, and other observations. To access the usability of the FFITVD, the framework was implemented in a fourth case study. The participants of this case study were given the framework prior to the commencement of the project in order to study and familiarise themselves with the framework, and then they implemented it on the project, following all the recommended steps sequentially. On completion of the project, seven participants were interviewed, and fifteen participants were administered with a survey. The results of the analyses were used for the evaluation and revision of the framework. The evaluation process involved key stakeholders to reduce prejudice in the results.

4.7.6.4 Framework Re-evaluation

This stage is the second research activity of DSR, referred to as "evaluation" by March and Smith (1995); it is aimed at improving performance. They claimed that the artefact evaluation refers to the development of criteria and the assessment of artefact performance against those criteria. Smith (2015) noted that the usefulness, quality and effectiveness of a designed artefact must be rigorously demonstrated via well-executed evaluation methods.

Three criteria were used to evaluate the framework developed in this study:

a. The completeness of the framework
b. The appropriateness of the framework
c. The ease of use of the framework

It is often difficult for the internal evaluation to produce objective criticisms of the work because of the close involvement of the evaluators with the project. This relationship limits their ability to suggest any innovative refinement solutions to the framework, whereas, for the external evaluation, the participants may not fully understand the goals and objectives of the artefact developed (Smith 2015; CELT 1998; Joseph 2010). Since the internal evaluation of the framework is based on the perception of the study participants, the evaluation is categorised as a weak market test (Kasanen et al., 1993); conversely, the external evaluation strengthens the results of the internal evaluation by verifying if the framework can be adopted widely or in other contexts (generalisability).

For this research, the diversity and number of the participants selected for the internal evaluation helped to curb bias and produce a more objective evaluation. A detailed explanation of the goals and objectives of the framework was given to the participants selected for the external evaluation. The second level of evaluation involves interviews and semi-structured surveys administered to the participants in the study after the implementation of the framework; the results of this evaluation were incorporated into the solution development used to refine the framework.

The final level of evaluation involved interviews and semi-structured surveys administered to non-participants of the study after the refinement of the framework.

A. Post-Framework implementation survey

Fifteen project participants of the framework implementation case study and seven non-participants were selected to participate in the survey. The researcher prepared a questionnaire to evaluate the framework (see Appendix 9 for a sample of the evaluation survey). The questions were designed to determine the completeness and appropriateness of the different elements of the framework. They were also designed to determine the ease of use. The responses from the participants were analysed and used for modification of the framework

B. Post-Framework implementation interview

Interviews were also conducted with the participants and non-participants of this case study, using questions prepared by the researcher (see Appendix 10 for a sample of the post implementation interview). As in the three case studies, the interviews were recorded with the consent of the interviewees and then transcribed for the purpose of analysis.

C. **Post-Framework implementation review**

The results from the analyses of the survey and interviews with the participants of the implementation case study (the clients, subcontractors, suppliers, etc.) were used to evaluate and make improvements to the FFITVD. The framework was also given to the academics, construction stakeholders and other lean construction experts to study; then, the evaluation survey and semi-structured interviews were administered to them and data from the analyses of their responses were also used to improve the framework.

4.7.7 Phase 7: Research Conclusion, Contributions and Recommendations

Following the framework evaluation, an overview of research aims, and objectives were revisited. The summary of the empirical findings from the literature review, interviews, survey, observation and case studies from phases 1 to 6 are presented (see Table 8.1). How the five research objectives of the study were achieved as well as the conclusions reached on each research objective was discussed. This phase stated the two research questions and how they were answered and presented the conclusions on both research questions. Contribution to the existing body of knowledge categorised into the practical and theoretical contributions of the study and framework was demonstrated (see table 8.2 and table 8.3). Brady et al., (2013) noted that one of the essences of evaluation is to establish the practical and theoretical contributions of the artefact.

The assessment of the artefact, focussing on its practical and theoretical contribution, is very important. Lukka (2003) noted that this is an unavoidable and critical stage of the project; he underscores the necessity of an explanation of the theoretical contribution of the artefact by the researcher, reached by relating the findings back to extant theories and or the literature. Hernver et al., (2004) also stressed the importance of identifying the contribution to the archival knowledgebase of foundations and methodologies as the major difference between routine design and DSR. Holmstrom et al., (2009), supporting this by stating that the design science researcher must be able to demonstrate the theoretical contribution of the produced artefact. He further noted that the theoretical contribution does not lie in the saving in monetary terms that a company gets from applying the solution, but it lies in something theoretically novel about improving processes that were learnt.

In this phase, the focus is not on the specific solution in only one setting but rather the researcher pursues theoretical justification by establishing its usefulness. Lukka (2003), in the case of constructive research, proposes that two major types of potential theoretical contributions will be open:

I) The novel construction itself. If the designed new construction is found to work in the primary case, it will provide a natural contribution to prior literature. In a constructive research project, the empirical work is typically strongly geared towards achieving this part of the potential contribution.

II) The positive relationships behind the construction. In addition to the attempts to design new constructions and test their functioning, a constructive research project is an arena for both applying and developing the existing theoretical knowledge about the structural and process features emerging in the case.

Following the contributions, the research publication including a plan for publication, limitations of the research, research recommendations for construction industry practitioners as well as recommendation for further research was assessed and documented (see chapter 8).

4.8 Data Evaluation and Quality of Research

The basis of problem-solving research is design science, and to ensure that the research has solved a problem it is necessary to assess the quality of the research. According to Saunders et al., (2009), concepts such as validity and reliability are used to assess the quality and credibility of the project. This research assesses the quality of its findings using the following criteria: reliability, validity, representativeness, flexibility, rigour, reflexivity, transferability and confirmability.

4.8.1 Reliability and Dependability

Leedy and Ormrod (2005) defined reliability as “the consistency with which a measuring instrument yields a certain result when the entity being measured hasn’t changed”. According to Ahiakwo (2014), reliability concerns the extent to which research can be repeated by others and the same results obtained. For this to be measured, it is important that detailed records of how the research was carried out are kept. This was accomplished in this study by ensuring that the data collection and analysis methods were accurate and consistent throughout and across the case studies. The taking and preserving of field notes, work progress and recorded and transcribed interviews also contributed to the dependability of the research.

4.8.2 Validity

Leedy and Ormrod (2005) refer to the validity of an instrument as being the degree to which the instrument measures what it is supposed to measure. Validity is met if the data gathered are a true representation of the study. Validity can be divided into internal and external validity, which Ellis and Levy (2010) call the two most common validity issues. Internal validity is also referred to as credibility (Daniel 2017). Bryman (2012) infers that validity seeks to find out how believable the research findings are. The strategy used to increase the validity of this research was data triangulation; this is when the same data are collected from at least two different sources. In this research, data were collected from multiple case studies.

4.8.3 Transferability

Also known as generalisability or external validity, this is the ability for the research findings to be equally applicable to other research settings, such as other organisations (Saunders et al., 2009). This can be achieved by using a method known as triangulation, which is also used to determine validity. The motivation behind the study was not to generalise the findings, but the researcher tried to attain external validity in the findings by using replication logic through conducting the multiple case studies in diverse project situations, as prescribed by Yin (2014). Findings were also obtained from external participants such as practitioners, researchers and academics who were not part of the case studies but who had experience in the field of study.

4.8.4 Representativeness

The representativeness of a study is basically how much the research (sample size, data, results, etc.) is a good representation of the study population. According to Bazerman (1994), the representativeness of data simply suggests that the data replicates the make-up group. Ballard (2000) established that representativeness could be established in a single project, while Ahiakwo (2014) argued that representativeness could be likely if the intervention were carried out successfully, to show that similar actions could produce similar results in different circumstances.

The implementation of TVD in four case studies located in three different locations (even though all were in the northern part of Nigeria) proves that the research is representative. The same actions carried out on the different case studies produced similar outcomes. Therefore, the findings can be generalised and used as a reference point for the implementation of TVD in similar projects in Nigeria.

4.8.5 Rigour

The dictionary describes rigour as the quality or state of being very exact, careful, or with strict precision, or the quality of being thorough and accurate (Oxford English Dictionary). The strength of the research design and the appropriateness of the method to answer the questions is rigour (Cypress 2017). Davies and Dodd (2002) refer to rigour as the reliability and validity of research and that, essential to the origin, the concept is a quantitative bias. Morse et al., (2002) state that research is insignificant without rigour; it becomes fiction. The 9 steps of DSR are rigorous.

4.8.6 Reflexivity

Reflexivity is the perception in the social sciences used to explore and deal with the relationship between the researcher and the object of research (Saunders et al., 2009). Reflexivity is basically how the researchers' views or mindset affect their research. Jupp (2006) refers to reflexivity as the level of bias a person's thoughts could be represented in their work. The researcher made efforts to be as open-minded as possible during the data analysis and in the interpretation of the results obtained because of being conscious of reflexivity.

4.8.7 Confirmability

Confirmability, also called objectivity, is the degree to which the researcher's personal philosophy or values affect the research and its findings (Daniel 2017). Researchers can endeavour for neutrality and objectivity, but it cannot be fully attained (Ritchie and Lewis 2003). To ensure a level of neutrality, the researcher utilised different methods of data collection, such as the literature review, interviews, observations and surveys. The participants in the interviews expressed their opinions freely.

4.9 Chapter Summary

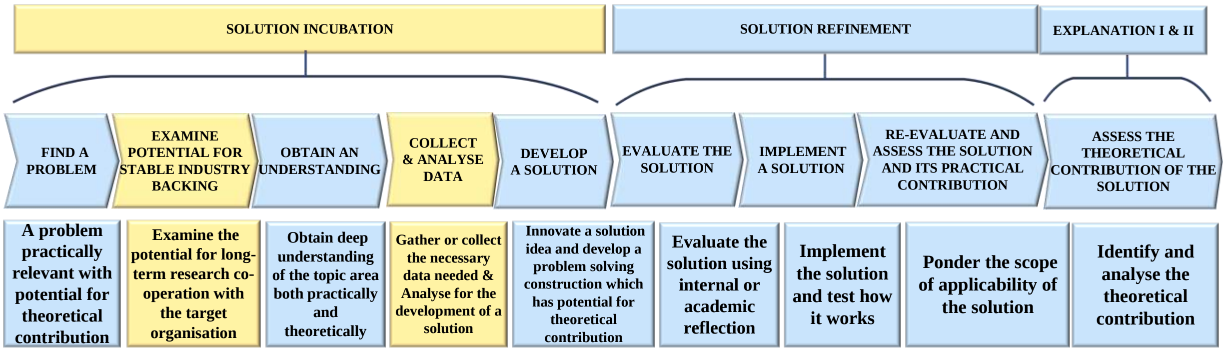
This chapter has presented a comprehensive description of the research philosophies, paradigms, approaches, and strategies used to achieve the aim and objective of the study. The chapter has described the methodology and methods used in conducting this research and justified the adoption of the research methods and paradigms used to meet its objectives.

The chapter has revealed that the researcher adopted the constructivist ontological position, the interpretivist epistemological positions, and the applied axiological school of thought for this study. The chapter has also discussed the relationship between all these positions. Furthermore, the study has adopted an interpretivist research paradigm and a mixed-method approach in the research strategy to accomplish the aim and objectives of the study.

DSR was considered suitable and was adopted because of the rigours involved. The chapter has concluded with a discussion of all the phases of the study, and how the research findings were validated. The following chapter investigates the current design management practices in relation to TVD, the awareness and practice of TVD and feasibility of TVD in the Nigerian construction industry. This is done by means of exploratory interviews, surveys and observations.

CHAPTER FIVE

FINDINGS AND DELIBERATIONS ON EXPLORATORY INTERVIEWS, SURVEY AND OBSERVATIONS



5.1 Introduction

The preceding chapter discussed the procedures of the process and the specific methods used in data collection for answering the research question. This chapter presents the empirical findings from the 26 interviews, the survey conducted, and the non-participant observations conducted to understand current NCI practice. The chapter seeks to determine the potential for co-operation with NCI practitioners, and determine the feasibility of TVD in Nigeria from the perspective of the industry players. This supports our design science step two.

5.2 Phase 2: Semi-structured Interviews

The section presents the analysis and discussion of the results of the semi-structured interviews conducted in phase 2 of this study. It discusses in detail the background information of the respondents, the current design management practices in the NCI, the awareness and practices of TVD in the NCI, and the feasibility of TVD implementation.

5.2.1 Analysis, Presentation and Discussion

Sequential to the literature review, a semi-structured interview guide was developed to determine the current design management practices in relation to TVD and value creation, the awareness and practice of TVD, and its feasibility in the NCI. This study used exploratory interviews to examine the current understanding and application of TVD in the NCI through exploring its social settings and Nigerian construction practitioners. Some researchers argue that exploratory interviews are more suitable in situations where a study try to find the meaning people give to a process/event and not the meaning given from literature alone (Creswell, 2014), which is in line with the aim of this research. Pioneer researchers are of the opinion that the detailed understanding derived from directly observing people and listening to their opinions at the setting cannot we dwarfed by any research method (Taylor and Bogdan 1984).

The interview consists of 31 open and closed-ended questions, which are divided into five themes covering: the respondents' background information; current design management practices in the NCI; the awareness and practice of target value design (TVD) in the NCI; cost-related practices; and the feasibility of TVD in the NCI. (See Appendix 1 for a sample of the interview guide and Appendix 3 for a sample of consent form and invitation to participate).

5.2.2 Background Information of the Interviewees

A total of 26 interviews were conducted with professionals from the NCI (see Figure 5.1) who all have over five years of industry experience. The demographic distribution of the interviewees is presented in Table 5.1.

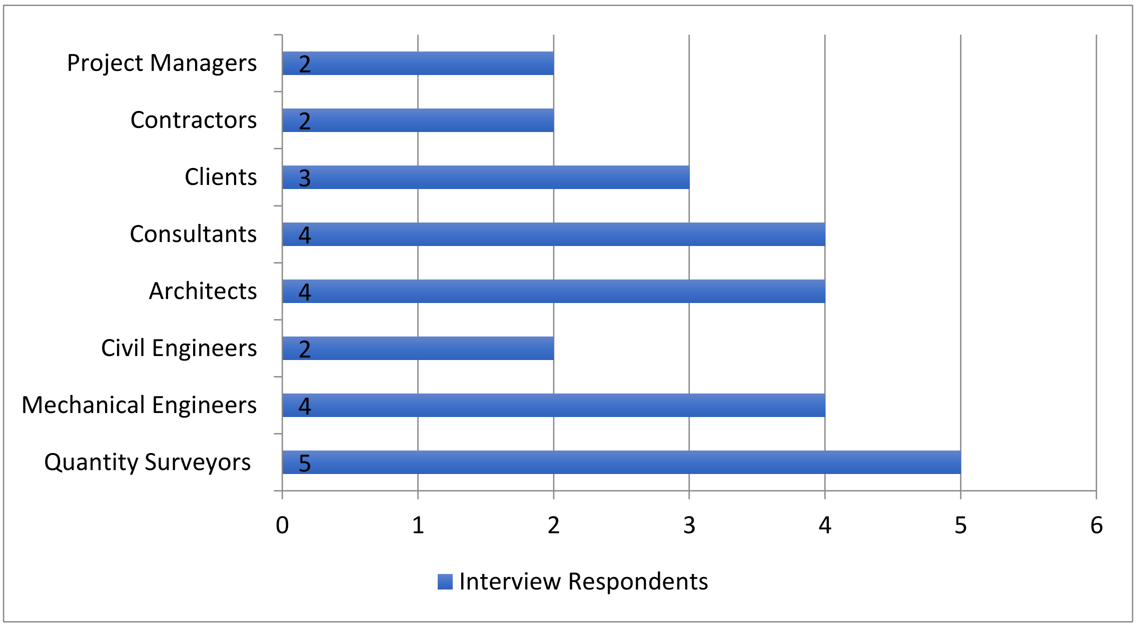


Figure 5.1 Interview respondents

Table 5.1 The Demography of the interview respondents

RESPONDENT CODE	SECTOR	DESIGNATION	YEARS OF EXP. IN CONST.
RES-01	Infrastructure	Project Manager	5
RES-02	Building	Project Manager	10
RES-03	Ancillary works	Contractor	6
RES-04	Infrastructure	Contractor	8
RES-05	Building	Client	18
RES-06	Building	Client	12
RES-07	Infrastructure	Client	22
RES-08	Building	Consultant	16
RES-09	Building	Consultant	15
RES-10	Ancillary works	Consultant	5
RES-11	Infrastructure	Consultant	6
RES-12	Building	Architect	12
RES-13	Ancillary works	Architect	22
RES-14	Building	Architect	6
RES-15	Infrastructure	Architect	9
RES-16	Ancillary works	Civil Engineer	5
RES-17	Building	Civil Engineer	5
RES-18	Infrastructure	Mechanical Engineer	13
RES-19	Ancillary works	Mechanical Engineer	16
RES-20	Ancillary works	Mechanical Engineer	7
RES-21	Building	Mechanical Engineer	10
RES-22	Infrastructure	Quantity Surveyor	15
RES-23	Ancillary works	Quantity Surveyor	10
RES-24	Building	Quantity Surveyor	17
RES-25	Building	Quantity Surveyor	12
RES-26	Ancillary works	Quantity Surveyor	14

Convenience purposive sampling was adopted due to the nature of the issues to be investigated to ensure that only experienced people with knowledge in design management participated in the study. The compiled data were categorized into data sets and analyzed using content analysis and codding processes (Miles and Huberman 1984). (see Appendix 7 for a sample of interview transcript)

5.2.3 Current Design Management Practices in the NCI

The respondents were interviewed on the current design management practices in the NCI and how close it is to TVD. The results reveal that:

a) The common practice is for the architect/civil/structural engineers to design first, then calculate an estimate.

b) Projects in the NCI are characterized by a design-estimate-rework cycle as missing information in designs, in most cases, leads to projects exceeding time and cost targets.

c) The term TVD is not used in the NCI.

d) However, practitioners are aware of target cost and target cost contracts. The words of a cost estimator explain succinctly;

> *Yes, I have heard about target costing, where the client already has a target, an amount in his mind to use to execute the project. He has a target, based on his target he tells his designer: 'I have X amount, can you give me a design that will fit this money I have?' [RES-22,* ***Quantity Surveyor****]*

e) Targets costs are determined from historical data of previous similar projects, preliminary estimates and market selling prices.

f) Cost reduction exercises are common through altering specifications and scope to achieve the client's budget through value engineering.

g) The most common procurement route adopted is the traditional route, which does not provide an avenue for all project members to participate at the beginning of the project; although design and build are partially done, the projects are normally called turnkey projects, which encourage team members to work in the same room.

h) Generally, the design team members do not stay in the same room during design but normally meet during coordination/technical meetings. However, developers/design and build contractors partially have their design teams in the same room.

i) Cost targets are not initially given to other designers, like MEP or landscapers, etc. However, technical meetings conducted later serve as an avenue to further break down and allocate cost to other team members, like MEP, to design to cost, based on the client's budget.

5.2.4 Awareness and Practice of TVD in the NCI

The respondents were further probed on their awareness and practices of TVD in the NCI. The analysis of the result reveals the following:

i. Not all key members of the project team partake in developing the business case; mostly, the QS participate in the business case preparation. This is corroborated by a consultant who stated:

> *"It is not our tradition to involve everybody from the beginning, you only involve the most important people. In a way, it makes sense for all stakeholders to be involved early, but that has not been our tradition. Most clients do not want to pay to involve all the stakeholders early because it will add to the project's cost." [RES-09,* ***Consultant****]*

ii. The business case is based on a forecast of the facility life cycle, and the customers' ability to fund the investment is included.

iii. Not all key members of the project team participate in feasibility studies; QS are frequent participants.

iv. A detailed budget aligned with the scope is done after feasibility studies.

v. Feasibility studies normally include assessing what is wanted, designing for construction, and by aligning project constraints of cost, time, location, etc.

vi. Reflection on routine and learning are done when finalising designs.

5.2.5 Cost-related Practices

The findings revealed the following cost-related practices in the NCI:

a. Budget estimates are done in collaboration with all team members.

b. Innovations are inspired when targets are set.

c. A form of value engineering is used to reduce specification continuously in order to achieve target cost during cost-cutting exercises; however, inadequate knowledge on how to drive the process leads to the essential cost being compromised just to contain cost with the target.

d. Cost estimators/QS are involved in concept design.

e. The barriers are procurement routes and cultural (traditional mindset) issues, both at the project and organization level.

f. There is often late involvement of some key stakeholders, including subcontractors and suppliers.

g. Reliable cost data is often unavailable; it is very difficult to obtain working accuracy of target cost.

5.2.6 Feasibility of TVD in NCI

The exploratory interview assessed the feasibility of TVD in the NCI; the findings reveal that:

i. The respondents were in strong agreement that designing to a target cost will increase cost certainty.
ii. They also strongly agreed that practices (like TVD) that will ensure a target cost lower than the market price or the allowable price will make products more competitive, thereby achieving value. A client opined that:

   "Any practice that will help us not to alter the scope of our work during construction and help us to achieve the project within the selling price is a good and welcome practice. I will personally support that because it will favour us." [RES-05, ***Client*****]**

iii. They were in support of TVD, stating that it was a good innovation that could be gained from. They recommended the use of TVD, saying that they would like to participate and adopt TVD in projects. The response of the following interviewees explains further:

"Yes, am just hearing about this Target value now, I can see its importance. It's a good innovation we can gain from it." [RES-07 ***Client]***

"TVD? I have not heard of it before, but it sounds like a good innovation. I would like to see how it works. I would like to participate in its implementation." [RES-14, ***Architect]***

5.3 Phase 3: Survey

The section presents the analysis and discussion of the results of the survey conducted in phase 3 of this study. It discusses in detail the background information of the respondents, cost estimating techniques, design management challenges encountered, TVD benchmark implementation, and the feasibility of TVD.

5.3.1 Analysis and Discussions

After the semi-structured interviews, a semi-structured questionnaire consisting of 20 questions was developed to determine the current cost estimating techniques used, the design management practices in the NCI, the challenges of the current design management practices, the level of benchmark implementation, and the feasibility of TVD in the NCI.

Saunders et al., (2012) noted that a survey enables researchers to collect a large quantity of data from a sizeable population in a highly economical way. In line with this, the questionnaire was adopted to provide more support to the research by determining the current design management practices in relation to TVD and value creation in the NCI. The nature of a survey makes it possible to reach a larger number of respondents compared to an interview.

5.3.2 Background Information of the Respondents

A total of 208 questionnaires were distributed to professionals in the NCI, with a response rate of 53 %; see Figure 5.2. The responses were from all four regions/zones of Nigeria (North 35%, West 21%, East 23%, South 22%). Furthermore, 85% of the respondents have more than five years' experience in the industry, with about 40% having over 15 years' experience.

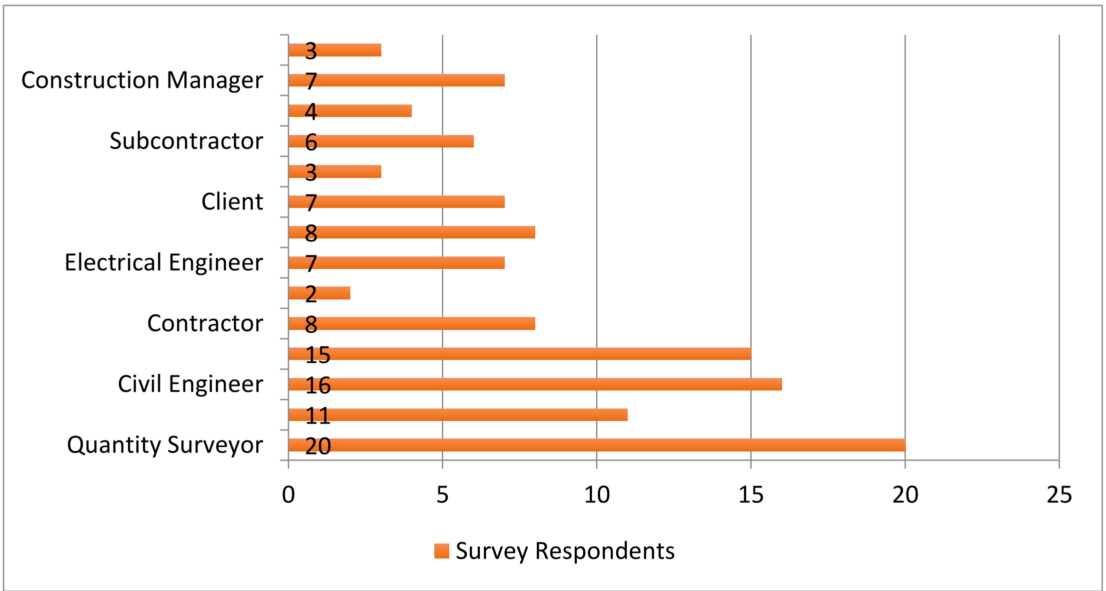


Figure 5.2 Survey respondent's distribution

5.3.3 Cost Estimating Techniques

Out of the cost estimating techniques used, 19% of the respondents claimed that they sometimes use TVD, while 22% rarely use it, and 47% have never used it before. With target costing, 21% of the respondents fully implement it, while 21% implement target costing partially, and approximately 58% do not implement it at all. In terms of the normal cost estimating techniques, it is worth noting that more than half of the respondents fully implement traditional cost planning.

5.3.4 Design Management Challenges Encountered

A high percentage of the respondents agreed that projects normally exceed time (94%) and cost targets (92%). Cost estimates are usually more than the clients can bear, leading to alterations on project scope (83%). It is difficult to obtain accuracy regarding the target cost (87%). When the estimated cost is more than the budgeted cost at the design stage, cost reduction is achieved by sacrificing scope, functionality and quality (76%). There is little interaction among designers, which results in design errors and construction rework (81%).

5.3.5 Current Design Management Practice

It was observed that the respondents' practices tend towards the traditional cost estimating practice instead of TVD, given that 98% of the respondents concur with the statement "Architects design, then other designers base their designs on the architects' design", and 90% agreed that "Architects/civil/mechanical and electrical designs are prepared, then an estimate is built up", while only 4% support the view that "A detailed estimate is always built up, then a design is made in line with the estimate". This is in opposition to the estimate design continuum that is akin to the intent of TVD. In order to examine this in more detail, the attributes of TVD that are practised and to what extent, the benchmarks and practices of TVD were employed.

5.3.6 TVD Benchmark Implementation.

i. As shown in Figure 5.3, the survey reveals that all the TVD benchmarks are applied to an extent. In particular: BM15 BM16a and B16b – (BM15 Cost estimates and basis of estimate (scope) were updated frequently, BM16a Team meetings were held frequently and BM16b project cost estimates are updated and reviewed in weekly team meetings which were open to all project team members); BM13 - Targets set as goals to spur innovation; BM11 - Costs are estimated and budgeted through collaboration with team members; BM10 - Team members come together at the same time to discuss cost, quality and schedule implications; BM8 - Relationship Contract for aligning interest; BM4c - Assessing feasibility studies by aligning Constraints; and BM2b – Clients' Project Funding Limitations Included in Business cases are frequently applied during projects.
ii. The benchmarks that are more partially implemented include BM4a and BM4b – (BM4a feasibility studies are assessed by aligning what is wanted and BM4b feasibility studies

are assessed by designing for construction) and BM2a - Business case being based on life-cycle cost and benefits from an operations model.

iii. The survey analysis suggests that the following benchmarks are not applied: BM17 – Co-location where project team members stay in the same room during design; B14 - Further Allocation of targeted cost and scope to Teams; BM12 - Use of Last Planner coordination systems; BM9a and BM9b - BM9a Cost and schedule targets cannot be exceeded, BM9b only the customer can change the target scope, quality, cost or schedule; BM7 - Team members understand the business case and stakeholder value; BM6 - Clients/customers being active and permanent members of the design team; BM3 -All key members participating in feasibility studies are not applied; BM 5a and BM 5b - BM5a Producing Detailed Schedule aligned with scope and quality is produced from feasibility studies; BM5b Producing Detailed Schedule aligned with scope and quality is produced from feasibility studies; BM1 - Client develops and evaluates business case with key project team members.

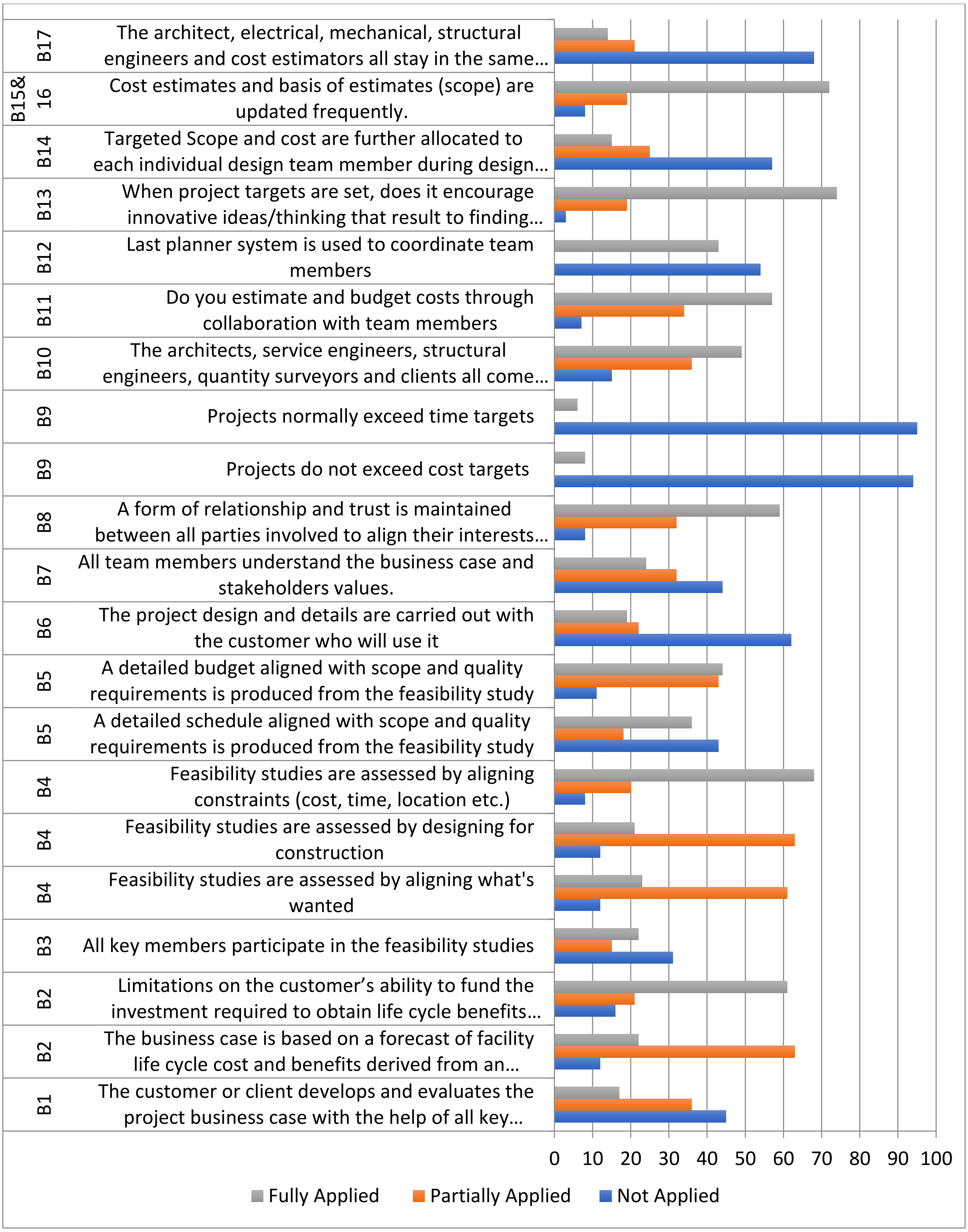


Figure 5.3 TVD benchmarks explored in the survey

5.3.7 Feasibility of TVD

More than half of the respondents feel that design, the predictability of cost, and quality standards just averagely meet the expectations of clients in terms of value for money, with room for improvement. In relation to cost predictability, 65% of the respondents strongly agreed that designing to cost will increase cost certainty. Their responses indicate that it may be possible to fully implement TVD as a high percentage of them concur that they would recommend a process aimed at increasing affordability while improving project delivery. This was also supported by the fact that most of them (95%) were willing to adopt a management practice that aims to achieve the maximum value where the set target cost is lower than the market benchmark price (TVD).

5.4 Phase 4 - Observation

This section presents the analysis and discussion of the results of the observation carried out during the fourth phase of this study. It discusses in detail the description of the projects observed, Findings of record and physical condition analysis, findings of the physical process analysis, and the findings of TVD implementation were observed.

5.4.1 Analysis and Discussions

The overview of findings of the interviews and the semi-structured questionnaire indicated some fundamental practices of TVD have not been adopted in the NCI, but a wide variety of the benchmarks appear to have been applied to a certain extent. However, most respondents recommend TVD for the NCI. This prompted the researcher to further conduct a structured observation of the projects with the aim of gaining more insight into the current design management practices adopted by the NCI in relation to the 17 TVD benchmarks and principles. This was done to identify the level of implementation of the benchmarks observed in the selected projects. The structured observation was suitable at this stage because the approach allows the researcher to record real-time evidence on current design management practices in relation to TVD in the NCI. The quality of data is enhanced by directly identifying behaviour or practice during structured observation as opposed to indirectly asking respondents about their own behaviour through a questionnaire, survey or interview (Bryman 2012). A non-participative observation was carried out as the researcher only observed the way the project activities were managed without any real dealings with the participants.

5.4.2 Description of Projects Observed

The observations were adequate in scope as they considered private and public sectors to achieve a broader viewpoint. The projects were all conducted over a time span long enough to qualify for dependable data to be captured according to the current design practice. The observations covered 13 public and private projects (see Table 5.2) through employing the document and physical condition analysis of their design management practices in relation to TVD practices and benchmarks. The access to these project documents and materials varied from one case study to another.

Table 5.2 Details of projects observed

CODE	MANAGEMENT PRACTICE	PROJECT SECTOR	PROCUREMENT ROUTE
P01	External Team	Building	Traditional Contract
P02	Internal Team	Infrastructure	Design and Build Procurement
P03	External Consultant	Building	Traditional Contract
R01	Internal Team	Building	Design and Build Procurement
R02	Internal Team	Building and Infrastructure	Design and Build Procurement
R03	Internal Team	Building	Design and Build Procurement
R04	Internal Team	Infrastructure	Design and Build Procurement
R05	Internal Team	Ancillary Work	Design and Build Procurement
R06	Internal Team	Building and Infrastructure	Design and Build Procurement
R07	Internal Team	Building and Infrastructure	Design and Build Procurement
R08	Internal Team	Building and Infrastructure	Design and Build Procurement
R09	Internal Team	Building and Infrastructure	Design and Build Procurement
R10	Internal Team	Building and Infrastructure	Design and Build Procurement

5.4.3 Findings of Record and Physical Condition Analysis

Documentary analysis was also complementary to the observation process. The researcher was involved in reviewing existing records of past design procedures, drawings, budgets, programs of work, and minutes of meetings among others. While, for the physical condition analysis, the researcher observed weekly meetings, current design management processes, planning documents, supply chain and subcontractor involvement, progress reports and the preparation of budgets comprising of bill of quantities, material and labour schedules, capital expenditures, operating expenditures, change orders, out of budget/variation and how the site was managed, tender documents, minutes of meetings, weekly work plans, and other correspondence. The information gathered from these documentary analyses were used to obtain an overview and case history of the individual projects, recording and observing how site activities were planned and controlled, without necessarily interacting with the project participants.

5.4.4 Findings of Physical Process Analysis

The last stage of the observation was the physical process analysis. The physical process provided an insight into the current design management practices within the individual projects. A survey guide was developed to ascertain how the current design management practice adopted on each project aligns with the 17 TVD benchmarks. (see Appendix 4 instrument). The instrument was based on the 17 TVD benchmarks developed at the University of Berkeley as a guide for TVD implementation, and which have been used by researchers to examine the level of its application. The 17 benchmarks were observed across all projects. During the observation, informal discussions and explanation on observations during the record and physical condition analysis were used in assessing the level of implementation on each project. Table 5.3 provides the compiled information on the seventeen TVD benchmarks observed in the 13 projects.

Table 5.3 Compiled information on the seventeen TVD benchmarks observed on the 13 projects.

		PROJECT CODE													
	TVD BENCHMARKS	P01	P02	P03	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	Mean
B1	The customer or client develops and evaluates the project business case with the help of all key project team members and decides whether to fund a feasibility study partly based on expected profit.	0.5	0	0.5	0.5	0.5	1	1	1	0.5	0	0	0.5	0.5	0.50
B2a	The business case is based on a forecast of facility life cycle cost and benefits derived from an operations model.	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.42
B2b	Limitations on the customer's ability to fund the investment required to obtain life cycle benefits are included in the business case.	0	0	0	0	0	0.5	0.5	0.5	1	1	0.5	0.5	0.5	0.38
B3	All key members participate in the feasibility studies	0	0	0.5	1	1	1	0.5	0	0	1	1	1	1	0.62
B4	Feasibility studies are assessed by aligning what's wanted, designing by construction and aligning constraints	0.5	0.5	0.5	0	0	0.5	0.5	0.5	1	1	0.5	0.5	0.5	0.50
B5a	A detailed schedule aligned with scope and quality requirements is produced from the feasibility study	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50
B5b	A detailed budget aligned with scope and quality requirements is produced from the feasibility study	1	1	1	0	0	0.5	0.5	0.5	0	1	0	0	0	0.42
B6	The project design and details are carried out with the customer who will use it	1	1	1	0	0	0	0	0	0	0	0	0	0	0.23
B7	All team members understand the business case and stakeholders' values.	0.5	1	0.5	0	0	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.42
B8	A form of relationship and trust is maintained between all parties involved to align their interests with project objectives.	1	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.62
B9a	Projects do not exceed cost targets	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
B9b	Projects normally exceed time targets	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
B10	The architects, service engineers, structural engineers, quantity surveyors and clients all come together at the same time to discuss cost, quality and schedule	0	0	0.5	0.5	0.5	1	1	1	0.5	0.5	0.5	0.5	0.5	0.54
B11	Do you estimate and budget costs through collaboration with team members	0	0	0	0.5	0.5	0	0	0	0	0	0	0	0	0.08
B12	Last planner system is used to coordinate team members	0	0	0	0	0	0.5	0.5	0.5	0	0	0	0	0	0.12
B13	When project targets are set, does it encourage innovative ideas/thinking that result to finding alternatives to achieve the target	1	1	1	0	0	0.5	0.5	0.5	0	0	0	0	0	0.35
B14	Targeted Scope and cost are further allocated to each individual design team member during design so they can design to cost.	0	0.5	0.5	0	0	1	1	1	0.5	0.5	0	0	0	0.38
B15& 16	Cost estimates and basis of estimates (scope) are updated frequently.	0	0	0	0	0	0.5	0.5	0.5	1	0	0	0	0	0.19
B17	The architect, electrical, mechanical, structural engineers and cost estimators all stay in the same room during design.	0	0	0	0	0	0.5	0.5	0.5	0	0	0	0	0	0.12
	Mean	0.34	0.37	0.39	0.24	0.18	0.50	0.47	0.45	0.29	0.37	0.24	0.26	0.26	
	P01-P03 PRIVATE DEVELOPMENT PROJECTS, R01-R10 REAL ESTATE DEVELOPMENT PROJECTS														
	Full implementation	1													
	Partial	0.5													
	Not Implemented	0													

5.5 Discussions on Findings of Implementation of TVD

Figure 5.4 provides a more visual summary of the level of implementation (as observed) of the individual benchmarks in all the projects. The observation results show that out of the 17 benchmarks observed, only 2 are applied systematically, with over 60% implementation. Most of the benchmarks are only partially applied, while some are not applied at all. The most implemented benchmarks include B3 “Participation of all key members in Feasibility Studies (62%) and B8 “Relationship Contract for aligning interest” (62%). A further six benchmarks are within 40-60% implementation in the projects observed. These include: B1 “Client develops and evaluates business case with key project team members”; B4 “Feasibility studies assessed by aligning what's wanted, designing by construction and aligning constraints”; and B5 “Producing Detailed Budget aligned with scope and quality from feasibility studies” were all applied at 50%.

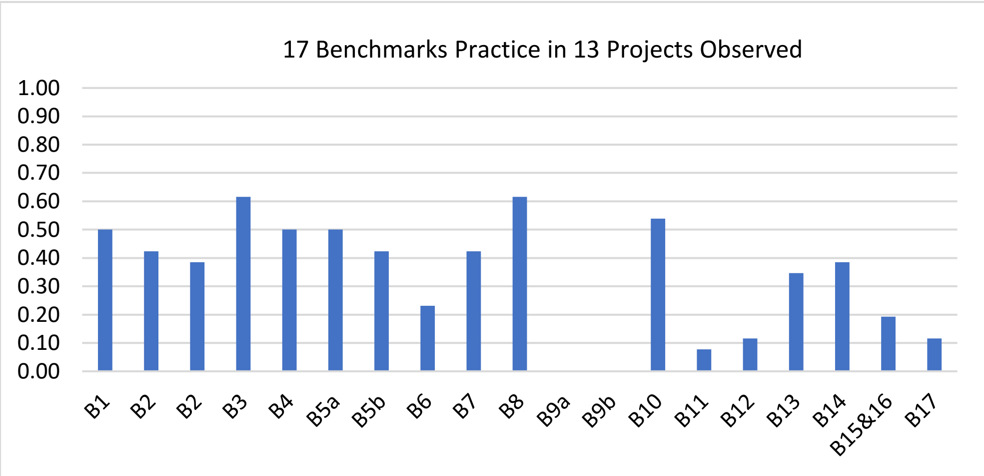


Figure 5.4 Level of implementation of the individual benchmarks on all projects as observed

The study also revealed that the end-user/clients do not take part fully in the product development phase, and value perception determination is taken up by the contractor/builder shown by the 23% implementation of B6 “Project design and details carried out with the customer who will use it”. Some of the other benchmarks with negligible application include: B11 “Budget estimates and costs done through collaboration with team members” (8%); B12 “Use of Last planner system to coordinate team members” (12%); B15 & 16 “Cost estimates and basis of estimates (scope) updated frequently” (19%) and B17 “Co-location During Design (12%)”.

Not surprisingly, the study also identified some practices that were not observed in any of the projects observed: B9 “Cost and Schedule target are not to be exceeded and only the customer can make changes in the scope, quality, cost and schedule”. All projects observed were found to normally exceed both cost and time targets (B9a & b).

Furthermore, Figure 5.5 provides a visual representation of the overall application of all TVD benchmarks observed in the individual projects. This helps in assessing how the design practices of the projects coincide with the TVD benchmarks. From the results, 3 out of 13 projects were observed to have implementation levels above 40% of the benchmarks. These are real estate low-cost housing projects, which is not surprising given that they have the highest need to reduce cost levels and be more efficient. These results corroborate some survey findings, with the design practices of respondents found to be more akin to traditional cost estimating practices (90%) with a negligible application of TVD practices.

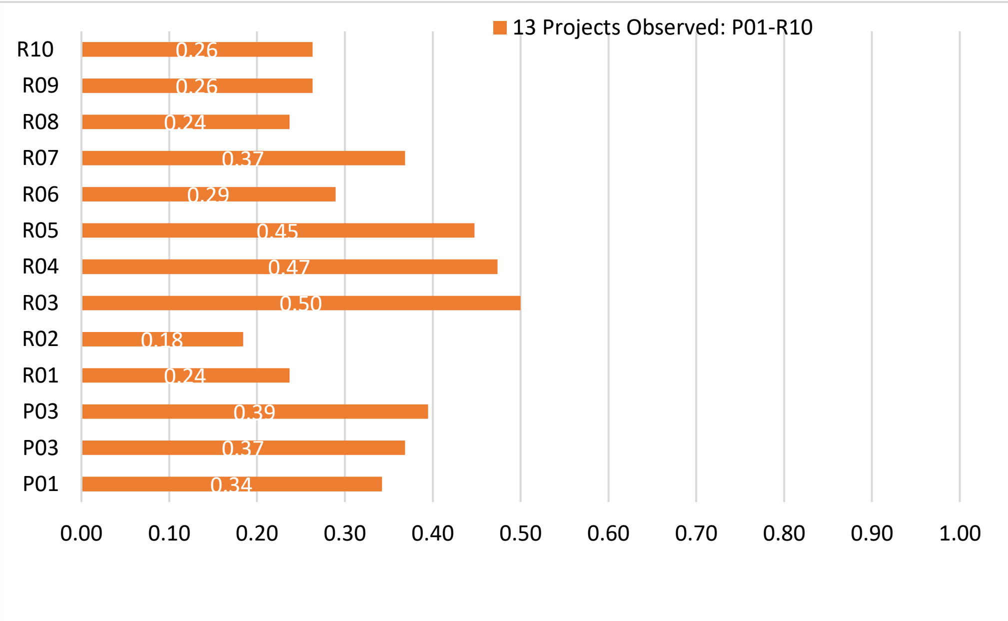


Figure 5.5 Overall application of all TVD benchmarks observed on the individual projects.

Findings of the survey indicate that most respondents felt that design, predictability of cost, and quality standards barely meet client expectations. A vast number of them were willing to adopt a management practice that aims to achieve the maximum value where the set target cost is lower than the market benchmark price (TVD).

5.6 Chapter Summary

This chapter has discussed the empirical findings from the interviews, the survey and non-participant observations conducted in order to understand the current design management practices in the NCI, awareness, practices of TVD in the NCI, cost estimating techniques, design management challenges encountered, and the feasibility of TVD implementation in the NCI.

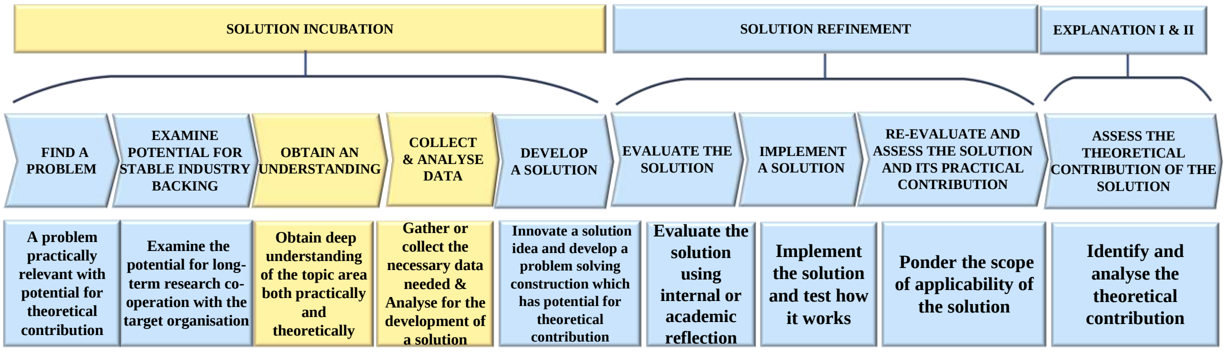
The chapter has revealed that fundamental practices of TVD have not been adopted in the NCI, but a wide variety of the benchmarks appear to have been applied to a certain extent. Most respondents recommend TVD for the NCI. The chapter has also revealed that private developers and design and build contractors apply some of the TVD benchmarks and practices to a certain extent, while government and private clients do not; this is because they face more barriers in terms of TVD practices due to the nature of the traditional procurement they generally undertake.

The chapter has shown that some interviewees challenged benchmark five, which states that the feasibility study produces a detailed budget and schedule aligned with scope and quality. It has shown some practices that might be considered TVD or have similarities with the current TVD benchmark practices have been developed, such as design and cost management, joint venture projects, target cost contracts, and procurement routes like design-build-own-transfer by private developers and contractors. But they are not complete adaptations. Generally, the chapter has established that practitioners are not aware of TVD, and only a few of the TVD benchmarks are applied consistently by projects in the NCI. Industry participants were fully convinced and showed interest in collaborating with the researcher for full implementation and adoption of TVD on projects. This view supported the application of TVD in case studies. The next chapter presents findings and discussions of the application of TVD in the case studies.

The next chapter reports the implementation of TVD benchmarks and practices on multiple case studies and records the results gotten from the survey and interviews

CHAPTER SIX

MULTIPLE CASE STUDIES ANALYSIS AND DISCUSSION



6.1 Introduction

The foregoing chapter examined the current design management practices in NCI, the awareness of TVD in the NCI and the feasibility of adopting TVD in the NCI. This chapter presents and deliberates the findings of the implementation of TVD benchmark and practices in three case studies, which involves obtaining a deep understanding of TVD practically in Nigeria. This part of the study conceptualises the problem area so that useful communication between the industry practitioners (practice) and researcher (theory) can take place. This chapter corresponds to the solution incubation stage, which is to gain an understanding and collect and analyse data steps of the DSR process. The case studies identified the benefits, barriers, impacts, level of collaboration, the influence of procurement route, conditions of success, support needed for successful implementation of TVD in NCI and levels of TVD benchmark implementation. Sections 6.3, 6.4 and 6.5 present the three case studies, the outcome of the implementation process, data generation process and detailed explanation of the findings. Section 6.6 discusses the cross-case study results and comparison. The results further validated the findings from the questionnaire survey, exploratory interviews and structured observation on the current practice. The chapter ends with the chapter summary. The general purpose of the case studies is shown in Figure 6.1.

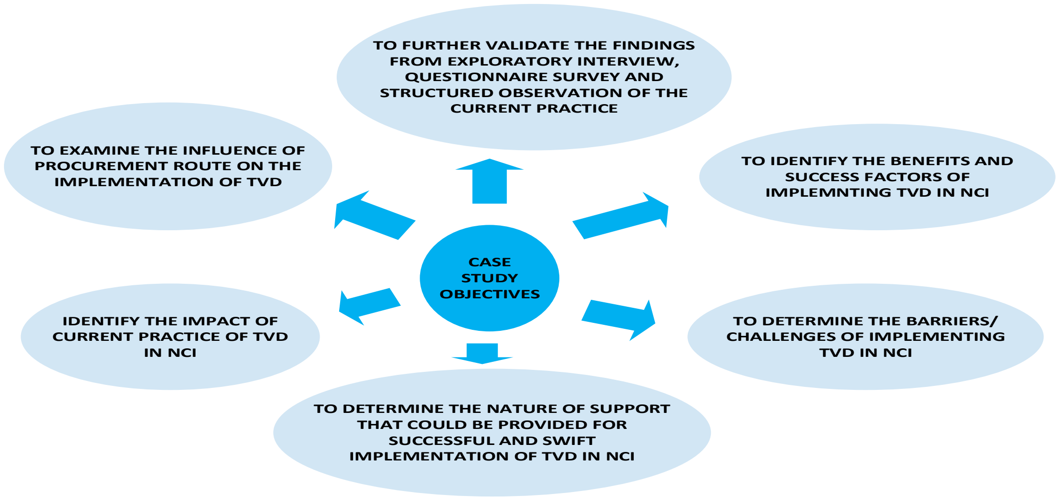


Figure 6.1 The purpose of the case studies

6.2 Phase 5: General Case Studies outline

In this chapter, three case study projects were reported. The first case study used the design and build procurement route for the construction of buildings, infrastructure and ancillary works of a housing estate. The second involves the implementation of TVD in the design stage of a filling station project using the traditional procurement route. The third case study involves the construction of a public fire station using the traditional procurement route. In addition to the rationale for conducting the exploratory interviews, questionnaire survey and observations discussed in chapter six, the case studies attempt to obtain a comprehensive understanding of the physical project setting which could not be addressed extensively during the exploratory interviews, questionnaire survey and observations previously carried out. Data was collected through questionnaire surveys, interview, unstructured observation and document analysis. (see Appendix 5 for case study participation consent agreement)

6.3 Case study one: Description of Case Study Project (CS-01)

6.3.1 Case Background

The case study was carried out in Abuja, the north-central region of Nigeria. The project is the development of a self-sufficient and affordable city on 72 hectares, composed of 3,500 units of various affordable house types; infrastructure covering a 7km dual carriage road with culverts and street lights to connect with the existing road network to provide access way for vehicles, improve safety of movement in the night and to shorten the distance from the central area; 10km internal roads; sewer and stormwater drainages and ancillary works covering 24 hour external electrical power supply from mains to feeder pillars with dedicated transformers; 24 hour intelligent real-time CCTV monitoring. It also includes fully independent external water recirculation from mains to buildings, external septic treatment plants facility, perimeter fences, towers and gatehouses. The commercial area includes recreational sports areas, theme parks, schools, a mall with cinemas, restaurants and shopping facilities. The project details are stated in Table 6.1

The contract was a joint venture partnership between the landowner and the developer. The developer is one of Nigeria's leading real estate private developers with over 4,500 units of houses delivered and 3,500 under various phases of construction.

Table 6.1 The project details

CLIENT:	**PRIVATE REAL ESTATE PROPERTY DEVELOPER**
Building Project:	Affordable and luxury residential new build. One and two floors of different building types.
Infrastructure:	7km dual carriage road with culverts and streetlight, 10km internal roads, external electrical power supply, water supply etc.
Ancillary:	External septic treatment plants, perimeter fences, tower.
Stage of the project:	Phase 1 to semi-finished stage
Floor area:	9,290.30 square metre
Trades on the project:	Over 150 trades on the project
Procurement route:	Design, Build and Transfer
Duration of the project:	14 months
TVD Applied:	Project initiation of the budget to semi-finished

The company's roots are in the design and building of high-end and affordable residential as well as commercial properties. The company has extended its core competencies to six specialities:

a) Infrastructure
b) Affordable Housing
c) Luxury Housing
d) Hotels and Luxury Serviced Apartments
e) Commercial trading markets
f) Facility Management

The project is divided into phases. This case study only concentrated on part of the first phase budget which included design and construction of about 640 units of the 3500 units of homes, infrastructure and ancillary works from project initiations to semi-finish. The project was conceived in 2016 with the developer having some concept designs and budget and had developed a business plan based on previous experience. When the company realised that the cost was more than it could afford and the time initially planned had elapsed while the sample houses were still at the foundation stage, the researcher was engaged and he came up with a full reassessment of the project in late 2016 starting with the business case, redesign of product and process then proceeded to the construction of the project.

6.3.2 Application of TVD

The company bought in and agreed to apply TVD after the researcher who served as the facilitator presented the previous successes of TVD from other projects to the board of directors in January 2017. The need for TVD was established which was to deliver the project within a set of targets so that the company's anticipated targets could be met. Already end-users and investors had paid for houses and an economic recession hit Nigeria leading to fluctuating prices for materials and transportation.

Observation

Record and physical condition analysis were carried out to ascertain how the organisation's practice differs from TVD practices; this was done to align the two practices. For document analysis, documents such as company policy documents, business plan, concept designs, budget, program of work etc. were reviewed. For physical condition analysis, the researcher observed weekly meeting, business case, feasibility study, contractual structure, incentive schemes, progress reports, training and simulation and all the processes in implementing TVD, all with are discussed in subsequent sections.

6.3.2.1 Project Initiation Stage:

6.3.2.1.1 Business Case

The reassessment of the project started with identifying key stakeholders, who then developed and validated the business case. The team worked face-to-face in a big room called the project management office (PMO) to determine the allowable cost of the project. The source of funding and the market selling price of the units were investigated and pegged as the benchmark. The project site is located about 7 km from the closest settlement, it had only rural pathways and no existing infrastructure provided by the government. All these parameters were assessed against the return on investment which initiated the strategy used. Although the results were not looking good, the company commenced feasibility studies because of its commitment to end-users.

6.3.2.2 Project Planning Stage

6.3.2.2.1 Feasibility Study

A. Contractual Structure

TVD was introduced in the project/organisation policy and adhering to the benchmarks was one of the conditions for working on the project for all staff, contractors, sub-contractors and suppliers. During the interview and orientation of new staff the company policy was handed over to them. The foremen oriented the daily one-off workers on the new policy under the supervision team heads and supervisors, this was done because the project was mostly a direct labour project with a few sub-contractors. The procurement route for the project is to design and build.

The motivation for the project was discussed and agreed on with the senior management. A pain/gain sharing formula was developed for five mid-level managers who are departmental project managers and heads of departments during construction. These include the project coordinator, building/ancillary project manager building, site manager, procurement head and infrastructure project manager. A one-off motivation payment for selected some staff was made; the beneficiaries include design team members, store heads, procurement staff, quality monitoring staffs, securities, site supervisors. The fee was set to ₦25 million (USD 69,444) in total. But after the first round of the payment, other staff who were not part of the incentive were demoralised. The pain/gain sharing formula is shown in Figure 6.2 and 6.3.

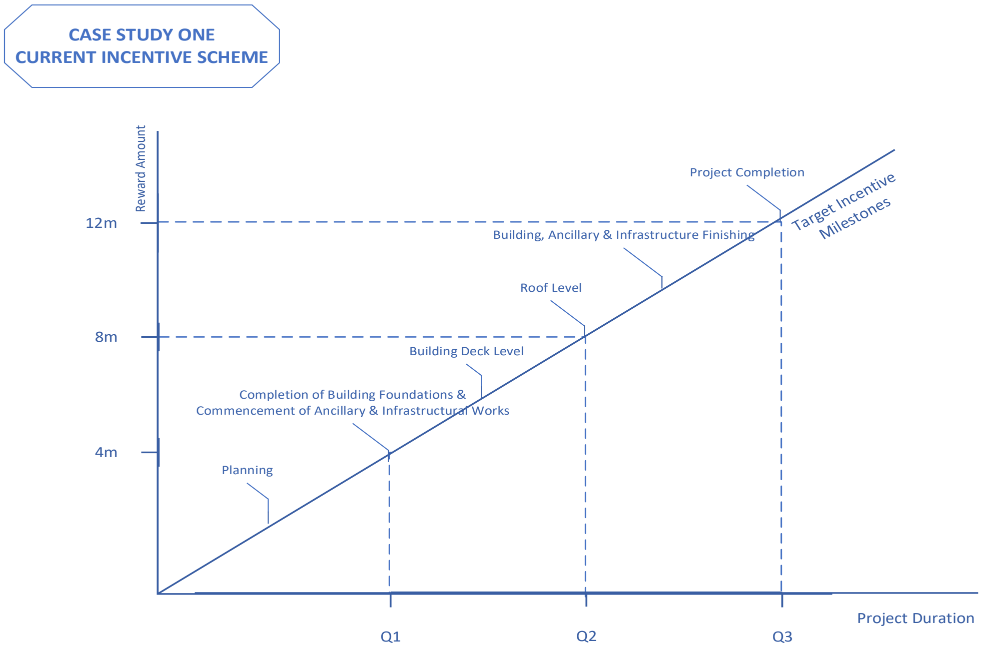


Figure 6.2 Incentive scheme of the for CS-01

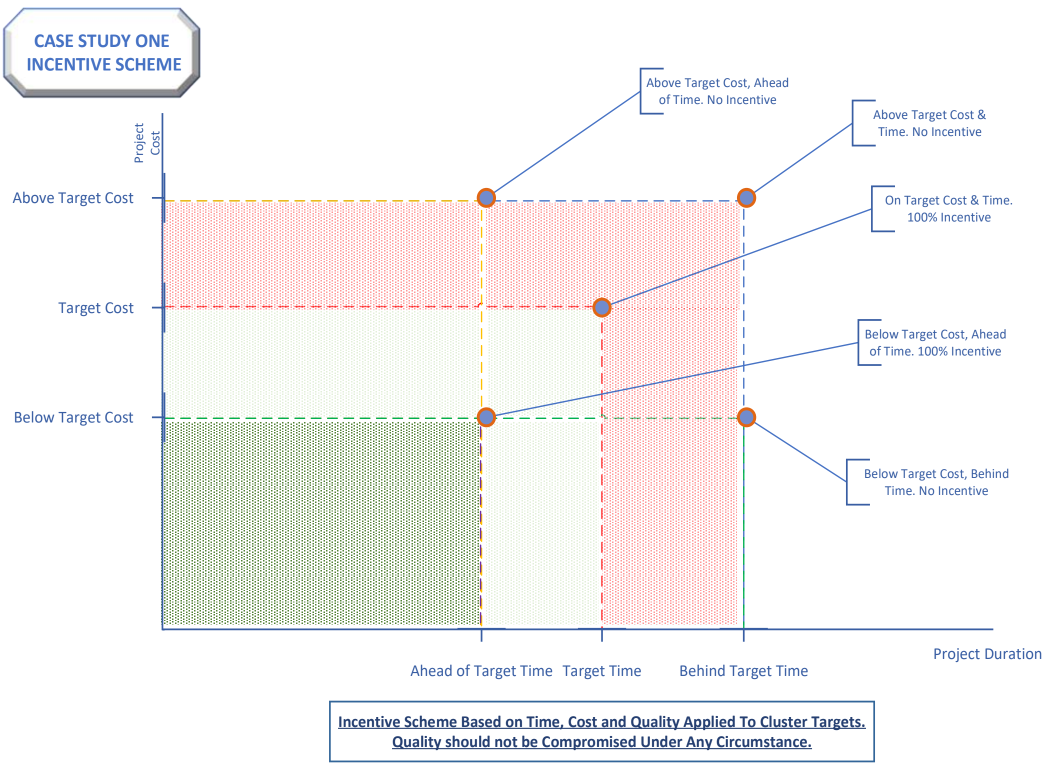


Figure 6.3 Incentive scheme of the for CS-01

B. Selection of Integrated team

During the concept design, the developer had a central design and monitoring team located in the same big room called the PMO which handled all its projects. Because the central team was moving from one project site to the other, a separate dedicated team was selected and dedicated for this case study project. The board appointed a senior management team comprising of the project director (the researcher), the executive director technical (EDT) and the assistant general manager (AGM), the senior management based on certain selection criteria, selected the other design team members from the PMO staff. The senior management observed that the constituted team lacked some expertise like the infrastructural civil engineer, mechanical and electrical engineers; these were outsourced and coopted to be part of the team. Also, the team heads of the execution team, specialist contractors and suppliers were part of the team. Roles and joint responsibilities and transparency were specified.

C. TVD Training/Workshop and Simulation

TVD training was carried out in form of a workshop, and a simulation exercise; the workshop was conducted on February 2017 at the beginning of the design stage while the simulation was conducted in April 2017 before the commencement of the execution stage. Both were facilitated by the researcher. The workshop lasted for about an hour with presentation and question sessions (see Appendix 11 for a sample of the simulation training slides and Appendix 13 for a sample of TVD Workshop/Training slides). Orientations were conducted for new employees and sub-contractors; each member was given the hard copy of the workshop slides to study and a soft copy was posted on the project's WhatsApp group.

TVD Simulation Game that includes measuring collaborative practice:

Recently, there has been an increase in the creation, re-invention and use of simulations and serious games to illustrate/teach lean principles to project team stakeholders encountering them for the first time. This approach can enhance learning in an applied setting (Rybkowski, 2017; Pollesch et al., 2017). Based on this fact, the TVD simulation game was developed by Munankami (2012) in Texas A & M University. The game uses the same concepts of Peter Skillman and Tom Wujec's "Marshmallow Challenge" but applies TVD processes (Ebbs 2015). The TVD Simulation Game was an exploratory study aimed at understanding the mindset and attitude of construction practitioners and teaching participants collaboration in construction through a simulation game. The live simulation was conducted in the big room at the PMO site office. It was introduced to facilitate an experiential "lightbulb moment" among construction participants, that is often more vivid than an instructional lecture alone (Rybkowski and Kahler 2014; Smith and Rybkowski 2013).

Rybkowski et al. (2016) describes the process of playing one such game they had created, noting that two versions of the simulation had been developed, both of which illustrated the basics of collaborative cost savings using TVD. At the end of the two rounds involved in this game, the participants were asked to complete questionnaires on their experiences whilst playing. Some of the questions were on collaborative innovation and decision-making, open communication, mutual respect and trust. Also, during the post-simulation discussions, the facilitator asked questions like; How did the decision-making process differ between the two rounds? And Which round offered better cooperation?

Rybkowski et al. (2016), who tested the TVD simulation game on students and professionals, stated that most of them reported that it effectively illustrated and taught TVD. They also advocated for additional testing of the simulation in projects. Since its development, the simulation has been tested at Texas A&M University's department of construction sciences courses in lean construction. Other researchers that have used the game include; Carolina Asensio Oliva in 2014, the University of Campinas Brazil; the Associated Schools of Construction Conferences, College Station, TX in 2015; and in Germany by Tobias Guller (lean consultant), who requested instructions from the laboratory and translated them into German, ; and the Centre for Lean Projects 4th Annual Research Showcase, Nottingham Trent University in 2019, where the mood of the participants were reported after both rounds of the simulation.

A review of the literature on the testing and application of the simulation reveals that the it places emphasis on collaboration and cooperation. For example, Munankami (2012) noted that the game was effective when tested; however, he suggested that the designers, owner and contractors should be separated in the first round to help participants to think about the value of cooperation during the discussion. Furthermore, he maintained that some terms should be explained properly to the participants.

Ebbs (2015) tested the simulation at a Boise State University workshop to prepare 30 practising professionals for the application of TVD on an actual project. He noted that the game illustrated cooperation, competition, team building, collaboration, creativity, innovation and design within budget constraints. Some of his outcomes are: seeing the difference between the old ways of silo “napkin sketch” thinking versus getting a greater project understanding by collaborating first; collaboration and communication are required between departments to see a way of making something better; experience should be combined for more informed decision-making. The review of the testing of the simulation game indicated how collaboration is a vital aspect of the game in that it illustrates how participants are to act during TVD. The literature reviewed further shows that the various studies available have not highlighted the interrelationship between cooperation, collaboration, coordination, coalition and networking during the pre-implementation as collaboration is discussed at the post-implementation discussion after round two. They also do not report the findings of other simulations involving encountering steering design to target cost, thus showing the iterative aspect of re-designing to a set of targets. This training strategy, using the TVD simulations, seeks to:

a. Identify the differences between environments with cooperation (round 1) and with collaboration (round 2)
b. Emphasize the need for collaboration by discussing the interrelationship between collaboration, cooperation, networking, coalition and coordination.
c. Illustrate the iterative designing and re-designing to set targets encountered during the TVD process

The 50-minute version of the game was selected in this study. Instructions for the simulation and the spreadsheet for recording the cost were requested from and sent by Zofia Rybkowski of the Texas A & M University. The study used 24 staff members (industry stakeholders) of the CS-01 company. The game was conducted during the workshop and training exercise at the initiation phase of the project embarked on by the company. The game created an environment to introduce TVD to construction practitioners with partial or no prior understanding of TVD. A presentation was made by the researcher to the participants prior to starting the game using the presentation slide sent from Texas A & M University as a training module/instruction of the TVD game simulation. The module stipulated the materials to be used in the simulation and the concepts of estimated cost, market cost, allowable cost and target cost. A spreadsheet of costs was projected on the wall by the facilitator. Figure 6.4 shows the key longitudinal costing milestones of TVD while Figure 6.5 shows the materials needed for the simulation game.

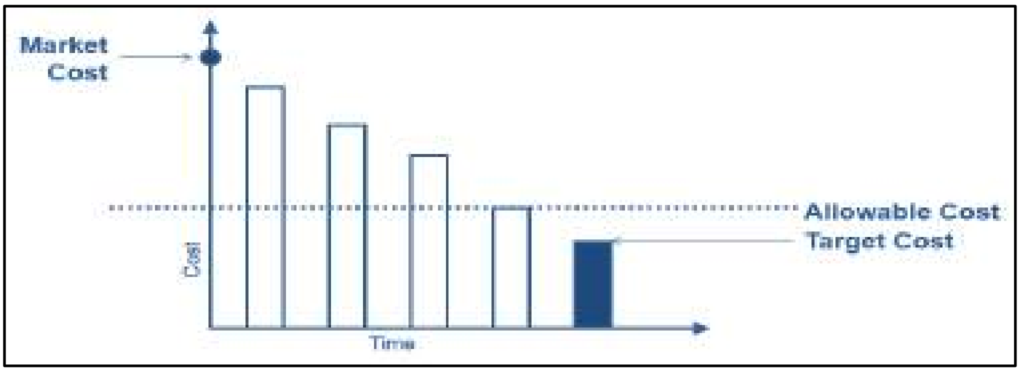


Figure 6.4 Key longitudinal costing milestones of TVD

Source: Adapted from Rybkowski (2009).

Figure 6.5 Materials required for simulation

Simulation Rounds: Two rounds of the simulation were done. Round 1 simulates traditional design-bid-build (DBB) processes while Round 2 simulates TVD processes. The simulation requires four teams, each comprised of three groups of customers, designers and constructors to build a tabletop tower with a marshmallow on top in each 15-20 min round following requirements.

Round 1: The team members worked separately in different areas to design, owner approves, and the towers were constructed without regard for cost during the design process. Figure 6.6 shows the Round 1 tabletop towers constructed.

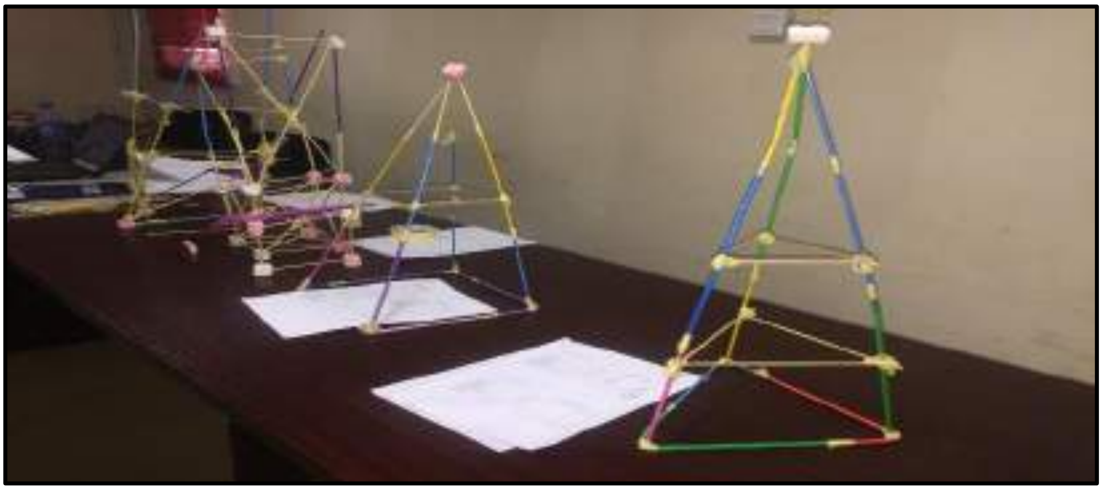


Figure 6.6 Round 1 tabletop towers

Costing: Costs are calculated only after the tower was completed, and teams were given a costing sheet as seen in Table 6.2. The following were calculated: market cost (average of Round 1 towers = ₦122.38, approximately 0.34 USD); allowable cost (20% less than market cost = ₦97.90, approximately 0.27 USD); target cost (average declared by teams as a stretch goal and should be lower than allowable cost = ₦86.75, approximately 0.24 USD).

Table 6.2 Round one; Establishing Target Cost

			Team Abuja		Team Lagos		Team Port Harcourt		Team Ibadan	
Materials	Unit cost	Unit cost	Units	Subtotal	Units	Subtotal	Units	Subtotal	Units	Subtotal
Spaghetti sticks	₦1.00	$0.0028	13	$0.0364	0	-	0	-	0	-
Coffee stirrers	₦5.00	$0.0140	4	$0.0560	0	-	3	$0.0420	4	$0.0560
Drinking straws	₦2.00	$0.0056	12	$0.0672	0	$0.0448	12	$0.0672	12	$0.0672
Bamboo skewers	₦3.00	$0.0084	12	$0.1008	8	$0.0896	15	$0.1260	12	$0.1008
Masking Tape	₦0.50	$0.0014	22	$0.0308	44	$0.0252	18	$0.0252	22	$0.0308
Subtotal				$0.2912		$0.1596		$0.2604		$0.2548
Profit				$0.0291		$0.0160		$0.0260		$0.0255
Total				$0.3203		$0.1756		$0.2864		$0.2803
Market cost (= ave. 20% of all towers)				$0.3427						
Allowable cost (= 20% < Market cost)				$0.2741						
Teams declared target cost (< allowable)				$0.2520		$0.2492		$0.2380		$0.2324
Target Cost (= ave. of all declared TCs)				$0.2429						

After the 1st round one, the facilitator asked the teams if they had collaborated and how they had. They assented that they collaborated by providing information to team members and they made all decisions within their fellow groups only e.g. the architects made all decisions among themselves for all design issues. The researcher then informed the teams that they were only cooperating but not collaborating. He noted that 'cooperation' has been wrongly used to mean 'collaboration' which has led to non-achievement of some so-called collaborative efforts. He noted that all team members including all disciplines should belong to one system, there should be frequent communication characterised by mutual trust and consensus is reached in all decisions by all stakeholders.

He then went further to give the participants talk on cooperation, coordination, networking, coalition and collaboration. He emphasised that a team can attempt to cooperate, or coordinate but are not actually collaborating. The differences between cooperation, coordinating, coalition, networking and collaboration were highlighted to the teams. The talk was in preparation for the second round.

Round 2: In the second round, designs, approval and construction were done collaboratively with all team members, with the aim of designing to target cost. teams (Abuja and Lagos) exceeded the cost target of ₦ 86.75 (approximately 0.2429 USD) (see Table 6.3).

Table 6.3 Round two calculated design cost for all teams

		Team Abuja		**Team Lagos**		**Team Port Harcourt**		**Team Ibadan**	
Materials	Unit cost	Units	Subtotal $	Units	Subtotal $	Units	Subtotal $	Units	Subtotal $
Spaghetti sticks	$0.0028	0	-	-	-	-	-	-	-
Coffee stirrers	$0.0140	0	-	-	-	-	-	-	-
Drinking straws	$0.0056	19	$0.1064	6	$0.0336	-		3	$0.0168
Bamboo skewers	$0.0084	13	$0.1092	21	$0.1764	15	$0.1260	12	$0.1008
Masking Tape	$0.0014	6	$0.0084	10	$0.0140	10	$0.0140	3	$0.0042
Subtotal			$0.2240		$0.2240		$0.1400		$0.1218
Profit (10%)			$0.0224		$0.0224		$0.0140		$0.0122
TOTAL			$0.2464		$0.2464		$0.1540		$0.1340

A second attempt was carried out to redesign to cost by the teams that exceeded the target cost with the hope of strategizing to achieve the target cost. Cost less than the target cost were achieved at the second attempt after brainstorming sessions and value engineering were conducted to redesign to target cost without affecting function, quality and time. Table

6.4 shows the costing of designs redone to target cost. Figure 6.7 and 6.8 show the Round 2 towers constructed redone to target cost

Table 6.4 Costing redone after the iterative redesign to target cost

		Team Abuja		**Team Lagos**	
Materials	Unit cost	Units	Subtotal	Units	Subtotal
Spaghetti sticks	$0.0028	0	-	0	-
Coffee stirrers	$0.0140	0	-	0	-
Drinking straws	$0.0056	15	$0.0840	6	$0.0336
Bamboo skewers	$0.0084	12	$0.1008	16	$0.1344
Masking Tape	$0.0014	8	$0.0112	8	$0.0112
Subtotal			$0.1960		$0.1792
Profit (10%)			$0.0196		$0.0179
TOTAL			$0.2156		$0.1971

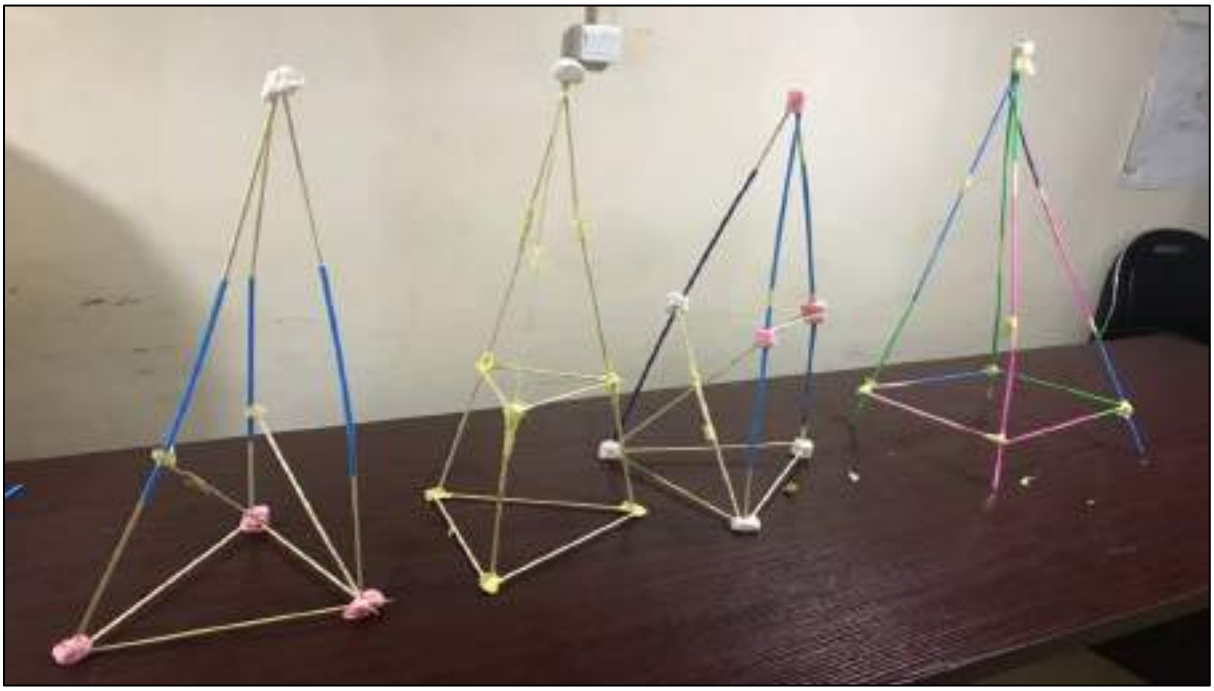


Figure 6.7 The round 2 towers constructed redone to target cost

Figure 6.8 The round 2 collaborative construction of the towers constructed to target cost

Findings of Post Simulation Interview

The facilitator conducted interviews and surveys for the participants of the game to assess their experience playing the simulation and its effectiveness with respect to factors such as mutual respect, trust, mutual benefit and reward among others. The participants were asked the following questions:

- What were some basic differences between two rounds?
- How did the decision-making processes differ between the two rounds?
- Which round was more stressful to you?
- Which round offered better cooperation?
- In which real-life circumstances might Round 1 be more appropriate? How about Round 2?
- What types of contractual arrangements and policies do you think would motivate better performance if Round 2 were an actual project?
- How might these processes be applied to your real-life projects?

Question a: What were the basic differences between the two rounds?

The respondents' collective answers reveal that less time was spent in the second round compared to the first round because of the collaborative working of the team. The teams understood the scope of work before execution in the second round compared to the first round. The game demonstrated the merits and demerits of the typical traditional DBB and the collaborative working in TVD processes.

Question b: How did the decision-making processes differ between the two rounds?

The participants noted that all decisions were made independently during the first round but in the second-round consensus was reached on all decisions, this shows that in the first round, the teams were just cooperating while in the second ideas were put together collaboratively.

The first round was considered more stressful by the participants.

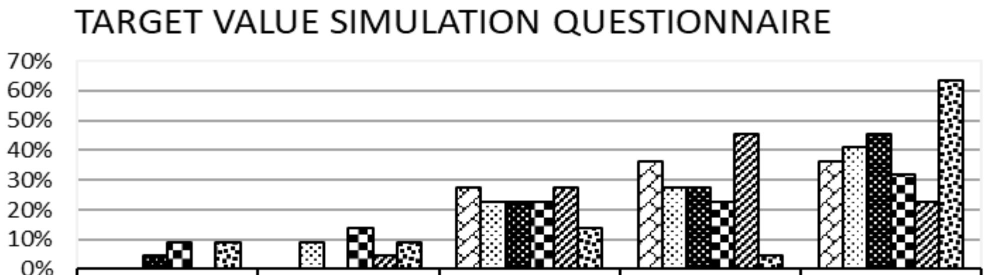
Question c: In which real-life circumstances might Round 1 or 2 be more appropriate?

The participants noted that the traditional DBB process would be appropriate in a case where there is a time limitation but with enough funds. While TVD process is suitable for when a client desires to get the best in design and aesthetics. It will also be appropriate when there is a paucity of funds and a target cost. They advocated for the use of TVD when a client intends to achieve the very best and obtain the maximum value of the project

Question d: How did the communication processes differ between the two rounds?

During the first round, there was more informal communication while in the second round there was more formal frequent communication characterised by mutual trust

The analysis of the questionnaire is shown in Figure 6.9.



	Not Effective	Somewhat effective	Effective	Very Effective	Extremely effective
Q(a)	0%	0%	27%	36%	36%
Q(b)	0%	9%	23%	27%	41%
Q(c)	5%	0%	23%	27%	45%
Q(d)	9%	14%	23%	23%	32%
Q(e)	0%	5%	27%	45%	23%
Q(f)	9%	9%	14%	5%	64%

Figure 6.9 Graph of response from 22 respondents

Most of the respondents agreed that the simulation game was very effective in demonstrating mutual respect and trust, collaborative innovation and decision-making, early involvement of key partners, early goal definition and open communication. Work environments characterised by collaboration is more enjoyable to work in and work takes little time when compared to the environment without collaboration. The study also illustrated the iterative redesigning to a set target in a scenario when initial targets have been exceeded. The TVD simulation game has demonstrated to be effective in teaching the principles and practices of TVD to first time users. The traditional design-bid-Build contracts are suitable for projects where collaborative practices cannot be adopted and when costing is done after designs have been completed, while the TVD approach is suitable for projects with a predetermined and benchmarked budget that must be designed to and not exceeded.

There is a need to conduct discussions on the different levels of collaboration preferably before the commencement of the second round; this is to enable participants to have a better understanding of the various concepts and how to apply them on projects. Also, before the commencement of the game, the specification of the tower to be constructed like the quality, height, and width should be properly stated, otherwise participants may reduce the scope to reduce the cost especially in round two. The inclusion of the TVD Simulation Game in training and workshops for project team before the commencement of construction projects is recommended since it has demonstrated to be a more simple and practical method of understanding collaboration and TVD practices.

D. Stakeholder and Project Value

The team collected project requirements from internal and external stakeholders by identifying their most desirable value to align it with the design. In order to achieve stakeholder value, which is one of the early steps of TVD process, a card game was introduced. This card was chosen because it has been used successfully on similar projects by De Melo (2015) and Oliver et al., (2016)

Card Game

A card game developed by Kowaltowski et al., (2006) to determine customer value was adopted and implemented in this case study. Target value design is about delivering the desired value to a client/end-user, the game was designed to investigate the desired (perceived) values of the client in case study CS-01. The card game was divided into five suits of value attributes, each suit represented a value perspective namely: financial aspects, cultural values, indoor environmental quality, spatial qualities, and socio-cultural perceptions (Kowaltowski and Granja 2011). The first four suits contained five cards each while the last suit contained six cards depicting six value attributes (A total of 26 cards in all).

The stated preference technique was applied to three study groups, which included fifteen (15) potential buyers and/homeowners: ten (10) facility management team members and seven (7) senior design team members of the project. The game was played in two cycles; the first cycle consists of five rounds while the second cycle consists of one round.

First Cycle

This cycle consisted of five rounds, one for each category (suit), so that the interviewee hierarchised their preferences of the items that made up each category. The cards were composed of user priorities within each category; the users ranked their priorities among all cards in each suit.

Second Cycle (Round 6)

This round is designed to establish the most important value in the five selected cards in the first cycle. This round was applied with the first cards of each suit selected by the user. The user was required to rank the most preferred cards selected in the first cycle (Rounds 1 to 5). Figure 6.10 shows a participant playing the card game.

Figure 6.10 A participant playing the card game

Analysis of card game

The analysis of the data of the declared preference technique was performed by calculating the General Importance Index (IGI) or Relative Importance Index (RII) for each card, within the categories, for the first five rounds and afterwards of all the cards for the sixth round. The calculation was done using the formula for calculating the Relative Importance Index (RII);

…Equation 2

Where w, is the weighting given to each factor by the respondents, ranging from 1 to 5. For example, n_1 = number of respondents for little importance, $n_{2=}$ number of respondents for some importance, n_3 = number of respondents for quite important, n_4 = number of respondents for important and n_5 = number of respondents for very important. A is the highest weight (5 in the study) and N is the total number of respondents. The relative important index ranges from 0 to 1 (Le and Tam 2007).

From the card game analysis, the most important value attributes for the study population are security (0.89), size of rooms (0.82), safety (0.82), financing and rent instalments (0.81), landscaping & green areas (0.8), and finishing quality (0.78). Detailed results indicated that homeowners (0.81) and the design team (0.94) considered security as the most desired value attribute. However, the facility management team on the contrary choose financing and payment instalment plans as the most important factors at (0.94). The least desired value attributes by the three study groups include; parking areas (0.42), community centres (0.41), more rooms (0.40) and business opportunities (0.37). Find card game instructions at Appendix 12. Figures 6.11, 6.12, 6.13, 6.14, 6.15 and 6.16 show the findings of the card game.

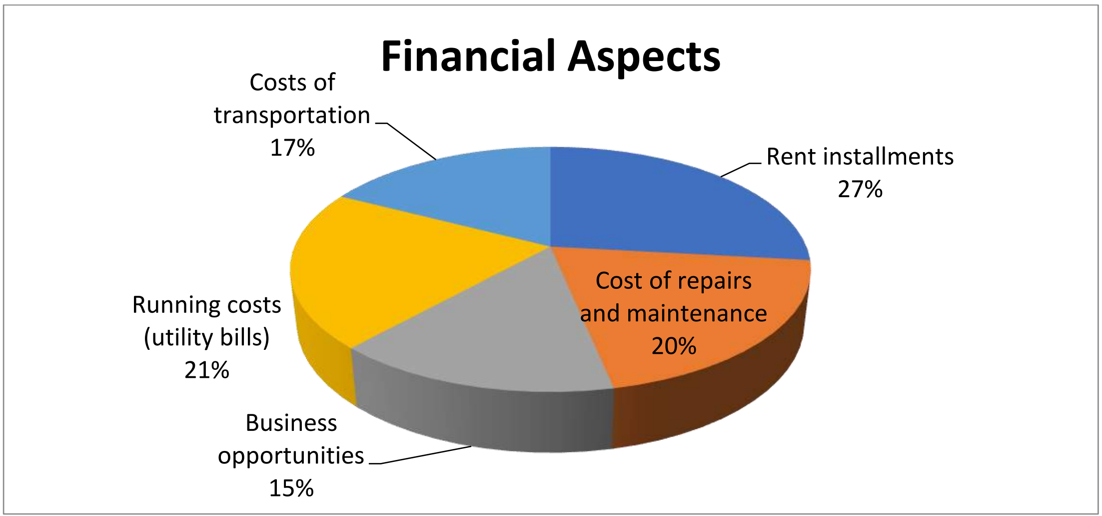


Figure 6.11 Showing the most desired value in the financial aspect suit

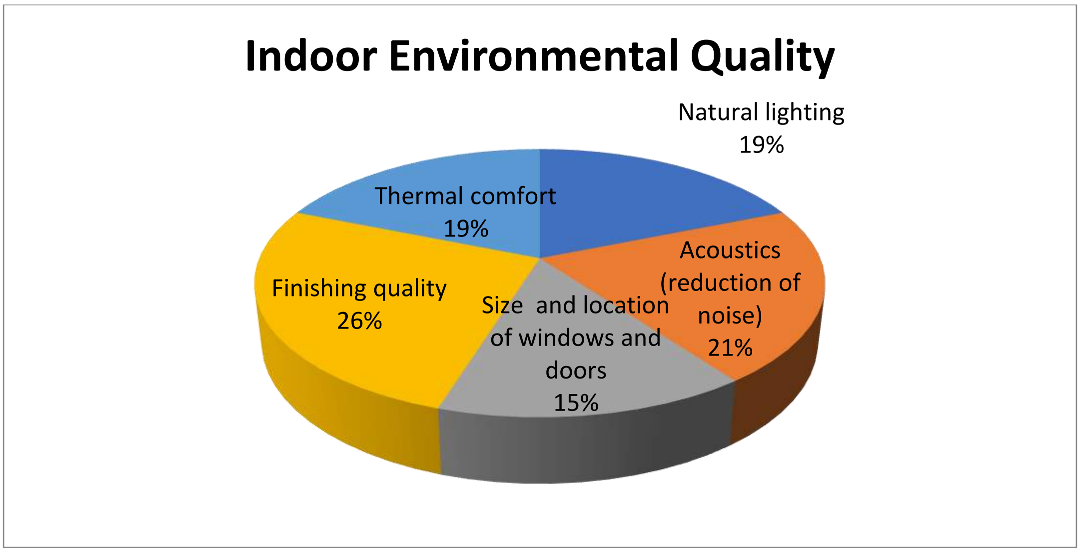


Figure 6.12 Showing the most desired value in the indoor environmental quality

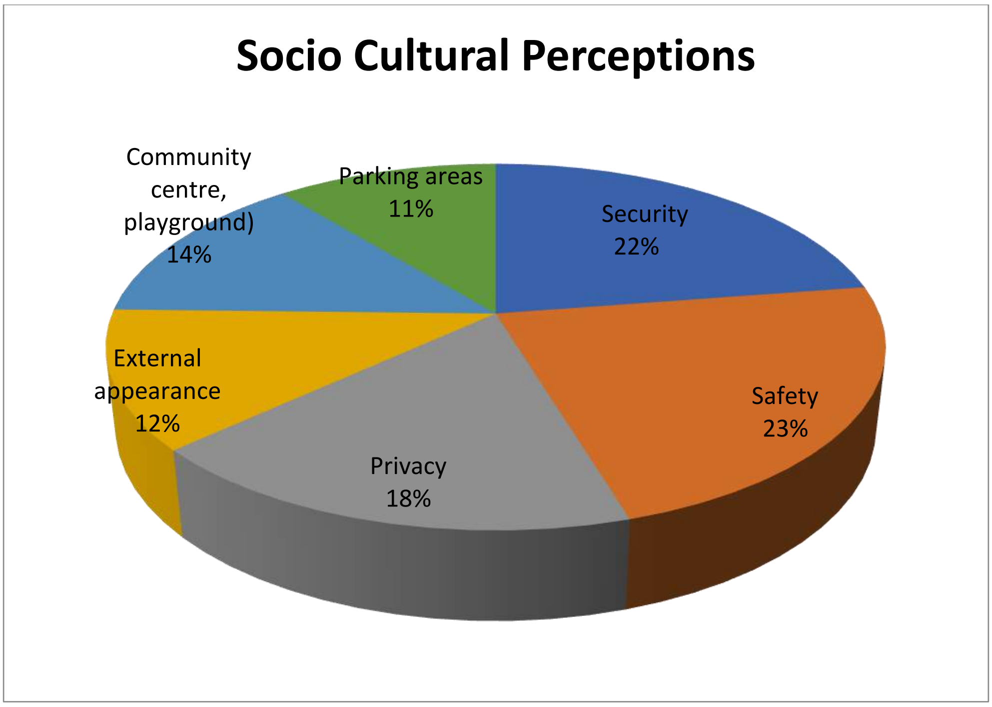


Figure 6.13 Showing the most desired value in the socio-cultural perceptions

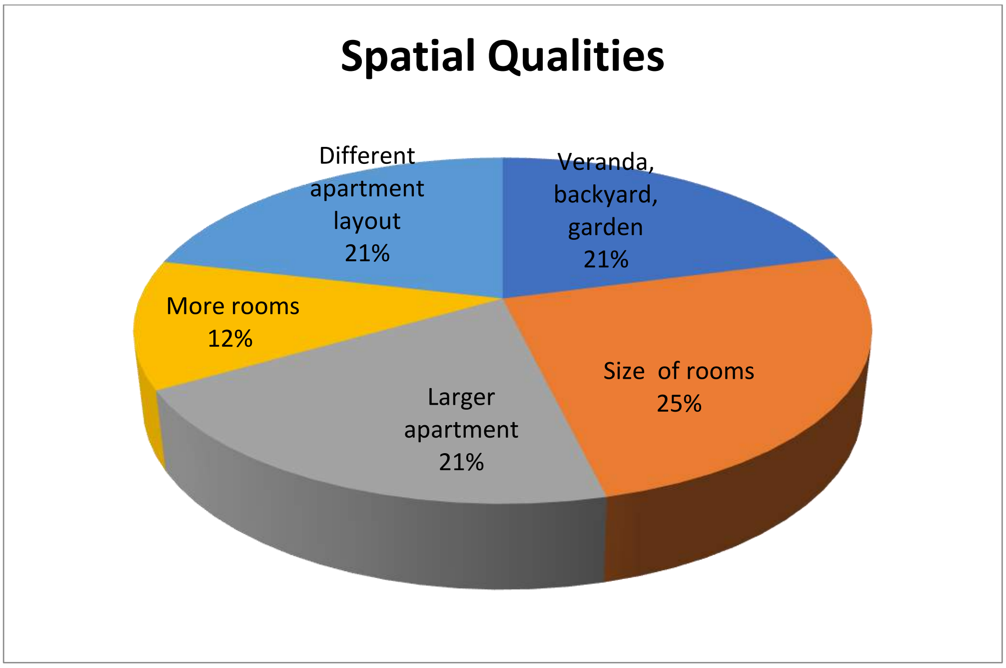


Figure 6.14 Showing the most desired value in the spatial quality suit

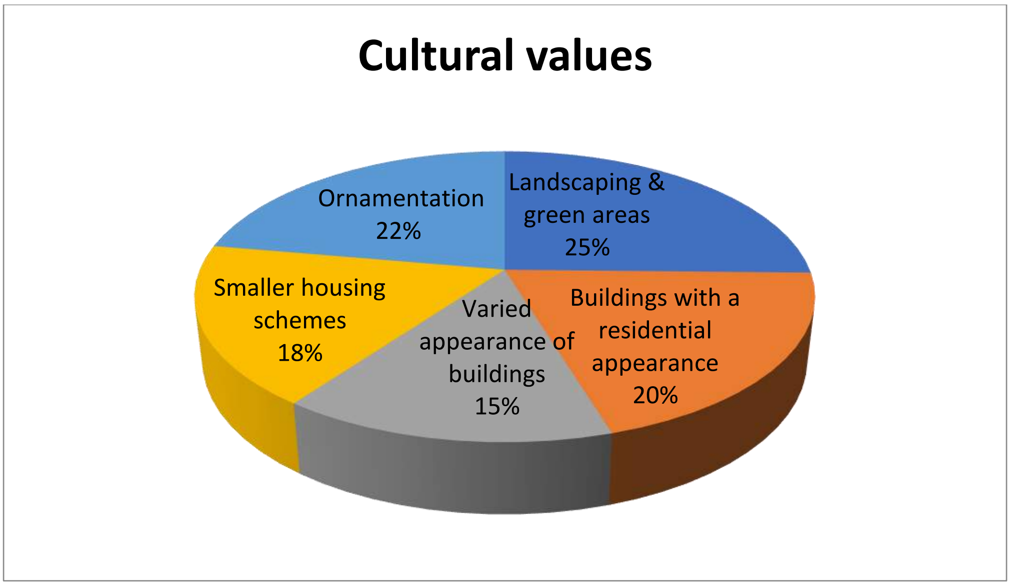


Figure 6.15 Showing the most desired value in the cultural values suit

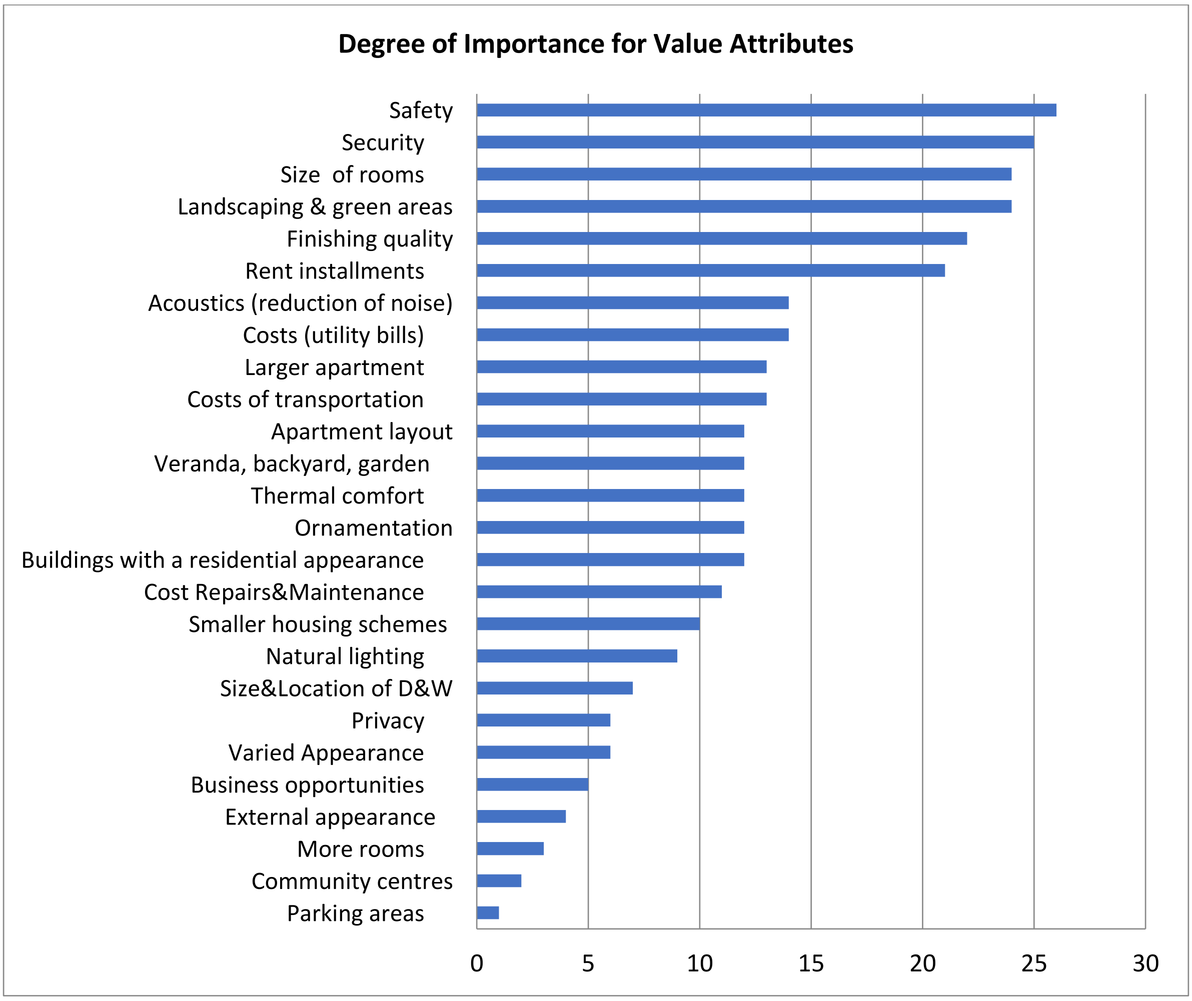


Figure 6.16 Showing the degree of importance for the value attributes

E. Target Setting

i. Setting Cost

The project team came up with an initial estimated cost (product-level target costing) of over N2.3 Billion (USD 6.39 Million). The team together with the president of the company set a target cost of over ₦1.3 Billion (USD 3.6Million) for the project while considering the company's selling price, profits and overheads. This was done during the budget request meeting where all items of the estimated cost were presented to the board for defence. The target cost was set below the market benchmark price so that the project would remain viable based on the outcome and parameters of the business case.

The board informed the project team of the available funds, the project director and the team believed that they had no option but to work in an integrated and collaborative manner to deliver the design of the product and process to targets within the requirement of the project without compromising scope, quality and functionality. The gap between the estimated and target cost was over ₦1.07 Billion (USD 2.97 Million) the gap was about 59.5% of the target cost. The team went back to the table to come up with new innovative strategies to reduce the expected cost. Figure 6.17 shows the cost model for the project.

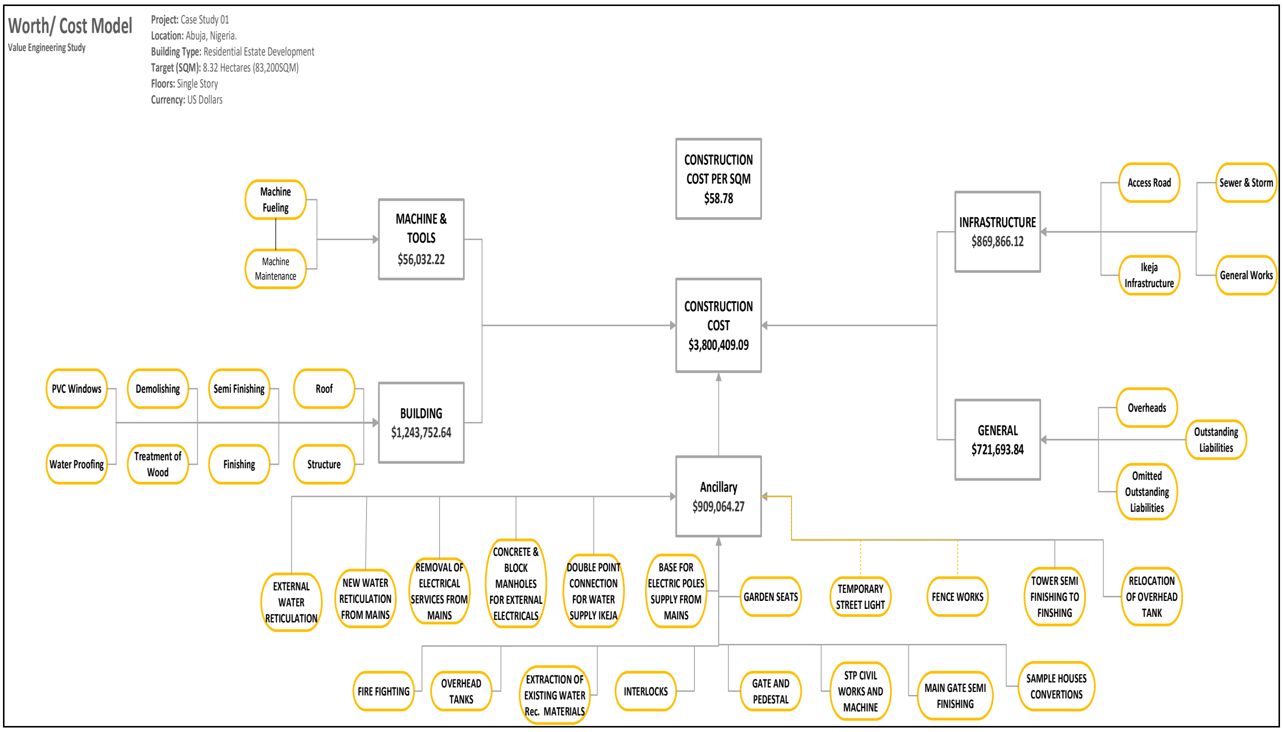


Figure 6.17 Construction cost model

ii. Setting Project Timeline

The time frame for carrying out the project was set by the board based on the following: historical timeframe for delivering houses, their competition and the demand of the end-users and their investors. A time frame of 18 months was given by the company to the end-users in their selling contract. The team set targets of 14 months for the project. The project timeline is shown in Figure 6.18.

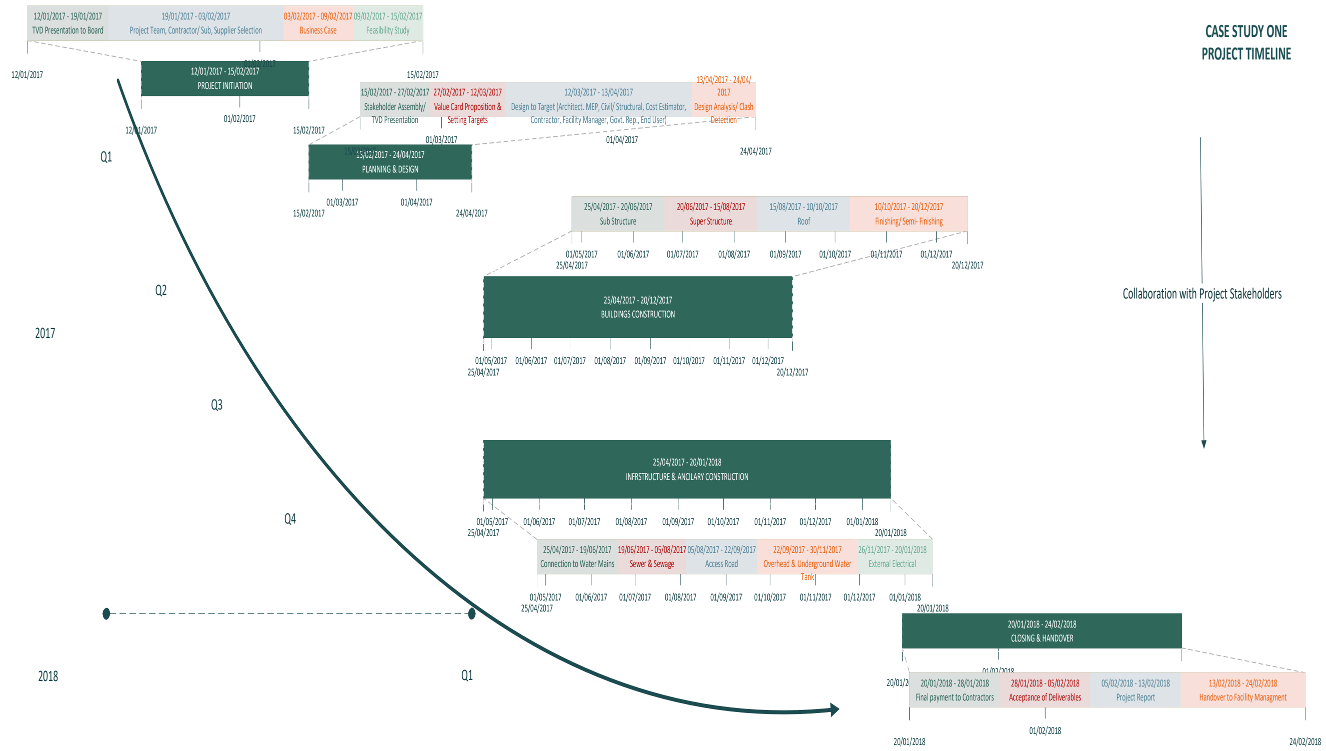


Figure 6.18 Project Schedule Milestone.

iii. Setting Quality Standards

The company set a quality target to surpass their previous projects.

> *"Even if it is a low-income affordable development, certain standards had to be maintained".* [MD]

The team developed a quality manual for design and construction as targets that could not be compromised.

iv. Setting Value Propositions

The value requirements of each stakeholder which were achieved from the card game were set as a target.

6.3.2.2.2 Pre-Design Planning

The planning of the designing to targets was conducted with all relevant team members. They made sure that the site conditions were investigated then aligned with the design as follows:

i. A confirmatory topography survey was conducted to compare with initial data used for concept design.
ii. Soil test was carried out for at the coordinate's positions of the buildings and a different soil test was carried out for the road network.
iii. The hydrological report was also carried out.
iv. Geophysical survey.

These were done to enable the cluster teams to align their designs to the site conditions. The teams noted all the problems that could lead to reworking the project for root cause analysis. Figure 6.19 shows the root cause diagram.

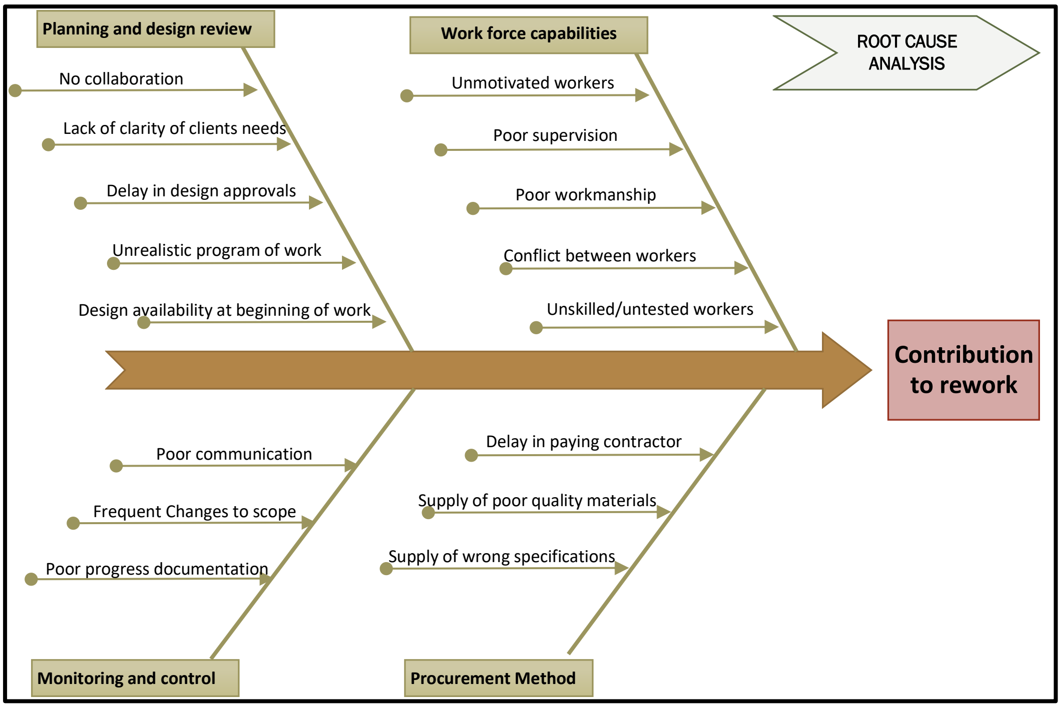


Figure 6.19 Root cause diagram

A. Steering to Targets During Design

The focus of the facilitator was to direct the team steering the design to the outlined targets. This process took more than one month where the targets were allocated to clusters to drive innovation. By the end of the exercise, the reviewed estimate cost was over ₦60 million (USD

166,667) above the target cost; this is about a 37% reduction from the initial budget estimate. The team was satisfied with this achievement and decided that they could close the gap during execution (construction). This was a leap of faith for the project team.

i. Cross-functional Teams for Design

The targets set at the product level were broken down into component targets comprising of costs, quality, time and value requirements. Targets were allocated to cluster groups comprising of multidisciplinary members, the cluster groups were responsible for designing the product and process to targets without reducing scope, quality and functionality and to make sure innovative alternatives which will steer the estimated costs to or under targets were created. Four main cluster groups comprising of a building work cluster, infrastructure works cluster, ancillary works cluster and administrative cluster were formed. Each main cluster had sub-cluster groups namely:

a) Building works civil/structural, electrical and mechanical sub-clusters.

b) Infrastructure works: civil/structural, mechanical, machines and tools sub-clusters.

c) Ancillary works: external electrical, external mechanical and external civil sub-clusters.

d) Administrative cluster: site capital expenditure and site operating expenditure.

The leadership and integrated governance constituted of core groups with cluster leaders and cluster groups with cluster members. Their roles and responsibilities were specified. The cluster group members reported and communicated with the cluster leaders who were central to all clusters. They organised the transfer of savings from cluster to clusters. Figure 6.20 shows the cluster teams components and the interaction of the clusters.

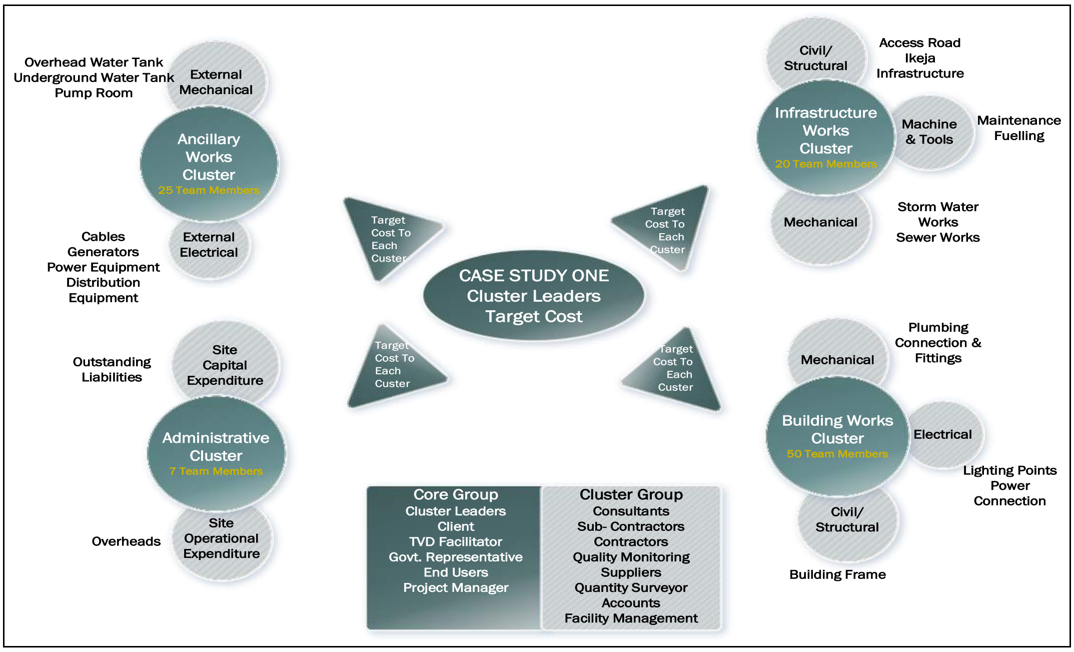


Figure 6.20 Cluster teams' components and the interaction of the clusters

The teams were guided by cluster leaders to adopt integrated and collaborative practices. Collaborative technologies which improve communication and real-time updates with other clusters were used. The facilitator (researcher) observed that even though the team was in the same room, they were not really collaborating; some members were working in isolation with different software this prompted the use of Revit which was used for clash detections. Clashes like the structural engineer's columns on the wall position in the same place as the mechanical engineer's pipes, columns passed in the middle of window positions in the upper floors etc, were detected. This helped to change the mindset of the team to adopt one software. The team members and core leaders held regular collaborative meetings. Brainstorming sessions were held regularly as part of the value engineering techniques used. This informed transparency which helped reduce corruption and contract padding while joint responsibility helped in full collaboration as suppliers were present during meetings.

ii. Co-location and Big room

During physical process observation, the researcher observed that the team, although all located in a big room, were not practising full collaboration. Their level of collaboration indicated that they were cooperating and networking but had little communication and collaboration. The teams were not fully coordinated as individual disciplines worked in isolation during their concept designs but shared information frequently and informally. Following the TVD benchmark which stated full collaboration, the researcher moved the PMO team to the project site. During collaborative and integrated sessions, the team conducted a manpower analysis in relation to the magnitude of the project which resulted in the introduction of two new teams called the ancillary team and administrative team. A collaborative and integrated meeting with the whole team was carried out every Monday while individual cluster/department meetings were carried out every Friday. At the PMO everyone was free to share their opinion, contribute innovative ideas, listen to others and relate with other cluster members. Cluster team heads met daily to discuss design outcomes. The co-location of the design team led to the identification of missing items, early identification of problems, better cost planning and helped prevent corruption.

iii. Integrated and Collaborative Conversation

The project team assembled in the same room to collaboratively interact with all members while the concept design was displayed. Members included designers, execution team, client representatives, procurement department, sub-contractors/suppliers and trades all contributed to the design, bringing different alternatives

iv. **Value Engineering Exercise:**

The basic approach of brainstorming in value engineering was used to innovatively look for alternative designs or elements in the design that are cheaper without compromising quality and functionality and the purpose of the element. As stated in the literature by Dell'Isola (1982), "the optimum time to conduct a value review is after the preliminary submittal stage and before working drawings are started".

v. Cost Modelling and Cost Tracking

TVD benchmarks clearly state that cost estimates and budget are done continuously throughout the project and should be updated frequently. This required rapid real-time costing inputs from the team. The cost estimators /quantity surveyors on the project had to follow the pace of the designs to feed the team with cost implications of different elements of the design. The cost information had to be reliable, transparent and to specification. The cost estimators and suppliers informed the designers of elements in the design that were not available in the market at that time, and alternatives were made. The cost estimators worked with the procurement department to update cost data during the market survey every two weeks. Table 6.5 shows the cost model dashboard. Figure 6.21, 6.22 and 6.23 show the comparison between the market cost and the actual cost, the grand total comparison and the savings from market cost respectively

Table 6.5 The cost model dashboard

		Market Cost	Target Cost	Actual Cost Before Execution	Costs Above Target Cost	Savings from Cluster Teams to Accommodate Approved Target Amount	Variance from Approved Final Budget Before Construction	Savings/ Addition During Construction	Additional Works During Construction	Actual Cost
1	Access Road	$1,095,653.68	$293,593.18	$284,033.50	$802,060.50	$9,559.68	$9,559.68	$10,709.09	$0.00	$273,324.41
2	Ikeja Infrastructure	$396,609.07	$320,868.54	$314,334.91	$75,740.53	$6,533.63	$6,533.63	$12,834.44	$0.00	$301,500.48
3	Group A Prime Infrastructure (Sewer and Storm Only)	$25,260.31	$25,260.31	$23,671.88	$0.00	$1,588.42	$1,588.42	$1,269.33	$8,333.33	$30,735.89
4	Ancillary Works	$2,520,757.90	$832,658.29	$909,064.27	$1,688,099.61	$0.00	-$76,405.98	$0.00	$0.00	$909,064.27
5	General Works	$429,940.58	$259,420.27	$247,825.82	$170,520.31	$11,594.45	$11,594.45	$7,785.48	$0.00	$240,040.35
6	Machine & Tools	$56,032.22	$56,032.22	$56,032.22	$0.00	$0.00	$0.00	$8,145.63	$0.00	$47,886.60
7	Building	$1,385,435.81	$1,144,664.85	$1,243,752.64	$240,770.96	$0.00	-$99,087.80	$64,799.22	$11,666.67	$1,190,620.09
9	Outstanding Liabilities	$477,928.27	$477,928.27	$477,928.27	$0.00	$0.00	$0.00	$45,297.78	$0.00	$432,630.49
10	Overhead	$221,277.75	$220,829.14	$223,606.92	$448.61	$0.00	-$2,777.78	$61,111.11	$0.00	$162,495.81
11	Omitted Outstanding Liabilities			$20,158.65	$0.00	$0.00	-$20,158.65	$0.00	$0.00	$20,158.65
	GRAND TOTAL	**$6,608,895.58**	**$3,631,255.07**	**$3,800,409.09**	**$2,977,640.52**	**$29,276.18**	**-$169,154.02**	**$211,952.06**	**$20,000.00**	**$3,608,457.02**
									Actual Cost Savings	**45%**

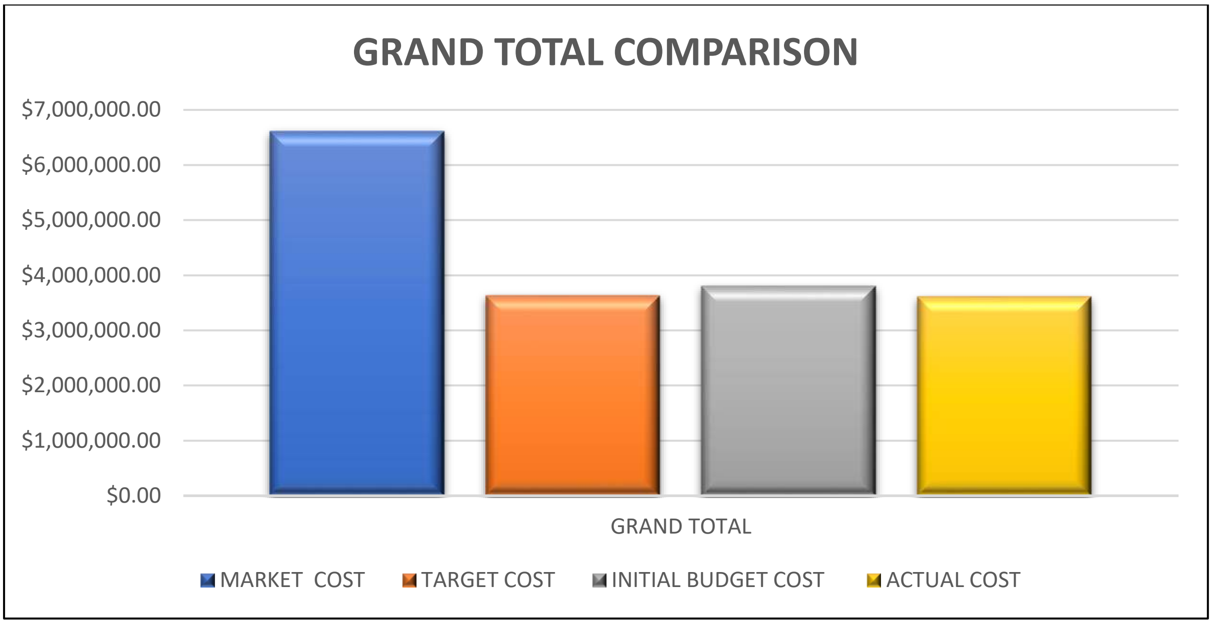


Figure 6.21 The grand total comparison

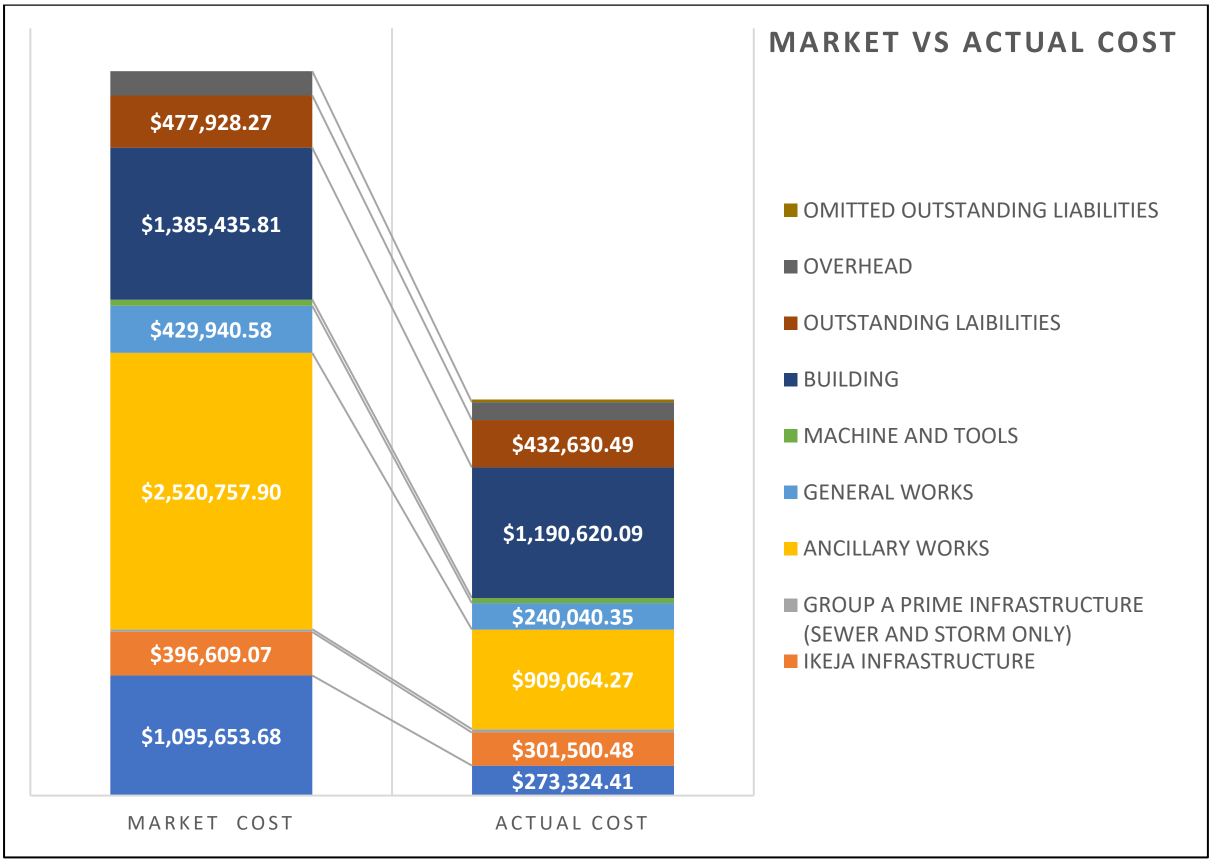


Figure 6.22 The comparison between the market cost and the actual cost.

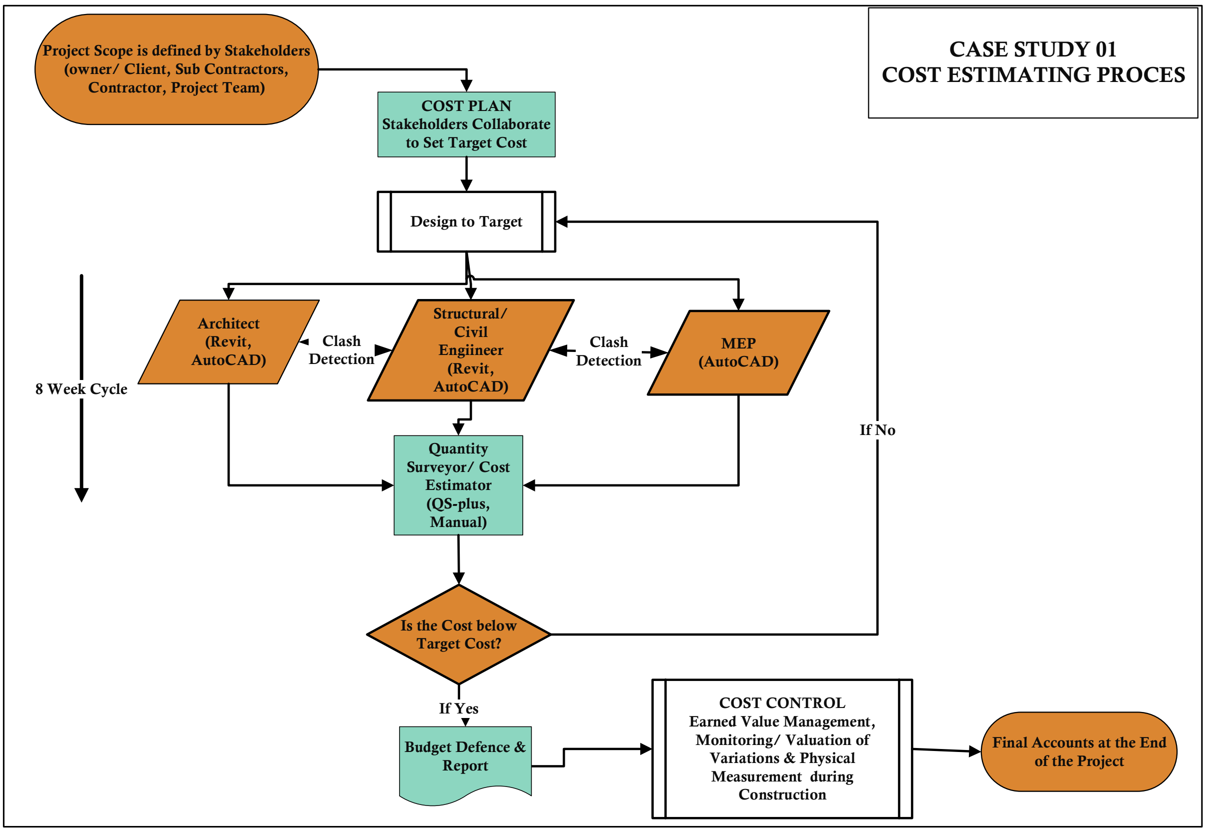


Figure 6.23 cost estimating process.

6.3.2.2.3 Execution Stage

A. Steering to Targets During Construction

The final cost estimate was about ₦60 million (USD 166,667) above the target cost; however, the team decided to go ahead with the execution in the hope of reducing the deficit during construction.

In a bid to ensure that the team constructed to target, the quality monitoring unit (QMU) was formed and charged with the responsibility of ensuring that all quality standards were observed. They monitored the quality of materials delivered to the site with a quality checklist. The QMU supervised and monitored the progress of work and collated weekly progress reports for each cluster. Weekly site meetings were held on Mondays to discuss the progress of the work and report.

The task of reducing the deficit of over ₦ 60 million (USD 166,667) and achieving cost savings from the budget was tackled from various angles. First, from the infrastructure cluster, the project team after deliberation decided that it will be more profitable to buy the heavy equipment instead of hiring for a long duration, as was the company's practice. A lot of cost savings were achieved from capital expenditure especially in the purchase of bulldozers, excavators, compactors etc. Before the peak of the recession, the project team foresaw a hike in prices and decided to buy materials in bulk; this action contributed to achieving another round of cost savings for materials purchase. There was also a cost-saving from OPEX. Also, other savings were achieved as a result of renegotiation with the labour/trades.

6.3.2.2.4 Closing Stage

All components of the project were completed except for the external electrical work component which was handed over to the external electrical sub-company. The buildings and infrastructural works were tested, and valuations were done; upon certification, were commissioned and certificates of practical completion were issued to sub-contractors for achieving the milestone which for some was at the semi-finish stage while for some at the decking stage. The lessons learnt were collated and documented for future reference.

6.3.3 Semi-structured Interviews

After the implementation of TVD, an interview guide was prepared and a total of 14 interviews were conducted with key members of the project team. (see appendix 6 for a sample of case study interview). The process and results of the interviews are presented in the following sections.

6.3.3.1 Demographic Information of Respondents on CS-01

A total of 14 respondents were interviewed in this first case study project. The respondents include the key stakeholders that were directly involved in the project, from the beginning to the end of this stage of the project. The demographic information of interviewee is shown in Table 6.6.

Table 6.6 Demographic information of interviewed respondents

SN	ROLE CATEGORISATION ON THE PROJECT	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.
1	Mechanical Designer	CS1-ED01	Mechanical Engineer	13
2	QMU Electrical	CS1-ED01	Electrical Engineer	11
3	Project Manager	CS1-ED03	Builder	9
4	Site Manager	CS1-ED04	Quantity Surveyor	7
5	Team Head (Electrical)	CS1-ED05	Electrical Engineer	6
6	Team Head	CS1-ED07	Civil Engineer	6
7	Design Team Member	CS1-ED08	Architect	4
8	Structural Designer	CS1-ED09	Structural/ civil Engineer	10
9	Design Team Head	CS1-ED10	Architect	12
10	Budget Officer infrastructure	CS1-ED11	Quantity Surveyor	8
11	Head Quality Control Unit	CS1-ED02	Civil Engineer	11
12	Procurement Head	CS1-ED03	Business Admin	10
13	Budget Officer	CS1-ED04	Quantity Surveyor	15
14	Facility Manager	CS1-ED15	Electrical Engineer	8

From the analysis of demographic information of the respondents as presented Figure 6.24, the result shows that about 57% of the respondents have between 5-10 years of experience in the construction industry while 36% have over 10 years of experience and only about 7% have below 5 years of experience. These respondents include the major stakeholders that actively participated in the design, construction, monitoring and closing stages of the project.

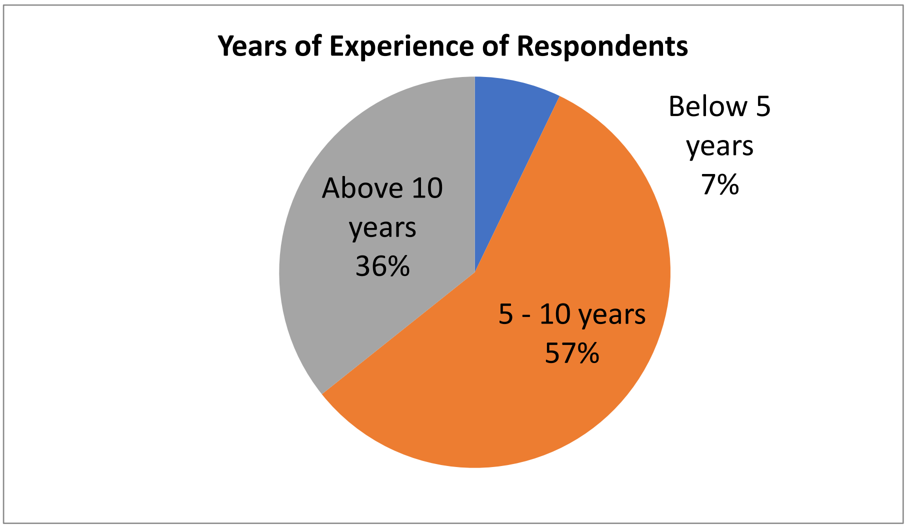


Figure 6.24 Years of experience of the respondents.

6.3.3.2 Benefits of TVD Implementation

The respondents were interviewed about the benefits of implementing TVD on the project, questions were asked about the benefits of TVD implementation at the different stages of the project (initiation, planning and design, construction/execution and closing). Figure 6.25 shows the main themes of benefits from the interview data analysis on the benefits of the implementation of TVD.

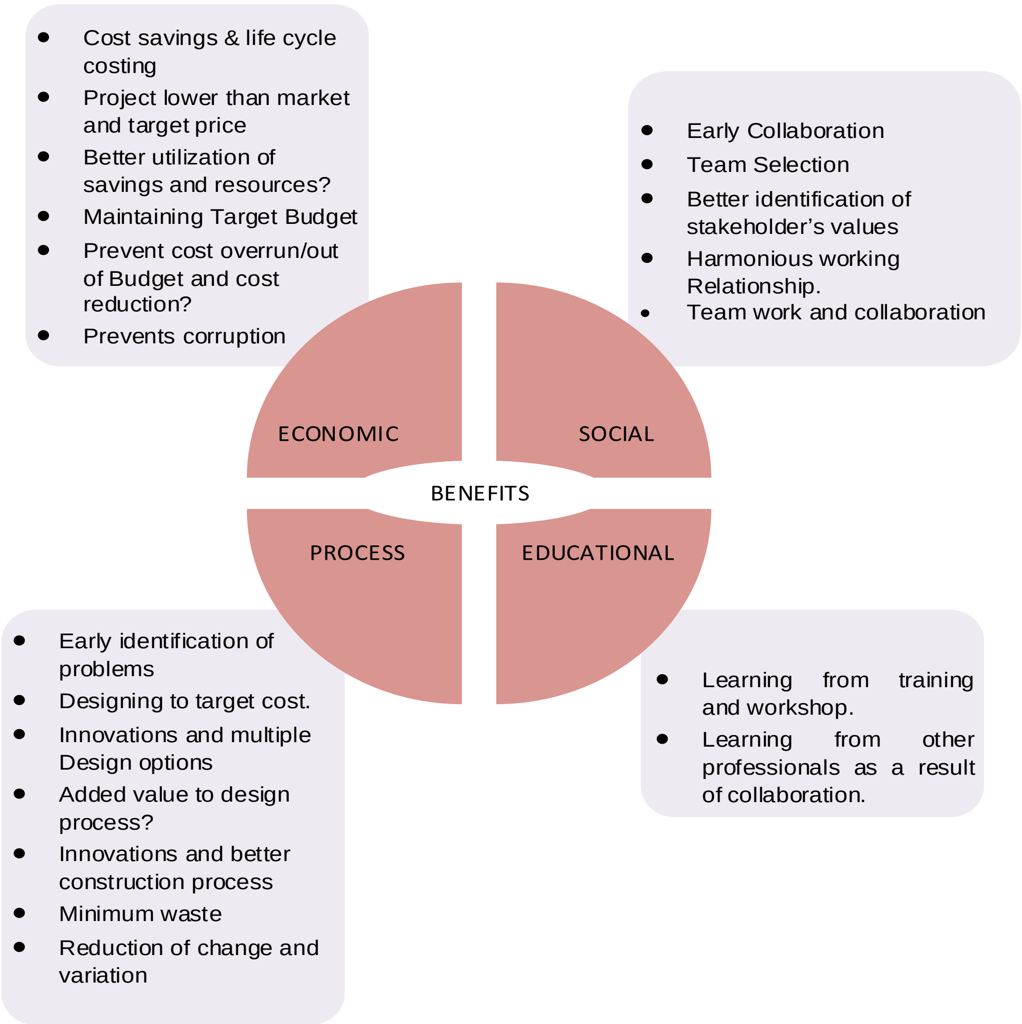


Figure 6.25 Main themes of benefits of TVD implementation.

The benefits were categorised in benefits at the initiation, the planning/ design, execution/ construction and closing stage; this is shown in Figure 6.26.

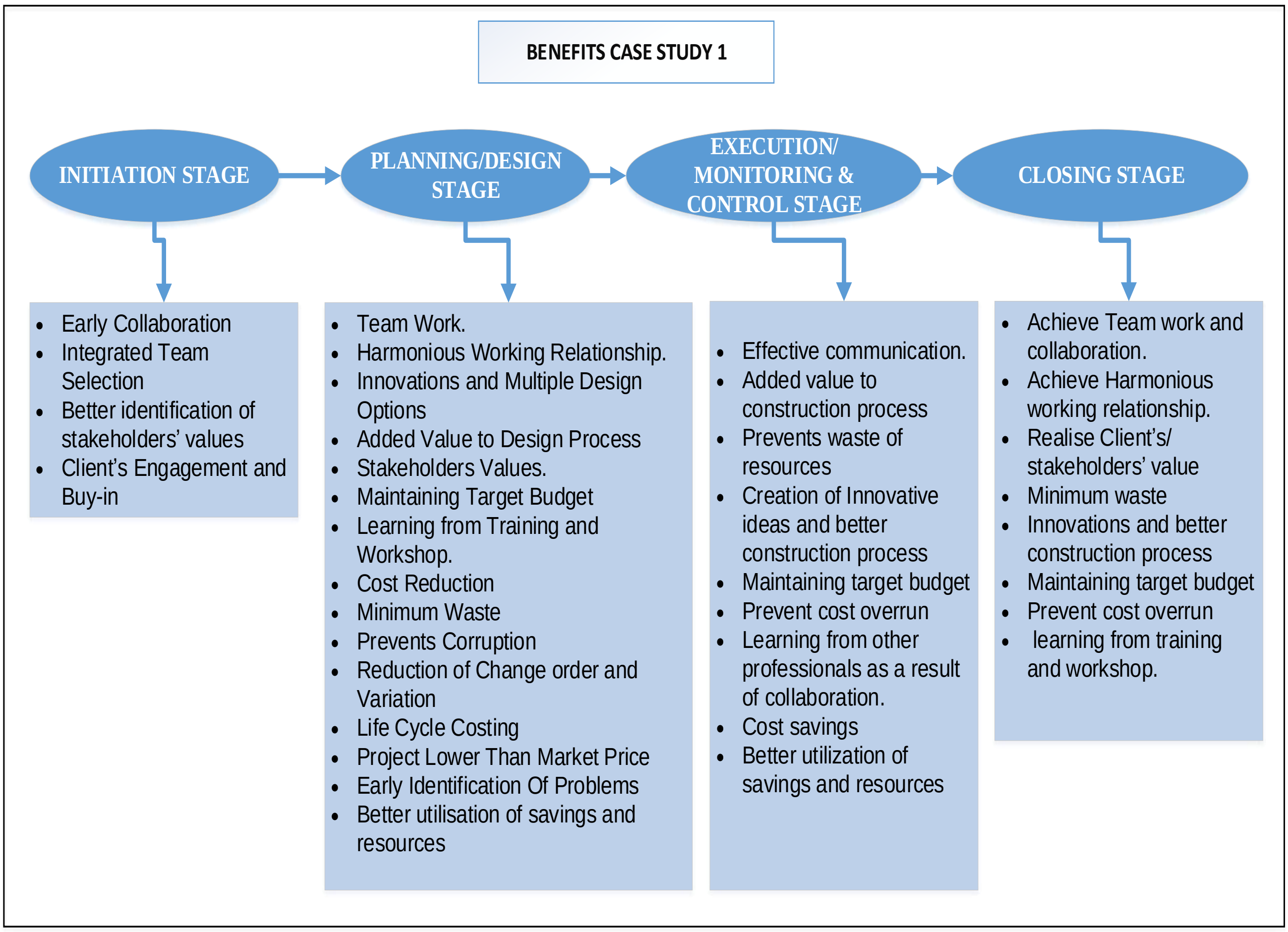


Figure 6.26 showing the benefits of TVD implementation in CS-01

6.3.3.2.1 Benefits of TVD implementation at the Project Initiation Stage

The analysis of the interview results reveals that the respondents clearly identified three major benefits of the implementation of TVD at the project initiation stage which are: early collaboration, integrated team selection and client engagement and buy-in. Most of the respondents suggested that the main benefit of implementing TVD at the project initiation stage is the early collaboration of the team as a result of co-location. A team of competent professionals that carried out the project was selected. Some of the respondents stated that:

> *"There was early collaboration and integrated team selection*. *What I am saying is that TVD helps bring people together early in the project in one place to discuss the project and then it helps to properly select the competent teams required."* (**CS-01-ED13 Senior Manager**)

Most of the respondents established that as a result of the implementation of TVD on the project initiation stage, the integrated team selected was able to engage with the client in a bid to establish the stakeholders' values, this is evident in their response:

> *"There was early collaboration during the initiation stage. Client engagement and buy-in were initiated." (***CS-01-ED08, Lower Mid-Level Designer***)*

> *All the key stakeholders participated in the business case. The feasibility study was done with all key stakeholders. During the feasibility study, we identified the key factors that are required to come up with the project, in case resources and design and to know whether the project is viable or not, and the risk involved."* **(CS-01-ED11 Upper Mid-Level Manager)**

This case study was a very big project by many standards, so there was a need for the selection of the integrated team who reassessed the project and then developed and validated the business case. As a result of the integrated team selection, all the key stakeholders participated in the business case and the feasibility study.

6.3.3.2.2 Benefits of TVD implementation at the Project Planning and Design Stage

The respondents were interviewed on the benefits of the implementation of TVD at the planning and design stage. The analysis of the interview revealed that the major benefits include: Harmonious working relationship, innovations and multiple design options, preventing corruption, stakeholders' values, learning from training and workshops, early identification of problems, cost savings and reduction among others.

The respondents believed the implementation of TVD on the project engendered a harmonious working relationship among the team members. It is a given that TVD improves communication and information sharing among teams thereby stimulating collaboration. The implementation of TVD on this project introduced innovation and multiple design options in the design and planning stage. The respondents also indicated that project team members were able to express themselves without inhibition:

> *"Being co-located improved collaboration, communication and information sharing and problem-solving. We didn't have to go out to source for information, because all we needed was within the team, for example, if I need a particular information from probably the electrical design team, I don't have to go out but ask directly or wait for them to finish up*

> *and pass it to me, because you know that collaboration is there, that communication is easy and time gap was eliminated." (**CS-01-ED04 Senior Manager)***
> *"Exactly, there are innovative ideas as a result of individual contributions; it also allows every team member to express their opinion freely without any hindrance" (**CS-01-ED01, Lower Mid-level Manager**)*

Identification of stakeholder value is of paramount importance in the TVD process, the satisfaction of the stakeholders will only happen when the values of stakeholders are properly identified and recognised during the design stage. Significant cost savings were also realised during the process of planning and designing because of the implementation of TVD, it gave a drastic reduction in the contingency percentage; thereby allowing for maintaining of the budget. The respondents noted:

> *"Of course, TVD gave us a better planning process. Based on that, it gave a better identification of stakeholders' value as well" (**CS-01-ED11, Upper Mid-level manager**)*
> *"We achieved a lot of cost savings. Because of the multiple designs we had and the construction processes, we had different options which were cost-effective and that brought down the cost. And the savings realised were reallocated to other departments and activities in the construction"* **(CS-01-ED08, *Upper Mid-level manager*)**

Koskela (2015) maintained that many of the traditional procedures and methods have actively increased waste in construction or allowed its formation. However, construction waste can be considerably reduced through focused and sustained efforts such as TVD and lean construction. Also, collaborative working prevents corruption through transparency especially in the area of purchasing materials.

The implementation of TVD in the project provoked the early identification of problems that would have occurred in the execution of the project. Clash detection exercise was carried out and this was successful because of co-location which is one of the benchmarks of TVD. It is a given that designers, subcontractors and other specialist groups working in isolation in their respective disciplines results in rework, change orders and re-pricing, but the implementation of TVD with all its benchmarks helped to reduce change orders and variation in the project. These points were reiterated by the respondents by stating:

> *"A very important benefit that we observed during planning was that TVD helped us to avoid what would have been a very serious case of embezzlement during the purchase. During the purchasing there was an avenue for conniving, budget padding and outright misappropriation of funds, however this did not happen because of the collaboration of key stakeholders; there was collaborating with contractors in the area of labour and in the materials, we went to the manufacturers to get materials from them directly, instead of going through sub-contractors or contractors" (**CS-01-ED04, Senior Manager**)*

> *"Like I just said it minimises waste, during the design, there are some structures that might not be necessarily needed. We did clash detection, we superimposed all the drawings together architectural, mechanical, electrical and structural, so that minimised rework and change orders" (**CS-01-ED11, Upper Mid-level manager**)*

A very important benefit of the implementation of TVD in the project is the knowledge gained by the project team as a result of the workshop and training organised for them. Also, the team gained knowledge as a result of the integration and association with other team members. This was confirmed by the respondents:

> *"As a result of TVD and the collaboration there was learning within the team; there are some aspects that those in infrastructure now understand better as a result of the interaction with those in building, some certain things in building that they did not know before and those in building now understand some things in infrastructures that they don't know before, even those in mechanical and electrical." (**CS-01-ED04, Senior Manager**)*

6.3.3.2.3 Benefits of TVD at the Construction and Execution stage

The implementation of TVD on the project added value to the construction process, it brought about a collaborative and harmonious working relationship which in turn added value to the construction process and innovation. The implementation of TVD on this project helped to reduce the unexpected costs that would have been incurred in excess of budgeted amounts. Cost overruns are usually due to an underestimation of the actual cost during budgeting, this was avoided in this project because of the rigorous process of budgeting and design of TVD. Savings were realised from different clusters as a result of the implementation of TVD on the project and saving from one cluster was moved to other clusters that needed extra funds as a result of inflation.

These views were upheld by the respondents when they said:

> *"We also understand that the system that we adopted has enabled us to control cost overrun and out of budgets and have a predictable cost". (**CS-01-ED14, Senior Manager**)*

> *"The cost savings that we got during the execution was allocated to other works where we have variation due to inflation as a result of the recession the country went into; so, things went high, so the savings were used to support them". (**CS-01-ED14,*** **Budget Officer*****)***

TVD helps in maintaining target, TVD Benchmark 9 which says "*A cardinal rule is agreed upon by project team members – cost and schedule targets cannot be exceeded, and only the customer can change target scope, quality, cost or schedule"* was observed in this project. The target set for the project was not exceeded, this was noted in the interview by the respondents saying:

> *"We had a cost target; we ensured we did not go above the target". (**CS-01-ED11, Upper Mid-level manager**)*

6.3.3.2.4 Benefits of TVD at the Closing stage

Finally, all the project team members were asked a question on "Who do you think benefits more from TVD in this project?" Although all the respondents agreed that all the stakeholders benefited in one way or the other from the process, it was established that the owner of the company (the Client) was the biggest beneficiary of the implementation of TVD. For example, the response of the team members confirms this observation:

> *Virtually everybody benefited, but sincerely the President/client benefited more, he is the investor (**CS-01-ED14, Senior Manager**)*

6.3.3.3 Barriers to TVD Implementation

The challenges encountered during the process of implementing TVD was assessed in the interview session, a list of barriers at the different stages of the project was generated from the interview. The barriers are shown in Figure 6.27

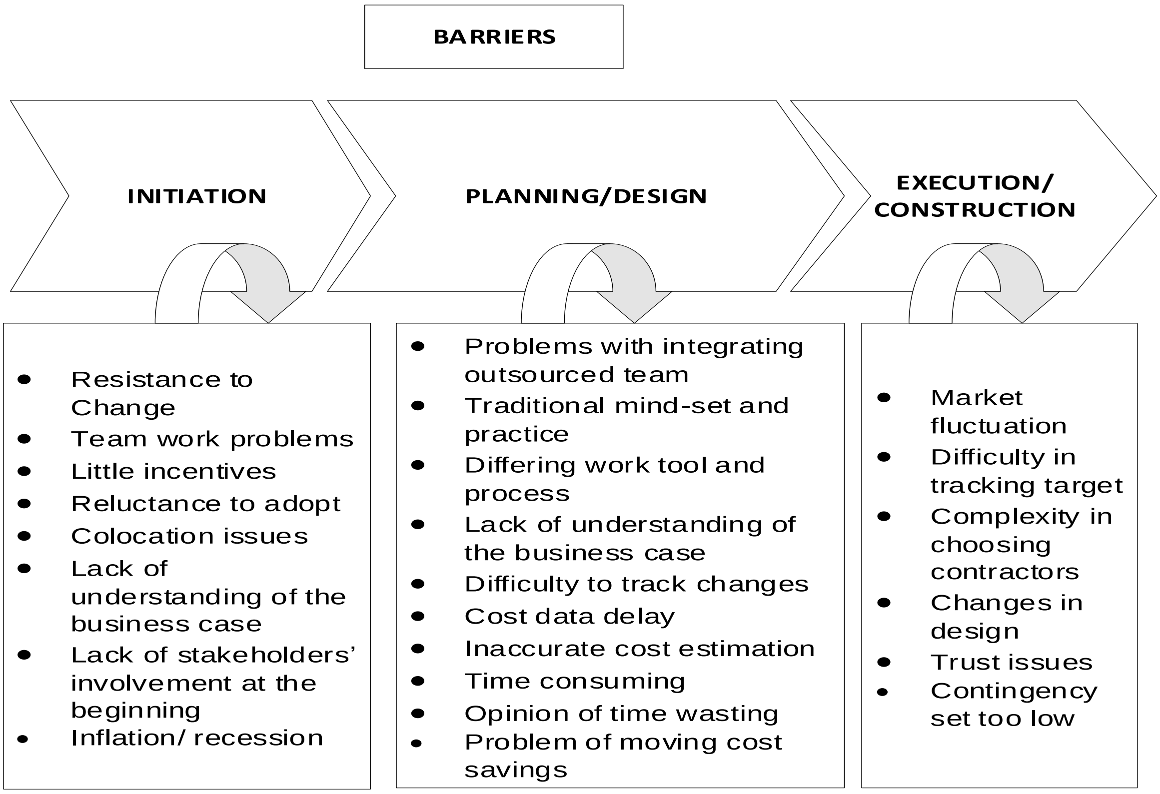


Figure 6.27 Barriers to implementing TVD in the stages of the project

6.3.3.3.1 Barriers to TVD Implementation at the Project Initiation Stage

Project initiation is a critical stage of the project where efforts should be made to reduce or prevent challenges that can derail the project. Evaluating the barriers to TVD implementation at the initiation stage is very important because the success or otherwise of the project depends on how well the challenges are mitigated.

The first barrier to TVD implementation identified was an unwillingness to adopt TVD. Target value design is a new concept and practice especially in Nigeria, and, as such, requires a mindset shift that is usually difficult for most professionals. The lack of awareness of TVD is another major barrier to its implementation, the concept is relatively unknown in this part of the world. Another major barrier is the lack of involvement of key stakeholders at the beginning of the project (business case and feasibility studies) this occurs because traditionally not all stakeholders are involved in the business case. The respondents noted:

> *"At the initiation stage, some of the barriers we encountered is buying of the system from the stakeholders because we all know that it is difficult for people to change if you have been using the traditional way of (doing things). They have not practised the*

system before, so the fear of the unknown is a factor” ***(CS-01-ED05Upper Mid-level manager)***

“Not being part of the initial business case in the project was a barrier”. ***(CS-01-ED15, Senior Manager)***

6.3.3.3.2 Barriers to TVD Implementation at the Project Planning and Design Stage

The respondents identified that team collaborative problems were experienced during the project planning and design stage, this was due to the introduction of new team members and outsourced team members. Another reason was divergent viewpoints, for example where the cost estimator was more concerned about the cost implications of the designs and maintaining targets, the architects and designers were more interested only in the aesthetics of the houses. The traditional mindset in the NCI is a big threat to the successful implementation of TVD; professionals work in isolation with little or no collaboration especially at the project planning and design stage. Working with diverse work tools and software that are not interoperable, leading to different work processes was another issue acknowledged by the respondents. As noted earlier, not all the stakeholders participated in the business case, this resulted in some project team members lacking a clear understanding of the business case. The interviewees captured it well by saying:

*“Developing trust was difficult. Yes, it was difficult because there were some new team members and some outsourced teams that just came in, and we have not worked together before” (***CS-01-ED04, Senior Manager).*** *“there was resistance, It wasn’t easy trying to get people who used to work in isolation to now come together and collaborate in a project that we all have different mindset together and we all work together to achieve a particular target.”* **(CS-01-ED15, *Senior Manager*)**

*“Use of different software was a barrier. For example, the civil engineers don’t use REVIT and so they found it difficult to understand some tools and templates used by others” (***CS-01-ED08, Upper Mid-level manager).***

Related to an unwillingness to adopt is difficulty in adoption. TVD being a new idea and practice requires a lot of training before implementation. The interview analyses showed that several of the interviewees heard about TVD for the first time during the organised training and workshop. The respondents noted that it was different to track changes during the design stage because of the multiple redesigns and design options. Cost data delay and inaccurate cost estimation was a major issue during the planning and design stage, this was captured by the interviewees:

> *"Another barrier is initially the company was not truly ready to understand the importance of TVD. Also, for us to assemble the team members and agree that this is the new way of doing things was also a challenge.". (**CS-01-ED14, Senior Manager**)*

> *"Another issue changed in the design which was time-consuming as well. It was difficult to track because different engineers were working on different things, we have the consultant doing a different thing, the in house doing a different thing. (**CS-01-ED03, Senior Manager)***

Some of the respondents believed that the process of TVD is time-consuming. The transfer of cost savings generated from one cluster group to another cluster group was very difficult, it was a big issue to the clusters where the savings were generated. The movement was not normally without resentment as they prefer keeping the savings for their cluster. Lack of incentives and motivations was another barrier to TVD implementation on this project. In the real sense, it was not a lack of incentive, but the issue was that the incentive and motivation scheme was not for the entire team but for a selected few team members, so those not part of the incentive scheme were discouraged or less committed. The respondents noted:

> *"TVD actually took much of our time, but it is actually worth it at the end of the day. The designers will change and after having done this exercise, we have to redo it again. Initially, I felt and discussed with some team members that this is wasted time and wasted efforts, but we later realised that it was never wasted time." **CS-01-ED14 Senior Manager***

> *"It was hard to move cost savings from one department to another, for example, when there was saving from infrastructure, we needed the savings in building but they refused to give it up till when the senior management had to intervene that the cost savings is for all department, if not they wanted to keep it for themselves." (**CS-01-ED03 Senior Manager)***

> *"Another issue is collaboration issues with consultants not on the incentive scheme. So, people that were not part of the incentive scheme really had problems collaborating".* ***(CS-01-ED05, Upper Mid-level manager).***

6.3.3.3.3 Barriers to TVD Implementation at the Construction Stage

Market fluctuations and inflation occasioned by the recession experienced by the country (Nigeria) in recent times was another challenge indicated by the respondents. There were uncertainties related to market fluctuations and how escalations will play throughout the year, the interview reported that during the construction stage, prices jumped up and down, which made it very difficult to maintain and track targets. It was very challenging but with TVD the team was able to plan ahead of time, make deposits with vendors, go to manufacturers, all in a bid to maintain target cost. Some respondents said:

> *"Another serious barrier is inflation, which is the unstable market for construction we experienced recently in Nigeria. When we started the construction, the prices went up, but the concept of target value helped us to play around, to work within the budget". (**CS-01-ED10**)*

Another challenge is the complexity of choosing the sub-contractors for a job, there were cases where the suppliers or contractors try to outdo each other in terms of the price to get the contract, it is a challenge because it can hurt the project when people going too low or compromise quality when they are delivering these products. Another barrier was that the contingency was set too low for such a large project. The incentives and motivation scheme in this case study was not for all team members but for a select few and that was another barrier reported by some interviewees:

> *"The decision of selecting contractors is a very delicate one because we have a case of many contractors jostling for few slots available and that opens up an opportunity for corrupt inducement (**CS-01-ED04, Senior Manager).***

6.3.3.4 Drivers of TVD Implementation

The drivers of TVD implementation for the project were assessed in the interview, the reported drivers are shown in Figure 6.28

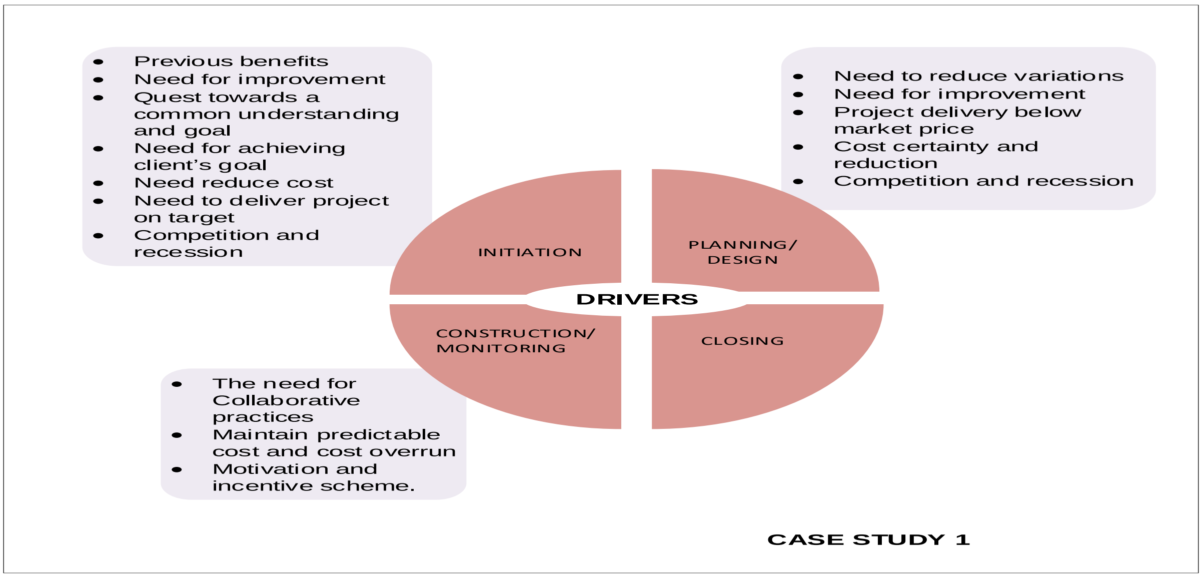


Figure 6.28 Drivers of TVD implementation

6.3.3.4.1 Drivers of TVD Implementation at the Initiation stage

The training, simulation and workshop conducted in the beginning exposed the team members to the benefits of TVD implementation in other projects and this was one of the drivers of TVD implementation. There was a need for improvement from the traditional method of construction. The quest for a common understanding and goal was another driving factor for the implementation of TVD in the project. This was captured by the respondents:

> *"I think it was the previous benefits and successes of TVD implementations in other projects that were marketed during the training that was also explained". **(CS-01-ED04, Senior Manager)***

> *"The quest for the delivery of projects on targets. You know there is stipulated time for these projects to be delivered to our clients while maintaining cost and quality standards; that is another driver in the beginning". **(CS-01-ED13, Senior Manager)***

6.3.3.4.2 Drivers of TVD Implementation at the Planning and Design Stage

During the planning stage, the need to reduce rework, change orders and variation were some of the major drivers of the TVD implementation. TVD helps in early identification of problems this, in turn, helps to curb rework, change orders and variation in the project.

The real estate development market in Nigeria is seriously competitive and as such there was the need to deliver products of a lower cost than the prevailing market so as to be ahead of the competition. The need to deliver the project on target and client's value and achieve cost certainty were other drivers of the TVD implementation.

> *"Part of the reason is that we have a general market price and our target is to achieve a structure which is below the market price..* ***(CS-01-ED08, Lower Mid-level Designer)***

> *"We wanted to reduce variations, wanted cost to be more certain, trying to get the best value for a particular item, product and design or planning stage".* ***(CS-01-ED15, Senior Manager)***

6.3.3.4.3 Drivers for TVD implementation at the Construction Stage

The drivers of TVD implementation at the construction stage as reported by the participants of CS-01 includes the need for collaborative practices, the need for a motivation and incentive scheme, and finally to maintain predictable costs and reduce cost overruns. Some of the respondents capture it thus:

> *"There is a need for an efficient working relationship, something that will foster the relationship of the team members. Need for consensus decision making and innovative ideas in problem-solving"* ***(CS-01-ED08, Lower Mid-level Designer)***

6.3.3.5 Success Factors of TVD Implementation

The success factors of TVD implementation as reported by the respondents in CS-01 are shown in Figure 6.29

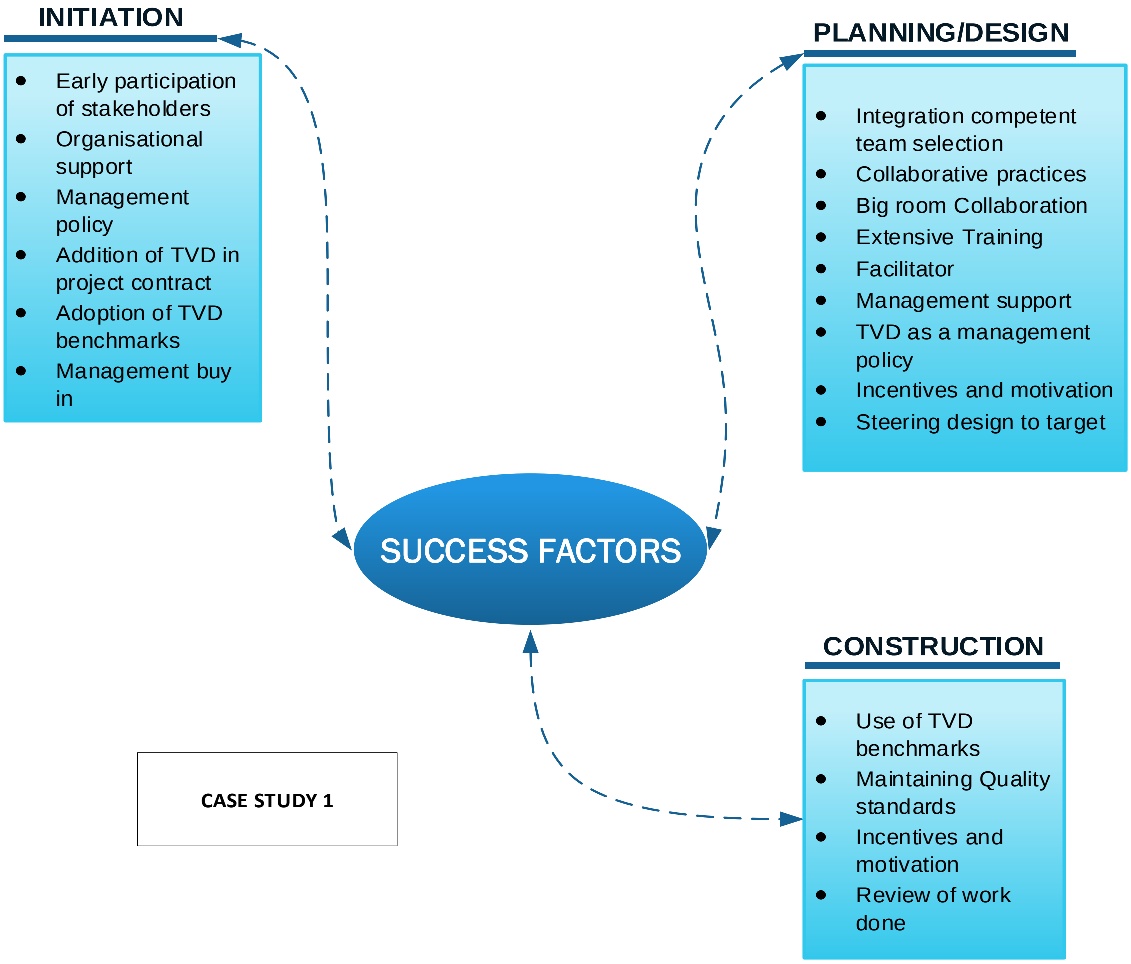


Figure 6.29 Success factors of TVD implementation

6.3.3.5.1 Success Factors at Initiation

Early involvement of stakeholders was one of the success factors needed for the effective implementation of TVD in CS-01. The other factors are the introduction of TVD in construction contracts, adoption of TVD benchmarks and senior management buy-in. Some of the respondents captured the ideas in the following statements:

> *"Collaboration and early involvement of key stakeholders, if that is done, TVD will work very well" (**CS-01-ED03, Senior Manager**). "Client and senior management should buy-in and should also be involved to make TVD function well" (**CS-01-ED04, Senior Manager**)*

> *"TVD should be added to project planning policy in the beginning, it should be a culture in the construction environment. They should be aware of the benchmarks in the early planning stage" (***CS-01-ED15, *Senior Manager****)*

They also noted that there must be organisational support and adoption of TVD principles and practices as a management policy for TVD to succeed.

6.3.3.5.2 Success Factors at Planning and Design stage

The respondents noted that for TVD to succeed at the project planning and design stage, there must be a TVD facilitator who coordinates the activities; an integration competent team must be selected, and the selected team must work collaboratively while being co-located. The comments of the respondents corroborated this fact when they said:

> *"for TVD to succeed, there should be a degree of integration of competent teams and governance, which will create constant and transparent collaborative information sharing among the team members from the planning stage to the execution stage"* ***(CS-01-ED03, Senior Manager)***

They equally noted that there should be adequate training, workshops and seminars for team members, management support and the use of TVD benchmarks

> *"First of all, the training, learning and simulations for all that will partake in the process are important. It really helped us in understanding TVD initially, the simulation helped more than the workshop because it was practical for everyone. The part that we even found out that we were not really collaborating but just cooperating"* ***(CS-01-ED14, Senior Manager)***

The real-time costing, incentives and motivation schemes were the other success factors that are necessary for the successful implementation of TVD

> *"Incentive and motivation worked for those that got incentives, but those that did not get incentive were demoralised; incentive for all key members will be a key success factor and not a few"* ***(CS-01-ED09, Lower Mid-level Manager)***

6.3.3.5.3 Success Factors at the Construction stage

The success factors at the construction stage identified by the respondents include the adoption and use of TVD benchmarks, incentives and motivation and review of work done.

> *"Incentive and motivation, like if the company can give bonuses, and rewards for all the people involved it will help" (**CS-01-ED08, Upper Mid-level manager**)". The regular review of the work done and checking whether it is done properly like the checking of usage by material managers".* ***(CS-01-ED14, Senior Manager)***

6.3.3.6 Impacts of TVD on the CS-01

The impacts of TVD on the CS-01 as indicated by the respondents are illustrated in Figure 6.30

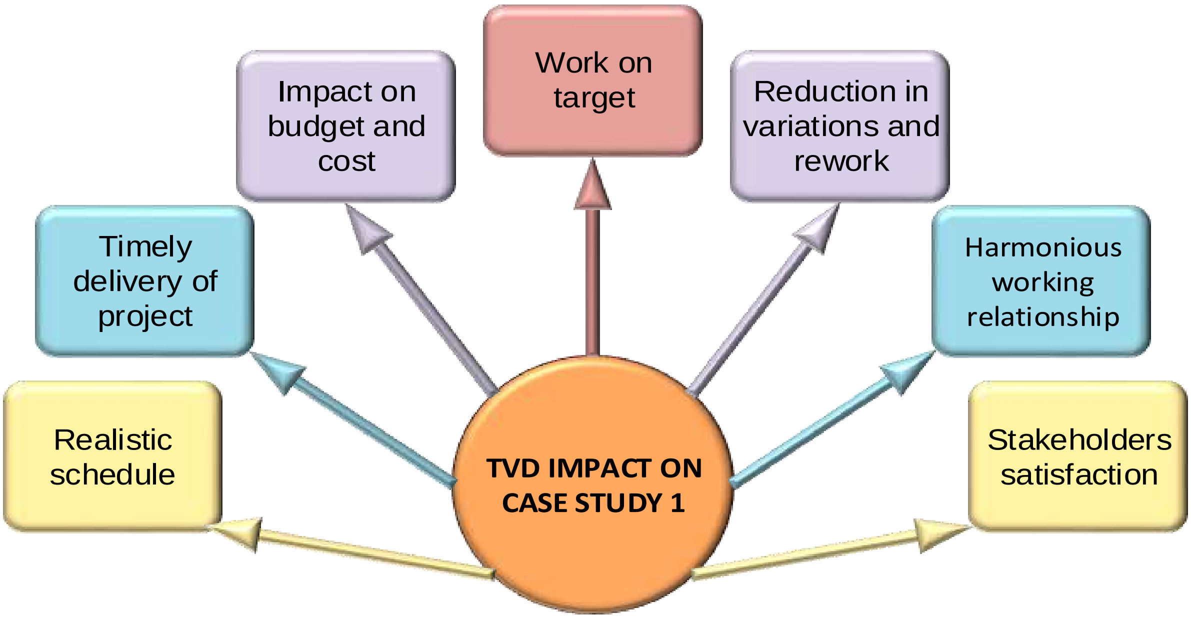


Figure 6.30 The impacts of TVD implementation

The impacts of TVD on CS-01 as indicated by the respondents include a realistic schedule, timely delivery of the project, impact on budget and cost, reduction in variations and rework, harmonious working relationship and stakeholder's satisfaction. The respondents stated:

> *"We were able to deliver the project to this stage of the budget as promised on time. There are much more savings in terms of cost and our budget is much lower than the actual budget and lower than previous sites" (***CS-01-ED14, *Senior Manager)***

6.3.3.7 Support Needed for the Implementation of TVD

The support required for the implementation of TVD to be successful from the analysis of the interview of this case study are shown in Figure 6.31

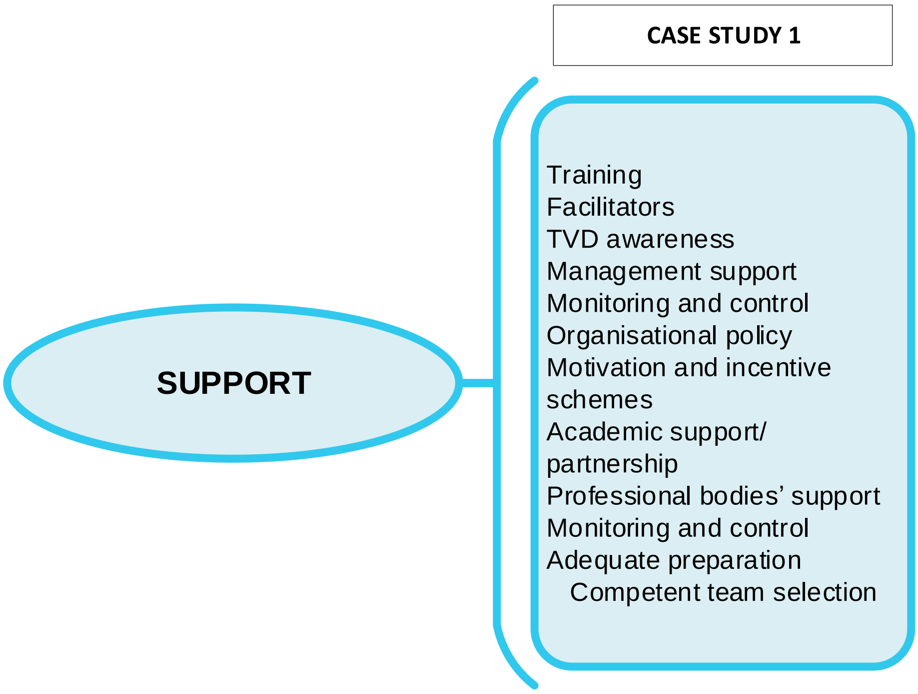


Figure 6.31 Support needed for successful TVD implementation.

The respondents of this case study were asked to identify the supports required for the successful implementation of TVD, some of them believed that appointing a TVD facilitator that will assist with training and raising TVD awareness.

> *"There should be a seminar and workshop, like the previous simulation for people to understand practically what TVD is and why it is done this way. Then it will help to create awareness of TVD" (**CS-01-ED14, Senior Manager)***

The results of the interview analysis revealed that the respondents emphasised motivation and incentive schemes as being critical to the success of TVD on the project. They encourage the partnership between institutions of learning and construction practitioners, saying that partnerships and supports from academic institutions, professional bodies and management of organisations will help a great deal to ensure success in TVD implementation.

> *"Everyone should be included in the incentive scheme irrespective of the hierarchy, I think that will encourage the staff. **(CS-01-ED04, Senior Manager)***

> *"Support from senior management, if not for the support we got from the Project Director, most of us wouldn't have gone this path". **(CS-01-ED15, Senior Manager)***

> *"There is also a need for industry and academic partnership support. That is collaboration with the higher institutions through training and workshops". **(CS-01-ED03, Senior Manager)***

The respondents also believe that there is a need for comprehensive monitoring and control of both the TVD implementation at the construction stage together with adequate planning before meetings. The selection of a competent integrated team was emphasised, the respondents said:

> *"Also, quality monitoring and control during execution is very important" **(CS-01-ED07, Lower Mid-level Designer)***

> *"There should be adequate planning before meetings, **(CS-01-ED14, Senior Manager)***

> *"Selection of competent team members is also key to reduce the risk of wastages and to avoid exceeding cost target" **(CS-01-ED03, Senior Manager)***

6.3.4 Case Study One Survey

After the implementation TVD on the case study, a survey questionnaire was prepared to assess the impact of TVD, level of collaboration and the level of TVD benchmarks implementation on the project (see Appendix 8 for a sample of case study survey). A total of 15 respondents were administered with the questionnaire (see Table 6.7); the analyses and results are presented in the following sections.

Table 6.7 Demography of survey respondents

SN	ROLE CATEGORISATION ON THE PROJECT	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.
1	Project Manager	CS1-ED01	Builder	9
2	Site Manager	CS1-ED02	Quantity Surveyor	7
3	Procurement Head	CS1-ED03	Business Admin	10
4	Team Head	CS1-ED04	Civil Engineer	6
5	Head Quality Control Unit	CS1-ED05	Civil Engineer	11
6	Budget Officer	CS1-ED06	Quantity Surveyor	15
7	Mechanical Designer	CS1-ED07	Mechanical Engineer	13
8	Structural Designer	CS1-ED08	Structural/ civil Engineer	10
9	Team Head (Electrical)	CS1-ED09	Electrical Engineer	6
10	Design Team Head	CS1-ED10	Architect	12
11	Design Team Member	CS1-ED11	Architect	4
12	Budget Officer	CS1-ED12	Quantity Surveyor	8
13	Facility Manager	CS1-ED13	Electrical Engineer	8
14	QMU Electrical	CS1-ED14	Electrical Engineer	11
15	Team Head	CS1-ED15	Builder	6

6.3.4.1 TVD Benchmark Implementation

The level of TVD benchmarks implementation was measured in the CS-01. The result of the analysis shows that Benchmark 8, 13, 15 and 17 recorded about 94% full implementation. The result can be attributed to the fact that the project team belongs to a single organisation that has the experience of working together over a long period of time, it was easy to cultivate and maintain trust within the team especially because of co-location at the early stages of the project.

The result also shows that Benchmarks 11 and 14 recorded about 88% full implementation. The project team was divided into clusters and target scope and cost were allocated to the cluster team; these targets were updated and reviewed in the weekly team meeting. The meetings were however not open to all project team members, as some meetings were just for a cluster team and not for the entire project team, which is why Benchmark 16a recorded about 56% full implementation and 38% partial implementation and Benchmark 16b which says Team meetings were held frequently recorded 88% full implementation.

Prior to the investment of design time, implications of cost, schedule and quality of design alternatives were discussed by team members and external stakeholders in team meetings that were held frequently as a result Benchmark 10 recorded 81% full implementation.

Benchmark 1, The customer/client developed and evaluated the business case with the help of the key project team members and decided to fund a feasibility study based on the gap between the project's allowable and market cost. They recorded about 38% full implementation and 25% partial implementation, the same figures were recorded for Benchmark 2a, while Benchmark 2b, the business case included a forecast of facility lifecycle costs, allowable cost and specifications of the project recorded 69% full implementation and 50% partial implementation. All key project team members participated in the feasibility study (Benchmark 3) recorded 63% full implementation and 25% no implementation. Benchmark 5a and 5b have a partial implementation of 44% and 55% respectively, with 38% and 30% full implementation respectively.

The result shows that the following benchmarks have between 50 – 60% implementation: benchmark 6; The customer/client is an active and permanent member of the project delivery team, Benchmark 9a, The cost target set by the project team in this project was not exceeded, Only the client/owner changed the target scope and quality during the project, Benchmark 9b; The target project schedule set by the project team in this project was exceeded. Only the client/owner changed the target scope and quality during the project and Benchmark 7b, all team members understand the business case. However, Benchmark 7a "All team members understand the stakeholder values" got a higher value for full implementation (75%) and 19% partial implementation.

In this study, while feasibility studies were assessed by aligning what is wanted, Benchmark 4a has recorded about 81% full implementation, Benchmark 4b (Feasibility studies are assessed by designing for construction) and 4c (Feasibility studies are assessed by aligning constraints; cost, time, location etc) recorded 38% and 31% full implementation and they both have about 56% and 50% partial implementation respectively.

The Last Planner® System was not used to coordinate the actions of team members, as a result, Benchmark 12 has about 81% no implementation and 19% partial implementation. The details of the levels of TVD benchmark implementation are shown in Figure 6.32

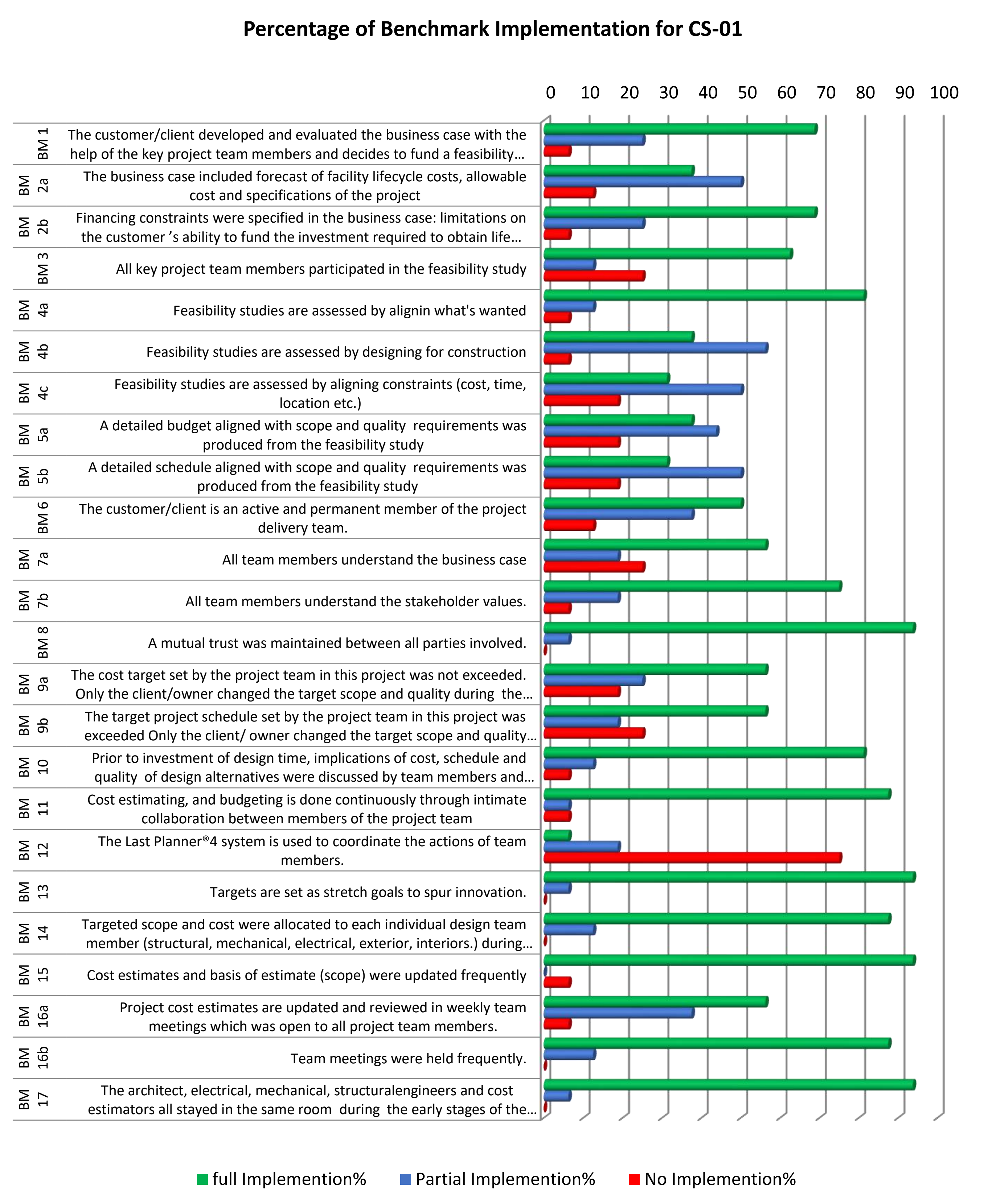


Figure 6.32 Percentage of TVD benchmark implementation for CS-01

6.3.4.2 Measuring Levels of Collaboration in CS-01

Five levels of collaboration were measured in the CS-01, they include collaboration, coalition, coordination, cooperation and networking. The questions in this section attempted to show the level of collaborative working practices in the TVD project.

A. Collaboration

These questions were designed to demonstrate how members are connected, how resources were leveraged and exchanged and the levels of trust as a result of collaboration.

Figure 6.33 shows that in the first question, a total of 53% of the respondents strongly agree and 26% moderately agree respectively that all the team members were located at the place during the design stage. While 6.7% and 6.7% of the respondents moderately disagree and strongly disagree respectively.

All the respondents agree that:

i. Information frequently shared by team members was characterised by mutual trust.
ii. A real feeling of teamwork is in place with my workgroup.
iii. The opinions and ideas of all team members are considered in my workgroup.

This can be attributed to the fact that the case study project was being executed by an integrated team of the organisation with few sub-contractors. This is further corroborated by the fact that about 93% of the respondents agree that team members belong to a single system.

From the questionnaire analysis, it can be deduced that there is a high level of trust within the project team as about 73% of the respondents disagree with the statement that “Team members are distrustful of each other in my workgroup”. Also 87% of the respondents indicated that data was shared in real-time and all decisions were taken with mutual agreement before implementation, only 13% of the respondents had a contrary opinion.

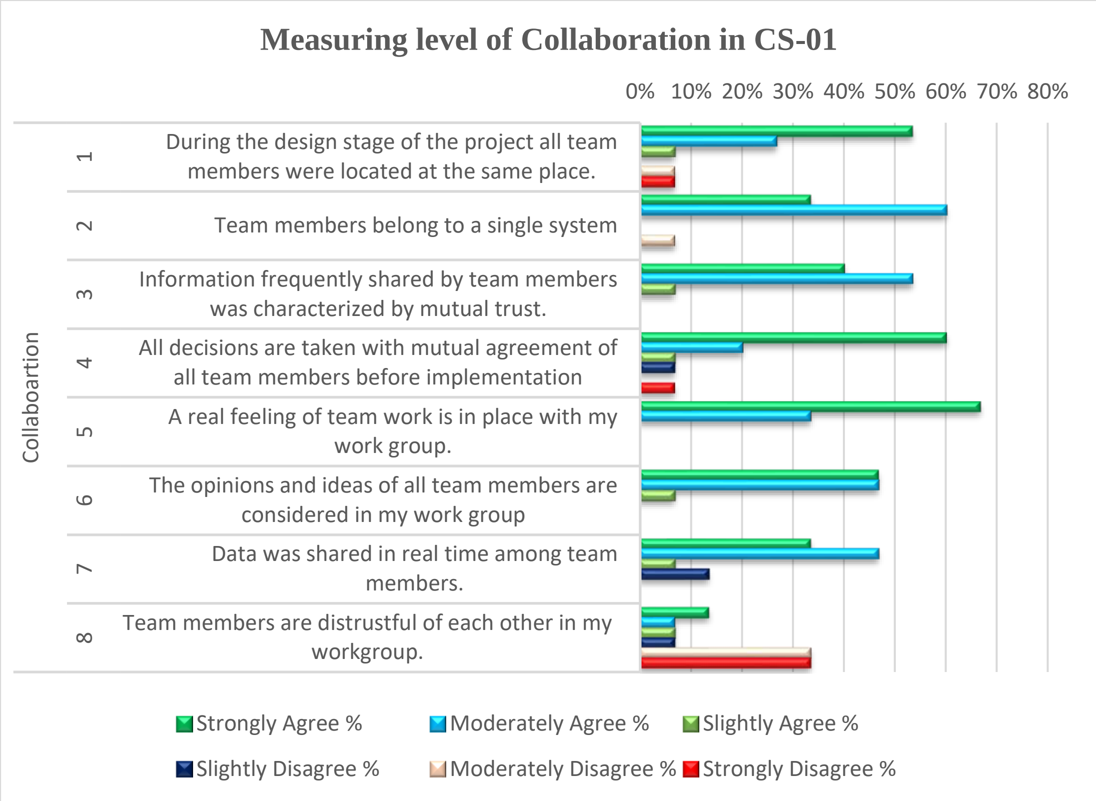


Figure 6.33 Measuring collaboration in CS-01

B. Coalition

These questions were designed to demonstrate how members share information and how they arrive at decisions during the TVD implementation. From Figure 6.34 all the respondents agree that team members had frequent prioritised communication. It also shows that 80% of the respondents indicated that all team members had a vote in the decision making.

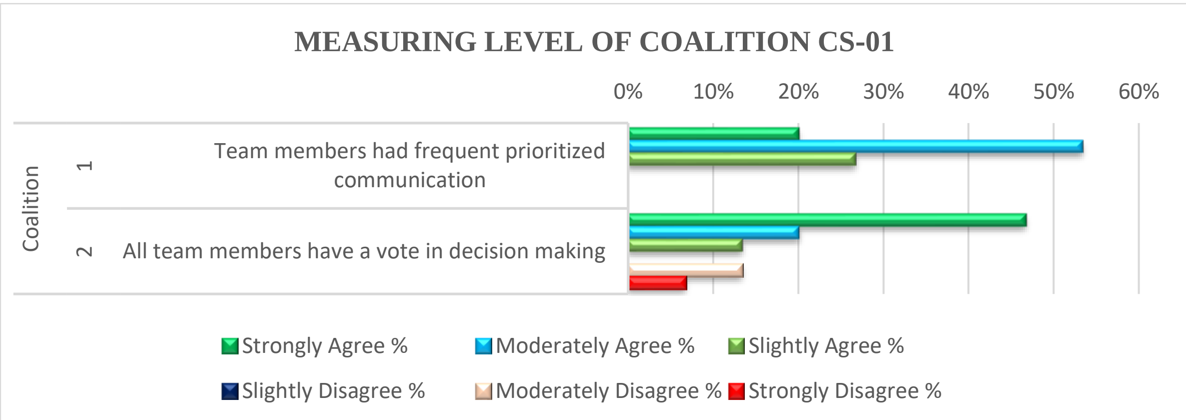


Figure 6.34 Measuring coalition in CS-01 (CS-01)

C. Cooperation

These questions were designed to illustrate the type of communication, the definition of the roles, and how resources were exchanged during TVD implementation. 80% of the respondents believe that all team members had somewhat defined roles, while 20% believe otherwise. 67% agreed that there was just formal communication; the remaining 33% disagreed. All the respondents agreed that information was provided by team members to each person. This can be seen in Figure 6.35

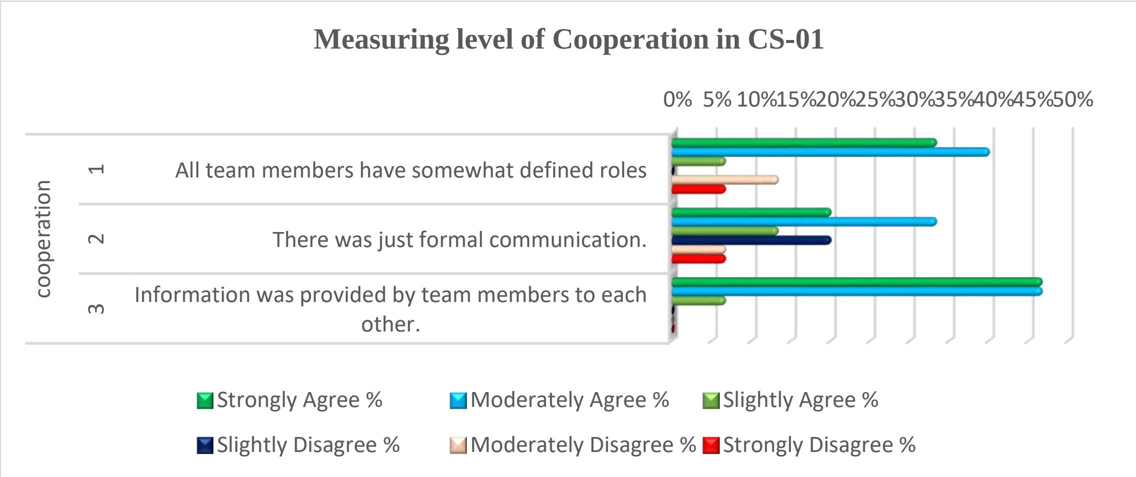


Figure 6.35 Measuring the level of cooperation in CS-01

D. Coordination

The questions in this category were designed to assess the level of coordination in CS-01, the questions were based on team members' roles, how decisions were made, and resources and ideas shared. The resulting analysis in Figure 6.36 shows that all the respondents believed that team members have clearly defined roles and shared resources and ideas frequently. Similarly, 80% of the respondents believed that there was shared decision making among team members and only 20% did not.

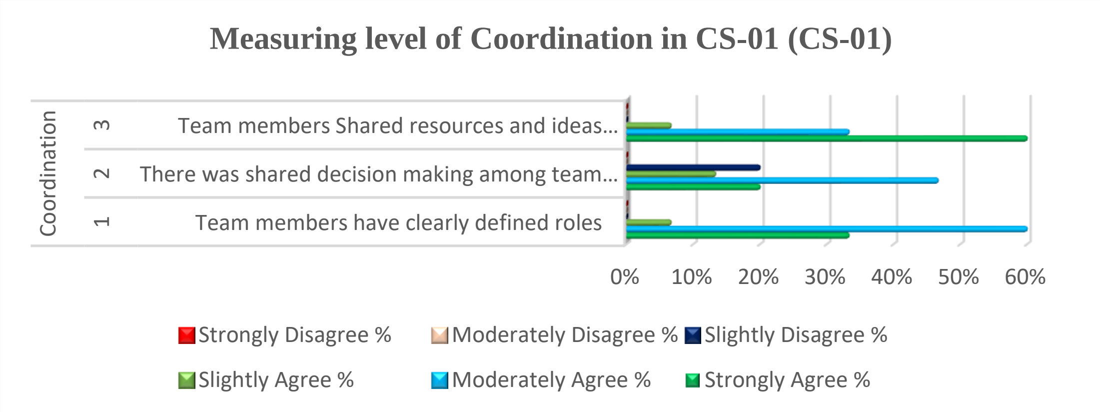


Figure 6.36 Measuring level of coordination in CS-01

E. Networking

The analysis reveals in Figure 6.37 that all the respondents disagreed with the statement "there was little communication". 67% of the respondents also disagreed with the statement "team members have loosely defined roles" while 33% agreed. 73% of respondents disagreed with the statement "all decisions were made independently". Most of the respondents (93%) disagreed with the statement "there was frequent communication without trust".

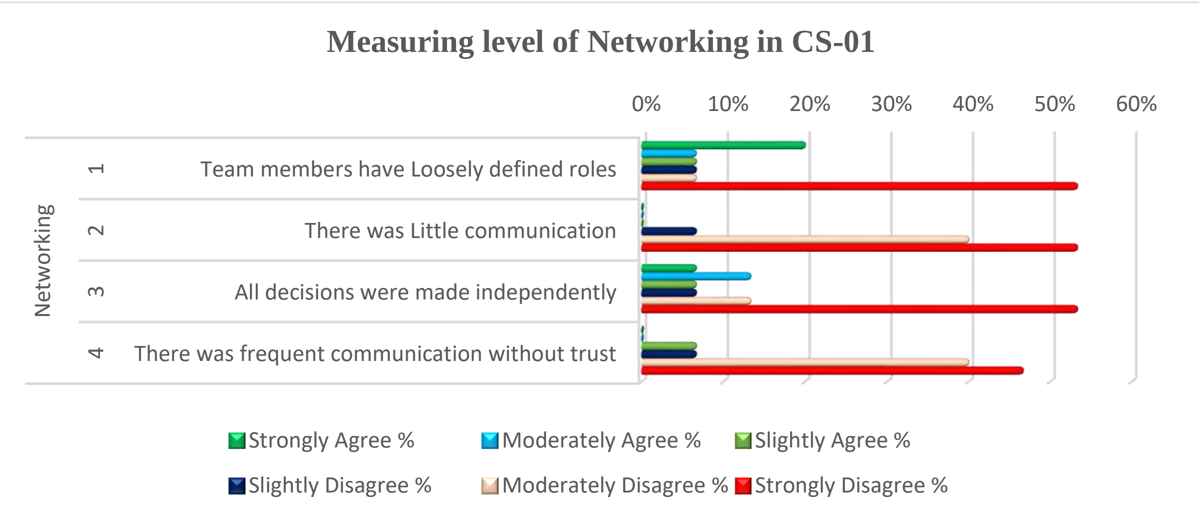


Figure 6.37 Measuring level of networking in CS-01

6.3.4.3 TVD Post Implementation Impact

A. Impact on Cost

The impact of TVD implementation on cost was evaluated in this case study, the views of the project team members were assessed using a survey questionnaire. The analysis of the results shows that all the respondents agreed that firstly: target cost benchmarking helped control cost overruns, secondly, TVD reduces uncertainty on projects which in turn reduces the contingency required to absorb variability, and lastly TVD has lowered project cost by reducing waste and adding value.

Majority of the respondents (93%) agreed that significant cost savings were realised with the use of TVD practices, there was more cost certainty with TVD, and also that the outcome cost is substantially below market price. These both were achieved without sacrificing scope or quality, only about 7% of the respondents were undecided. Furthermore, 87% of the respondents agreed that the project was delivered to budget cost (see Figure 6.38). The analysis of the results shows a very positive impact of TVD implementation on the cost in this project. The implementation of TVD in this case-study enabled the team to gain about 45% savings from the market cost. (see Table 6.5)

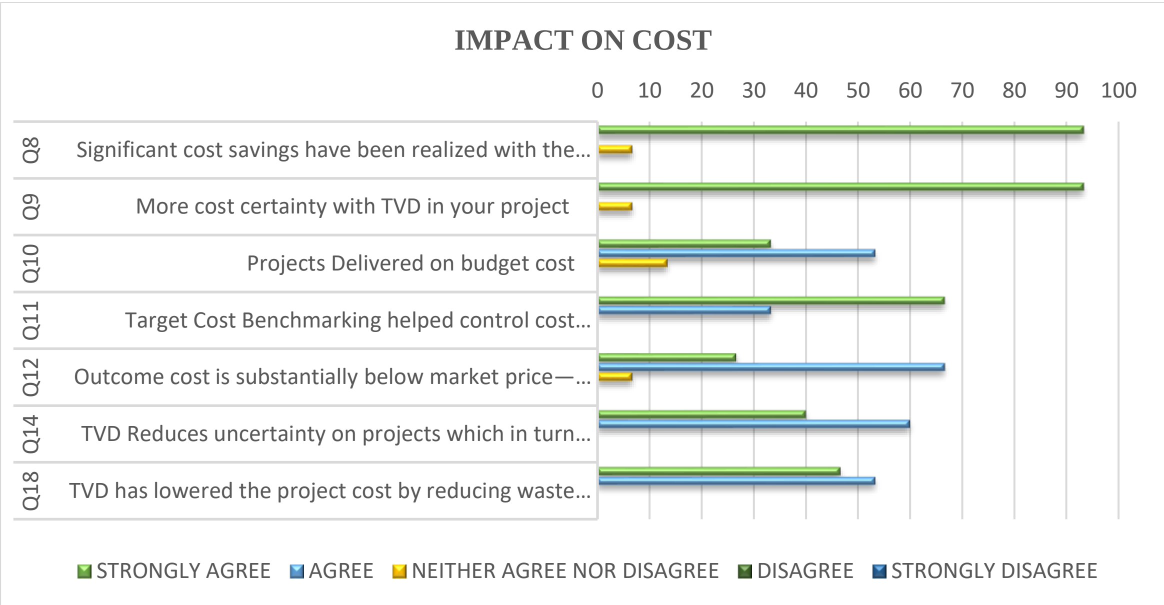


Figure 6.38 Impact on cost

B. Impact on Quality

The impact of TVD implementation on product quality was measured in this project using the survey questionnaire, the result analysis indicated that all the respondents (100%) agreed that better stakeholder value has been achieved with TVD and that the process and tools created the conditions for identifying and delivering the target value from the design process during the planning stage. Similarly, majority of the respondents (93%) of the respondents agreed that "Engaging the client and other stakeholders as key performers reduced change orders and variations". They also agreed that "The TVD process has enabled us to reduce the level and number of re-works on this project significantly".

Likewise, 93% of the respondents agreed that "Results from TVD did not compromise quality and best quality was achieved despite designing to target" and the TVD process increases the quality for the product delivered considering all stakeholder interests. In this case study better target value was achieved by engaging with the client, designers and end-users as 93% of the respondents agreed while only 7% were undecided (see Figure 6.39).

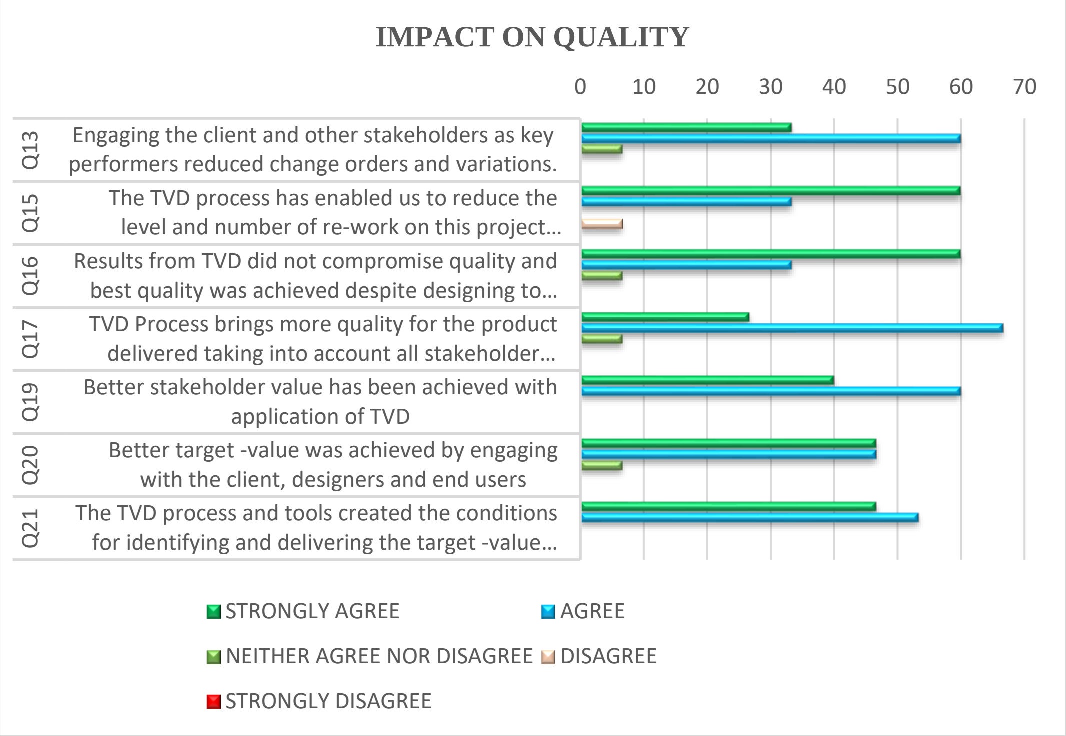


Figure 6.39 The impact on the quality

C. Impact on the working relationship

The evaluation of the impact of TVD implementation on working relationships in this project consists of about seven questions, out of which three questions had 100% agreement, another three had 93% agreement with 7% undecided and the last question had about 86% agreement with 7% undecided and 7% disagreeing.

The questions with 100% agreement include: Co-location improves communication and facilitates consensus decision-making among stakeholders, collective planning was important in implementing TVD in your project, stakeholder collaboration helped in setting targets.

The questions with 93% agreement included: A harmonious working relationship is maintained which encourages a teamwork approach to innovative ideas in problem-solving, I like working in this manner, and trust and confidence in other project team members have improved because of colocation as practised in TVD. And lastly, 86% agreed that use of cross-functional teams/cluster teams increased the efficiency of the TVD project (see Figure 6.40).

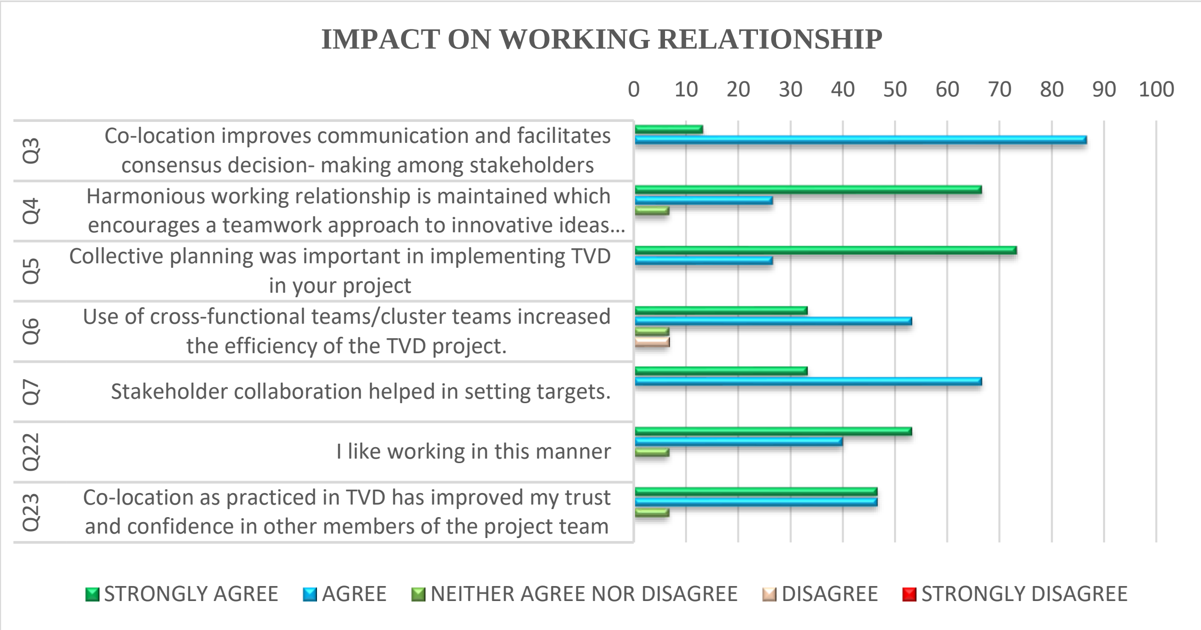


Figure 6.40 Impact on the working relationship

D. **Impact on Time**

The impact of TVD implementation on time was measured, the result presented in Figure 6.41 shows that all the respondents agreed that the process consumed time in the planning stage but helped them gain more speed in the execution stage, 66% of the respondents agreed that "We were able to deliver the project on or before scheduled time with TVD". This stage of work was scheduled to be completed in fourteen months, but the implementation of TVD enabled the team to complete that phase in eleven months, three months ahead of scheduled time.

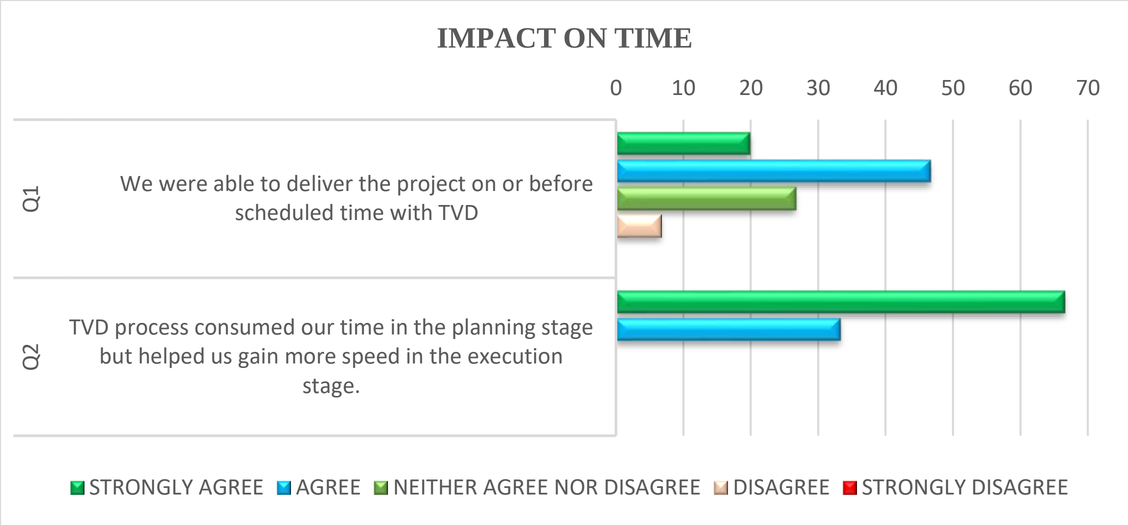


Figure 6.41 showing impact on time

6.3.4.4 Impact of Procurement Route on TVD in CS-01

On CS-01 which is a private real estate company, the study used the design and build (DB) procurement route. The impact of the DB procurement route on a private real estate developer may differ from the impact of DB on other construction project types. This study reveals the three impacts of procurement route on TVD in CS-01. These are:

a. Early involvement of stakeholders
b. Client satisfaction.
c. Working relationship

For CS-01, TVD thrived at project initiation and planning. This can be attributed to the fact it is a private real estate development company operating an integrated team that was colocated, this enabled early involvement of the design team and key stakeholders. Also, TVD was successful at the project execution, monitoring and control stages as the project achieved client satisfaction. There was collaboration among the team members as a result of the procurement route chosen for the project. This the respondents noted that it greatly helped to improve the working relationship. Eriksson and Westerberg (2011) observed that both practitioners and academics argue that many of the problems in construction projects are linked to choosing the wrong procurement route where the focus is on short-term individual sub-optimisation rather than on long-term project team performance.

6.4 Case Study Two: Description of Case Study Project (CS-02)

6.4.1 Case Background

Case study (CS-02) is one with the traditional procurement method located in Barnawa, Kaduna state of the north-west region of Nigeria. It entailed the demolition of a dilapidated filling station, redesign and construction of a new one that will serve commercial purposes. The project's duration was planned to last 5 months with a value of approximately ₦85 million (USD 236,111.00). The project included the construction of a station building with a lube bay, burial of tanks, construction of the forecourt, external works and the erecting of a steel canopy where pump islands will be located.

In this case study, TVD was implemented only at the initiation and planning/design stage of the project. The project details are stated in Table 6.8

Table 6.8 Project information

CLIENT	**PRIVATE OIL AND GAS COMPANY**
Building Project	Development of filling station
Floor area	3500 Square metre
Contract Mode	Traditional procurement route (Tendering).
Duration of project	5 months

The client was a company established over 29 years ago as a manufacturer and marketer of reliable and high-quality lubricants and oil products across the ECOWAS sub-region and traded in crude.

Part of the business plan of the client was to continue to invest in developing filling stations across Nigeria. They had already contracted a filling station near the international airport in Abuja, where the researcher was the project manager of the development. The contract for the Abuja station was a traditional one awarded through a tender process which the researcher was not part of. The project faced many challenges at about 60% completion with variations due to site conditions, electrical and mechanical design not being done and a lot of the provisional sums exceeding their budget. The client notified the researcher that they wanted to develop a similar filling station in Kaduna which is about 2-hours' drive from the first project. The researcher presented TVD to the management team in charge of construction clearly showing how TVD would avoid previous challenges and how it was successful in other projects especially if implemented at project initiation. This was the major driver for implementing

TVD. The researcher served as the facilitator for applying TVD. Data collection was done through interviews, participant observations and survey questionnaires.

6.4.2 Application of TVD

The client bought in and agreed on TVD, but the company was concerned about paying for a design team when the contract had not been awarded. The researcher identified the need to reduce rework and changes as the major driver for the company to implement TVD, other drivers recognised include; the need to save costs, to improve the construction process and to achieve the construction cost below their budget.

Observation

Record and physical condition analysis were conducted to determine how the organisation's practice differ from TVD practices and to align the two practices. The document analysis involves the scrutiny of the company policy, business case, concept designs, drawings, etc. The researcher observed the weekly meeting, contractual structure, progress reports, training and all other processes involved in implementing TVD on the case study.

6.4.2.1 Project Initiation Stage

6.4.2.1.1 Business Case Review

TVD was not part of the business case for developing the filling station. During the review of the business case, the facilitator discovered that relevant stakeholders were part of it. The researcher studied the documents and advised the client that the team (Including the proposed tenderers) needed to be integrated and work collaboratively.

6.4.2.2 Project Planning Stage

6.4.2.2.1 Feasibility study

A. TVD in Bid Process (Prequalification of Tenderers, Invitation to Tender and Inclusion of TVD benchmarks and practices in Tender criteria).

The project adopted a traditional procurement route: a shortlist of contractors was drawn up from the list of former contractors and prequalified by the client with the help of the researcher. The prequalified tenderers were chosen for a selective tendering process and were invited to submit tenders. The purpose of the selective tendering was to ensure that only contractors with the necessary experience and competence were given the chance to submit the bids which, in turn, improved the quality of the bids received. Another major reason for the selective tendering was to make the tendering process more manageable and less a burden on the parties involved since TVD was going to be implemented on the project.

A major and compulsory term and condition for participation in the tendering process was that the prequalified tenderers would send in representatives that would participate during the design stage where TVD practices and benchmarks would be fully implemented. They were informed that their innovative contribution during the design would be used as one of the technical evaluations for the bids. Two contractors were prequalified for the building construction, while four contractors were prequalified for the electrical works.

The contract was divided into two, the first part involved the civil/mechanical bill of quantities (BOQ) while the second involved the electrical BOQ; this was divided into Lot 1 for internal and Lot 2 for the external electrical BOQ.

B. Submission of Tender and Selection of Integrated team

The client awarded the project management (PM) to a company where the researcher was the Managing Director. Two groups of team members were involved in this project: the team from the PM firm and the teams from the tenderers. The team from the PM firm consisted of the researcher, a senior project manager/QS, a site project manager, a quantity surveyor/estimator and an architect, all of which were in-house staff of the PM firm. The prequalified contractors (tenderers) had representative consultants as team members for the planning and design stages of the project. Each team from one prequalified tenderer, together with the team of the PM firm, formed cluster teams independently of the other prequalified tenderer teams during the planning and design stage. Their roles and responsibilities were assigned and transparency was a requirement for all. The team utilised virtual collaboration because some of the participants were not located in the same city; communication and sharing of data between team members were done via emails, phone calls and other software applications like WhatsApp video calls.

C. TVD Training Workshop

A workshop was conducted at the PM’s office in Abuja with all the team members. The workshop served as training on TVD for the project team and lasted for about 60 minutes. TVD successes and benefits were presented, a question and answer session was conducted after the training with the facilitator (researcher) as the presenter.

D. Stakeholder and Project Value

The teams collated the stakeholders' values by discussing with each stakeholder. The client disclosed their perception of value to be the adherence to the department of petroleum resources'(DPR) specifications.

E. Expected Cost During Design and Construction

The researcher asked the client what the budget/benchmark was, but the client representative said that it was a confidential figure approved by their board and as such, the team should figure out a way to benchmark. The facilitator and the team agreed to use the ongoing Abuja project rates awarded by the client as the client's allowable cost.

The allowable price was about ₦147.5 million (USD 409,722.00), the expected cost (product-level target cost) was estimated by the team to be about ₦124,913,964.41(USD 346,983.20). The estimated cost from tenderer 1 was about ₦128 million (USD 355,555.60), while tenderer 2 was ₦127 million (USD 352,777.80).

F. Target Setting

i. Setting Cost

The benchmark price was set based on the previous similar contract by the team. The target was set at ₦121,532,226.64 (USD 337,589.50) lower than the allowable and the estimated cost. The setting of the target was done by the project team, they took the Abuja price as the benchmark market price for setting the targets. Figure 6.42 shows the project cost model:

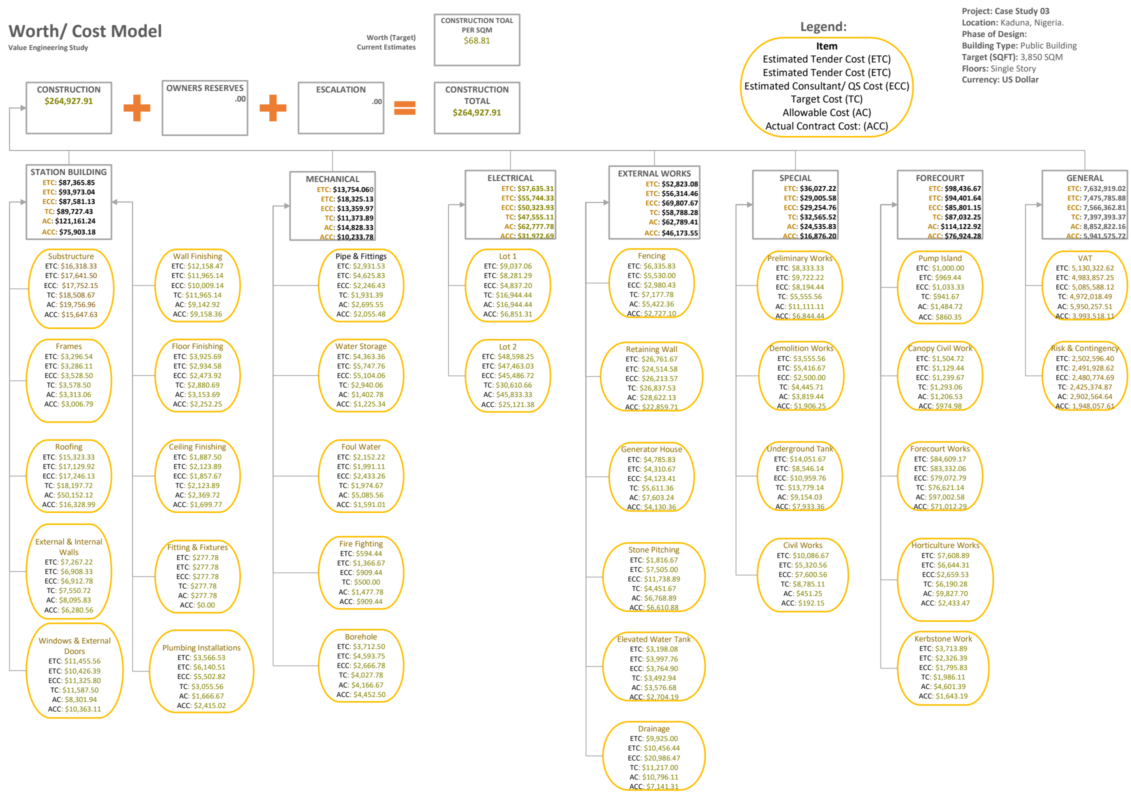


Figure 6.42 Project cost model

ii. Setting Project Timeline

The duration of the project was agreed on by the team who collaboratively set the timeline for the project design and planning at 5 months to allow proper estimation. The team also set the target timeline for the execution of the project at 4 months. The client was initially worried that the tendering process was taking longer than they anticipated but when they saw the attention to detail of the team (the discovery of missing items in BOQ and attention are given to statutory decisions which would have affected the project), they understood the reason for the duration set. This was possible because the client was an active participant in the whole process. The involvement of the proposed contractors/tenderers also allowed the project team to determine which contractor was capable and best suited - better than the usual judgement based on company profile alone. Figure 6.43 shows the project timeline.

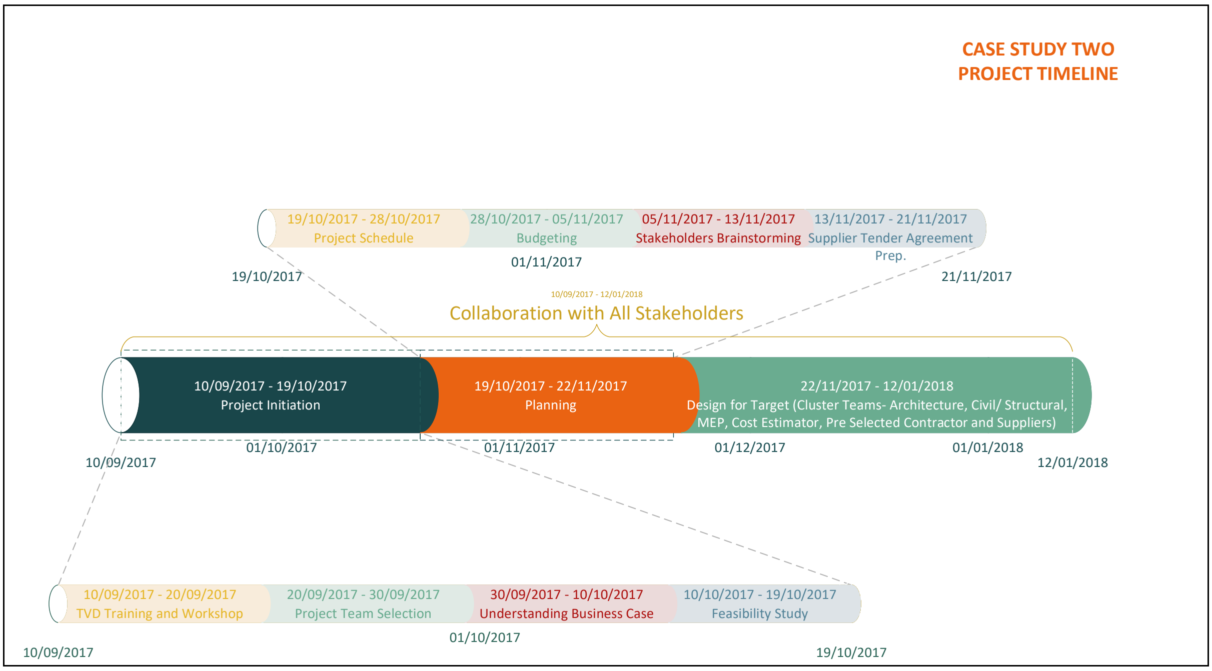


Figure 6.43 Project timeline

iii. Setting Quality Standards

The specifications of the project were fully examined and set by all cluster team members depending on their expertise.

iv. Setting Value propositions

The value requirements of all stakeholders were identified and included in the designs as described in Section D.

6.4.2.2.2 Pre-Design Planning

a. Evaluation of the tenders/tenderers' competences during collaborative design

During the pre-design planning and design stage proper, several meetings between the PM team and the prequalified tenderers' teams were conducted (face-to-face and virtual meetings) where the agenda and requirements were discussed and agreed. The planning included aligning the design to site conditions by:

i. Conducting a confirmatory topography survey to ensure that the design could be achieved in relation to the topography.
ii. Conducting a geotechnical investigation comprising of a soil test for the buildings and tank burial locations, as well as on the external site.
iii. Conducting a geophysical survey for the design and the positioning of a borehole.

iv. Preparation of hydrological reports to plan the drainage.

The teams from the prequalified tenderers actively participated in the design stage of the project. (see Figure 6.44 for the project modelling process).

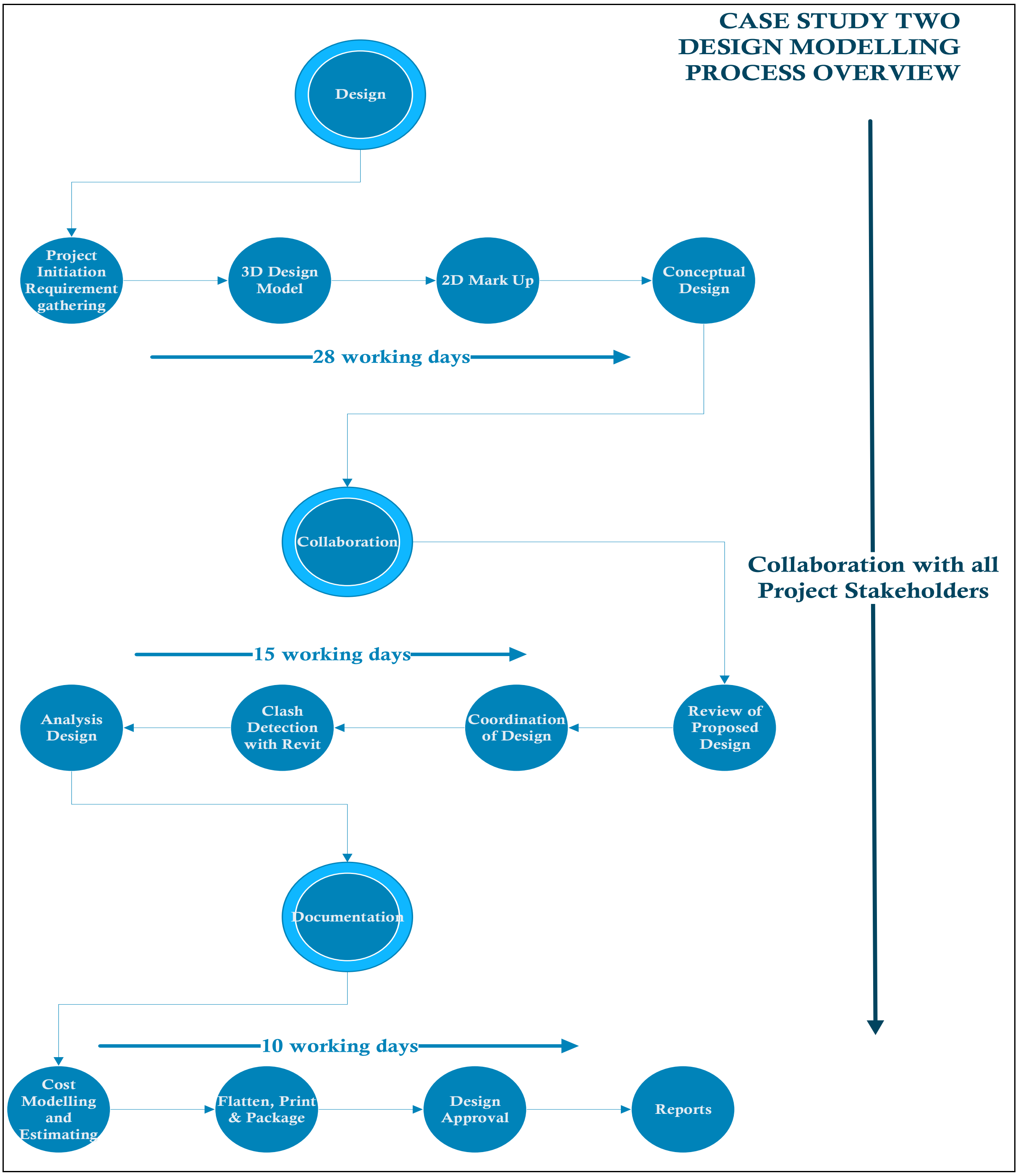


Figure 6.44 Project modelling process

A. Steering to Targets During Design

i. Cross-functional Teams for Design

The targets set were decomposed into component-level targets, each cluster was allocated targets to design the product along with processes. There were four main clusters namely;

a) Civil/structural
b) Architect/building and prelims
c) Electrical
d) Mechanical/plumbing

The clusters all reported and communicated to their cluster leaders who were central and charged with the responsibility of leadership and integrated governance. The clusters came up with multiple designs and the most responsive innovative design was selected, cost and specification steering the component costs under or equal to targets. All provisional sums provided in the bill were broken down into details by the clusters team and detailed designs were provided for all project components. all modification and missing items in the initial bill were also designed to cost. Figure 6.45 shows the project cluster team. Their roles and responsibility were specified, savings from one cluster were transferred to others that had cost over their targets or those that had to fund missing items or variations.

Cluster members were guided by cluster leaders who adopted integrated and collaborative practices. Collaborative technologies such as emails and WhatsApp Video calls were used to improve communication, real-time updates of costs with other clusters. The members had to be transparent, work collaboratively and share all information and ideas freely, this helped prevent corruption, contract paddings and incorrect pricing.

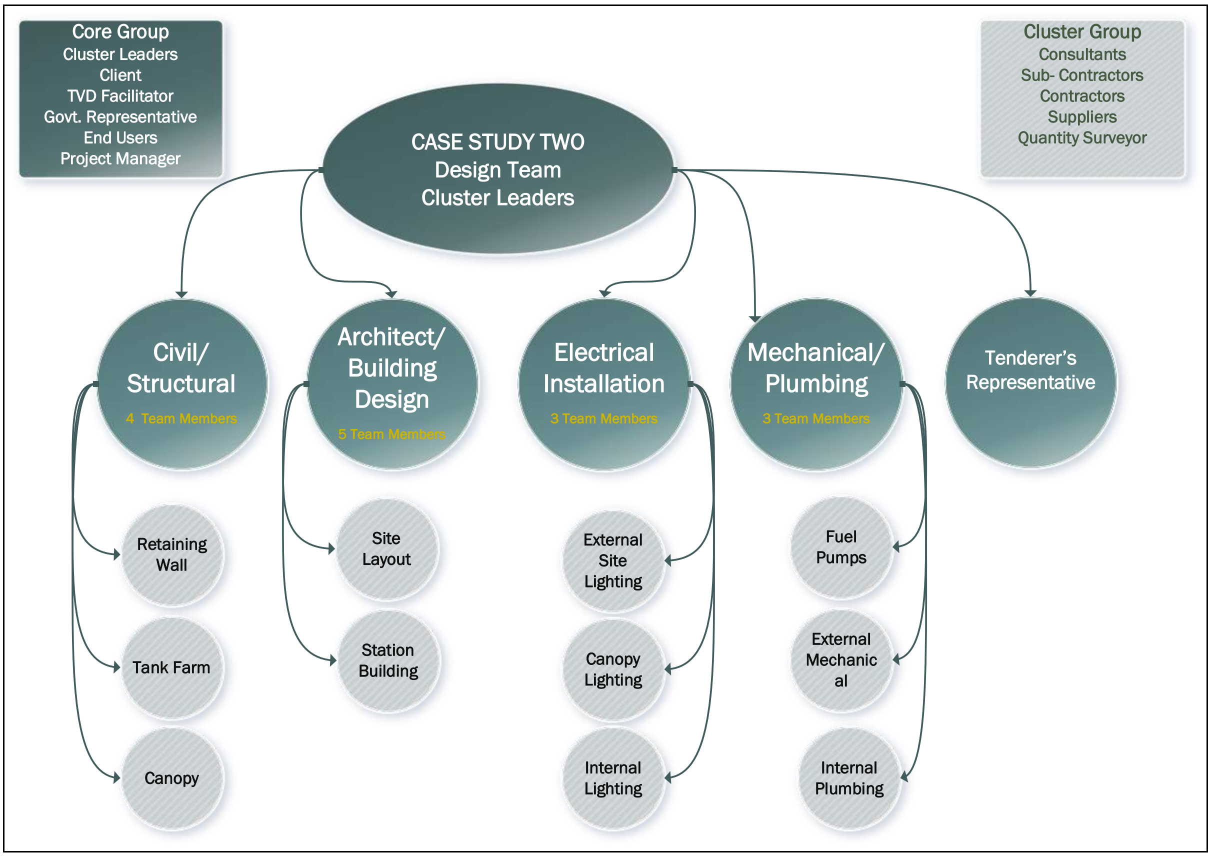


Figure 6.45 Project cluster teams

ii. Co-location and big room

Team members were not all located in one room, Only the initial project briefing and TVD training meetings were held in a big room. The project had a virtual team with cluster group members meeting weekly.

iii. Integrated and collaborative conversation

The project team was integrated and worked collaboratively to set and design to targets as early as concept design, leading to contributions of sub-contractors, trades and suppliers.

iv. Value Engineering Exercise:

The brainstorming technique in value engineering was used to seek alternative product and process designs without affecting their function, scope and quality specifications.

v. Cost Modelling and Cost tracking

Costs were continuously updated during the exercise to reflect new estimates and to indicate if costs of elements were more than the set target. Real-time costing was done to report the cost implications of different options proposed by the team. Table 6.9 shows the project cost model-dashboard, Figure 6.46, 6.47 and 6.48 show the Case study comparison of the total cost, Comparison between allowable cost and actual contract awarded figure and Project cost estimating process. The estimating process was done using extraction and measuring quantities from AutoCAD software, QS plus software.

Table 6.9 Case study-02 project cost model- dashboard

SN	Description	Estimate Tender Cost (1)	Estimate Tender Cost (2)	Estimate Consultant Cost	Target Cost	Allowable Cost	Actual Contract Awarded Figure
1	Preliminaries & General Items	$8,333.33	$9,722.22	$8,194.44	$5,555.56	$11,111.11	$6,844.44
2	Demolition	$3,555.56	$5,416.67	$2,500.00	$4,445.71	$3,819.44	$1,906.25
3	Station Building	$75,476.96	$78,834.15	$77,418.09	$79,726.17	$106,230.69	$67,152.48
4	External Works	$54,371.36	$56,314.46	$69,807.67	$58,788.28	$62,789.41	$46,173.55
5	External Mechanical	$13,754.06	$18,325.13	$13,359.97	$11,373.89	$14,828.33	$9,324.33
6	Underground Tank Installation	$14,051.67	$8,546.14	$10,959.76	$13,779.14	$9,154.03	$7,933.36
7	Civil Work for Product Pipeline	$10,086.67	$5,320.56	$7,600.56	$8,785.11	$451.25	$192.15
8	Forecourt/Pump Island/ Canopy/ Soft Landscaping/ Kerbs/Underground Safe	$98,436.67	$94,401.64	$85,801.15	$87,032.25	$114,122.92	$76,924.28
9	Electrical Bill Lot 1	$9,037.06	$8,281.29	$4,837.20	$16,944.44	$16,944.44	$6,851.31
10	Electrical Bill Lot 2	$48,598.25	$47,463.03	$45,486.72	$30,610.66	$45,833.33	$25,121.38
11	Contingency 2.5%	$6,951.66	$6,922.02	$6,891.04	$6,737.15	$8,062.68	$5,411.27
12	Vat 5%	$14,250.90	$13,844.05	$14,126.63	$13,811.16	$16,528.49	$11,093.11
	TOTAL COST	$356,904.13	$353,391.36	$346,983.23	$337,589.52	$409,876.13	$264,927.91
						Actual cost Savings %	35.4

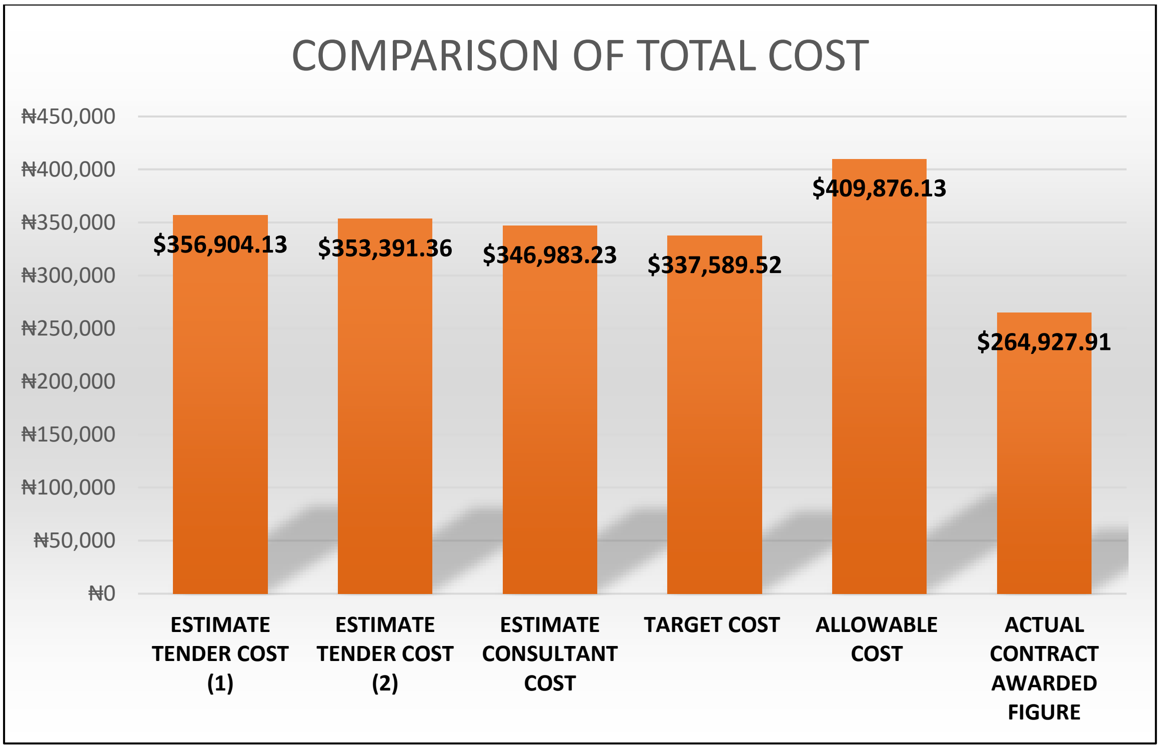


Figure 6.46 Case study comparison of the total cost

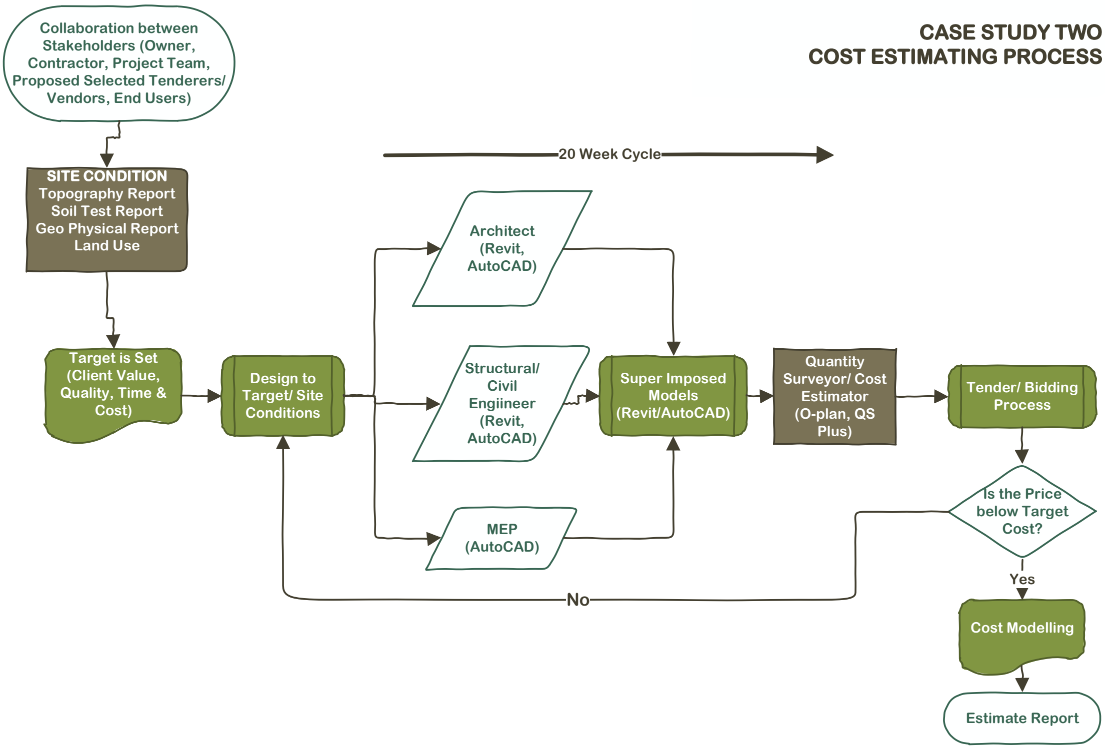


Figure 6.47 Project cost estimating process

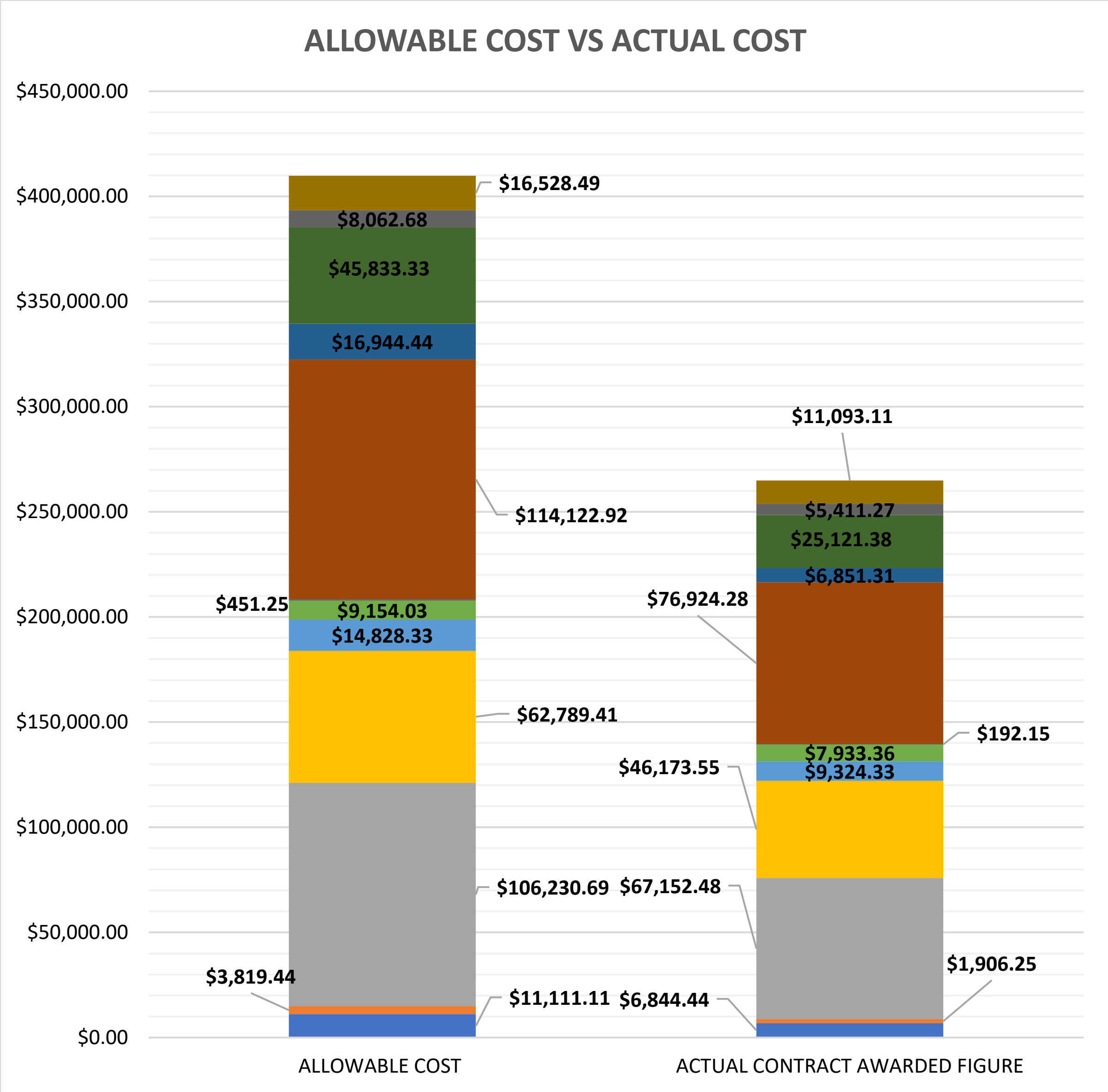


Figure 6.48 Comparison between allowable cost and the actual contract awarded figure

Assessment of the 'Most Responsive Bid'

The most responsive bid was determined based on their compliance with the TVD practices, the aesthetics of the design options and their quotations.

Negotiations for discounts and the inclusion of TVD benchmarks and practices in the contract

The final stage before the award of the contract involved a detailed discussion with the tenderers individually about the offer. This was carried out to ensure that the improved value was being obtained, even after the design. Because of the collaborative designing that involved the PM team and the tenderers' teams, the tenderers were willing to offer an additional discount on the price for the project.

Award and Announcement of Results

After the negotiations, the tenderer with the most responsive bid was declared the successful contractor. The unsuccessful tenderers were informed about not being awarded the contract, and they expressed satisfaction with the whole process.

6.4.3 Semi-structured Interviews

After the implementation of TVD, an interview guide was prepared for key participants, the analysis of the results is presented in the following sections

6.4.3.1 Demographic Information of Respondents on CS-02

A total of nine respondents were interviewed in this case study project. The respondents include project manager, quantity surveyors, architects, civil engineers, builders, mechanical engineers and electrical engineers (see Table 6.10). The interviewed respondents cut across the key stakeholders that were directly involved in the project, from the beginning to the end of the project design stage.

Table 6.10 The demography of interview respondents.

CODE	POSITION IN ORGANISATION	YEARS OF EXPERIENCE	PROFESSION
CS-02-PS01	QS Custer team member	25	Quantity Surveyor
CS-02-PS03	Head of Architectural team	12	Architect
CS-02-PS04	Head of Structural Cluster	14	Civil/Structural Engineer
CS-02-PS05	QS/PM	16	Quantity Surveyor
CS-02-PS08	Electrical Sub contractor	24	Electrical Engineer
CS-02-PS09	Civil Cluster member	27	Civil Engineer
CS-02-PS10	Client	25	Civil Engineer
CS-02-PS11	Head of Electrical cluster	15	Electrical Engineer
CS-02-PS12	PM	3	Civil Engineer

6.4.3.2 Benefits of TVD Implementation

Benefits in this thesis refer to the positive outcome of TVD implementation. Figure 6. 49 shows the benefits that were reported by the respondents in the project.

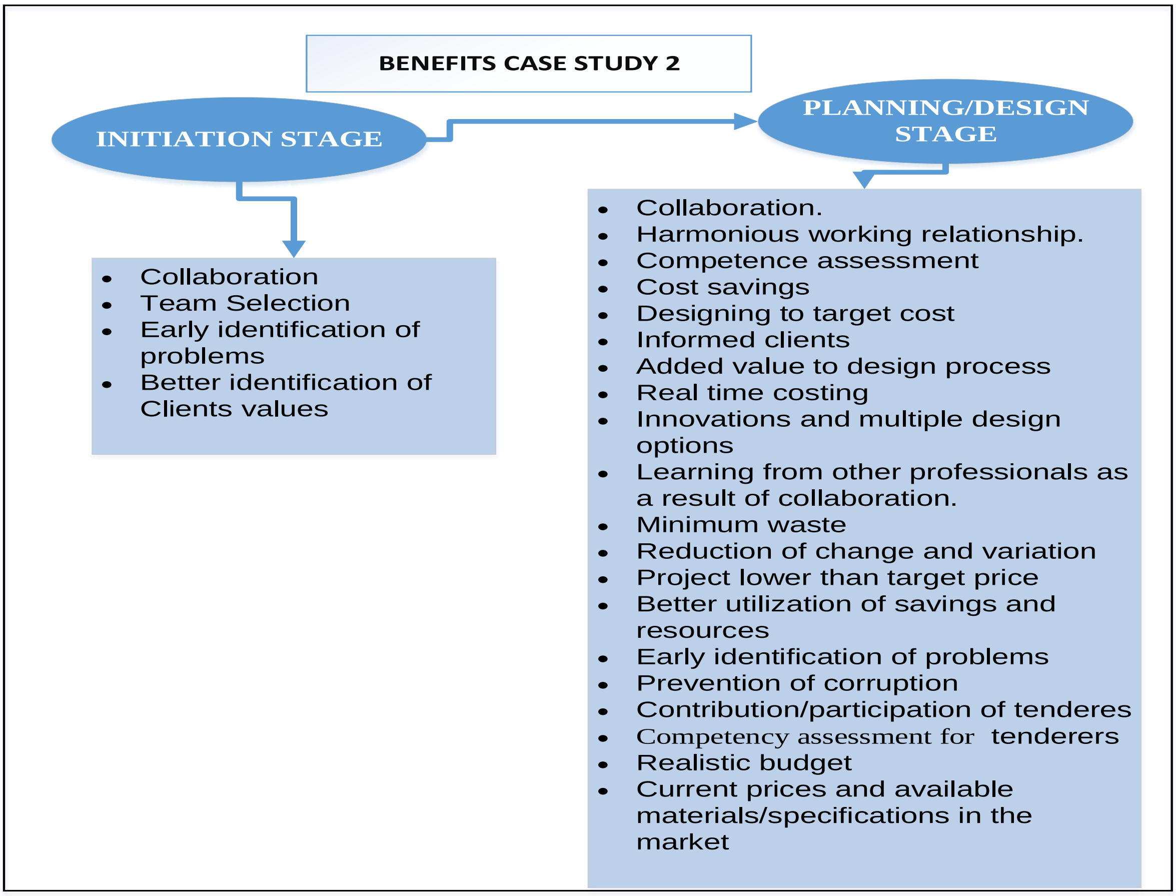


Figure 6.49 Benefits of the implementation of TVD.

6.4.3.2.1 Benefits of TVD Implementation at the Project Initiation Stage

The respondents were asked about the benefits they observed in the implementation of TVD in the project initiation stage. The benefits as recognized by the respondents were; collaboration, integrated team selection, better identification of stakeholders' value and early identification of problems.

Majority of the respondent believed that the implementation of TVD brought about the collaboration of all the team members, although the team members were not located in the same place, implementing TVD ensured that there was a collaboration because the team had to relate together, sharing information with each other. Selecting an integrated team is another benefit of the implementation of TVD that was noted by the respondents of the interview for this case study, all the team members were aware of the project requirements, this made the criteria for choosing team members clear and team selection was easier. The implementation of TVD helped ensure that the project team understood all stakeholders' values, the meetings and collaboration between them ensured that everybody understood what was expected from them and the team. Respondents in this case study also mentioned the early identification of problems as one of the benefits of TVD implementation in the initiation stage

The early identification of problems is possible with the implementation because the team meets and discusses all aspects of the project, identifies and addresses issues that might arise. These were expressed in the respondents' words;

> *"During the initiation stage, I think one of the benefits we saw was the team was integrated. All disciplines were brought together to participate right from the beginning." (**CS-02-PS12 PM**). "It identifies problems early as all stakeholders are involved, it brings us cohesion in the team to see what we are looking at, the price we are looking at and this is the way we are going to get it right." (**CS-02-PS10 Client**)*
>
> *"We identified the stakeholder values; everybody knew what they were supposed to do, what the client wanted." (**CS-02-PS12 PM**)*

6.4.3.2.2 Benefits of TVD Implementation at the Project Planning/ Design Stage

Analysis of the interview revealed that the respondents identified the following as the major benefits of the implementation of TVD in the planning stage of the project; teamwork and collaboration, harmonious working relationship, team selection, competency assessment for tenderers, design to target, cost savings, stakeholder values, missing items, identification of current material prices and there availability in the market, realistic schedule, innovation and multiple design options.

Most of the respondents believe that TVD implementation fostered teamwork and collaboration, just as was seen in the initiation stage, it encouraged teamwork and collaboration even though the team members were in different states of the country. Some respondents are convinced that implementing TVD had led to the development of a harmonious working relationship between the team members, sharing ideas and knowledge, collaborating with each other through face-to-face and virtual collaboration has built trust and understanding between them which has led to a harmonious working relationship and better communication. The interaction with the people ensures that you can assess them, and you are sure that you have selected the best team/tenderers for the project. TVD also ensures that the team members develop themselves and work well as a team. This is captured in some responses:

> *"It encourages teamwork. We now know we have a target, so we all worked together to see that that target is achieved. Though we were not all physically located in the same location one of the things I noticed during the planning stage was that communication via email and video calls was very effective especially from the projects manager's angle." (**CS-02-PS08 Electrical Subcontractor**)*
>
> *"Every team member had the opportunity to review tenderers profiles to see their experience. so, it is quite different from somebody imposing a contractor on you. TVD helped in team selection" (**CS-02-PS11 Electrical Cluster Head**). "TVD reveals the capacity of subcontractors, I showed more teamwork approach that is required in TVD and because of my contribution, my competence and experience. they were able to access me from the beginning that I am a better contractor." (**CS-02-PS08 Electrical sub-contractor**)*

Designing to target is the fundamental principle of TVD, the team and all the clusters were given targets that they could not exceed, and they were able to use their experiences and skills to steer the design to the set target cost by applying innovative thinking and creativity. TVD also prompted the team to visit the site, conduct surveys and tests that ensured that their changing designs were feasible. Profit-making is the desire of every investor and cost savings (when investing the capital) is one of the ways to maximise profit. The study shows that the implementation of TVD helped the project team to save cost and as designs changed to attain the target cost, the cost of these new designs was updated, and the information shared across the team. The team knew of the cost updates as soon as they happened (real-time). The study also shows that stakeholder values were identified because of the implementation of TVD, they expressed this by saying:

> *"We were able to direct the team to design towards a particular cost, we were able to have a focus, we had a target and everybody knew that they could not exceed the cost" (**CS-02-PS12 PM**)*

> *"TVD helps us get current real-time cost. And it helps us get the specification of available materials in the market" (**CS-02-PS03 Architectural cluster head)**)*

Designing to target in TVD pushed the design team to bring up innovative ideas and out of the box thinking to find ways to reduce the cost of the project, multiple design options were suggested and assessed to figure out a way to save cost without compromising quality. The interview analysis shows that the design process improved with TVD, because of the practice there was added value to the design process for subsequent use. Training and workshops were conducted to introduce TVD to the participants of the project, this improved the team members because they gained added knowledge, the team benefited from the implementation of TVD because they were able to learn from each other, learning even across disciplines was possible because of collaboration. It is evident from the analysis of the interview that the early identification of problems was possible because of the implementation of TVD, following the steps (benchmarks) ensured that problems were identified early in the planning stage of the project, this is critical because it ensures that the problems identified are tackled head-on using innovative ideas and redesigns, respondents noted that;

> *"We were able to bring in different design alternatives rather than having a fixed design since we had a cost in mind." (**CS-02-PS04 Structural cluster Head**). "The benefit in this aspect is that it added value to the design process itself as a result of that many issues were raised based on the initial concept of design. We sat down and decided what needs to be done based on the site conditions." (**CS-02-PS03 Architectural cluster head)***

> *"Part of the benefit for us was learning from each other like I said many of the team members working effectively is the key to achieving this particular objective." (**CS-02-PS11 Electrical subcontractor)**. "TVD has helped to eliminate any sharp practices of corruption in this project that would have resulted in a waste of resources." (**CS-02-PS11 Electrical subcontractor**)*

6.4.3.3 Barriers to TVD Implementation

The general barriers reported by the respondents were collected and categorised, this is shown in Figure 6.50.

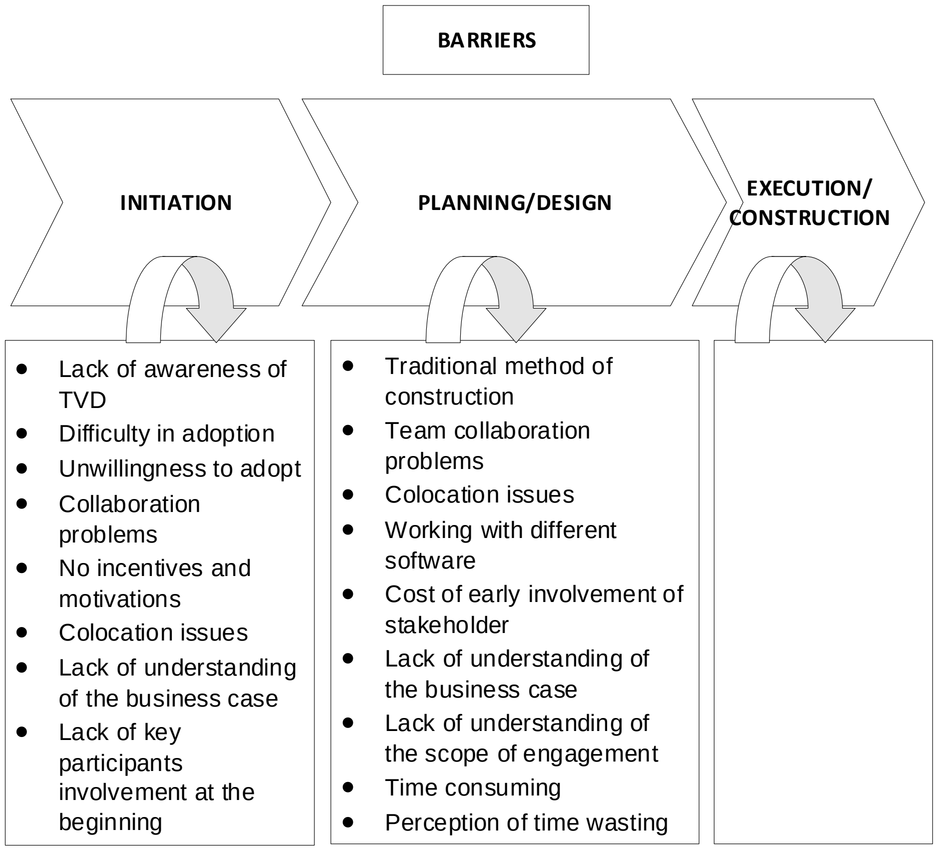


Figure 6.50 Barriers to the implementation of TVD

6.4.3.3.1 Barriers of TVD Implementation at the Project Initiation Stage

TVD implementation came with its challenges like any other new practice, the participants of the interview identified some of the barriers to TVD implementation. The major barriers all the respondents recorded in this case study is the lack of awareness of TVD, many Nigerians have not heard of the concept let alone practised it. The study shows that there was some difficulty in adopting TVD mainly because of the lack of awareness about TVD and being used to construction in the traditional way. The study also shows that after overcoming lack of awareness, there was unwillingness to implement TVD for various reasons. In this case study, collaboration was a challenge at the beginning but with time, the team adjusted to working in the group and sharing ideas and concepts. Some respondents even blame it on the lack of commitment of some people. The respondents of this interview expressed that lack of incentives and motivation was a barrier of implementing TVD, they said that having incentives would encourage them to participate more. Analysis of the interview showed that there were co-location issues on this project because most of the team members were in different states. Another major barrier to the implementation of TVD in this stage was the lack of involvement of all key stakeholders at the beginning of the project which in turn caused a lack of understanding of the business case by some of the project team members. Some respondents stated that;

> *"The client was not willing to accept the TVD in the beginning. In fact, when we asked them to give us the budget benchmark amount, the clients said he didn't want to give us the answer to the question, it is kind of confidential."* ***(CS-02-PS05)***

> *"Lack of incentive is a barrier. The professionals would have felt better if they knew what they were going to be paid immediately*." ***(CS-02-PS04)***

> *"A lot of the team members were not collocated. At first, there was scepticism towards adopting TVD, but after the brief education, the seminar and virtual collaboration a lot of us were more open toward TVD"* ***(CS-02-PS12)***

6.4.3.3.2 Barriers of TVD Implementation at the Project Planning/Design Stage

Adopting TVD was a challenge mostly because the team members were used to the traditional way of construction, they were also unaware of TVD practices. The fixedness on the traditional method became a barrier to TVD implementation. Co-location in the planning stage like in the initiation was a challenge because the project team members were from different companies in different locations. Another major barrier in the planning/ design stage of the project was the use of different software by the professionals, this caused some frustration between the team members. Another barrier is the cost of involving all key stakeholders at the beginning of the project, in terms of who bears the cost especially when the client does not know about TVD, this might be seen as a form of extortion by the client. Another barrier was a lack of understanding of the scope of engagement by some team members, this was a challenge because they did not know what to design for and elements could not be taken out of the design when trying to reduce a cost.

> *"Team members are used to working on their own but now they have to start working together by convincing them to adopt the new approach"* ***(CS-02-PS01)***

> *"Not being in the same place was a challenge. If we were in the same location it would have been better."* ***(CS-02-PS03)***. *"Designers (structural and M&E) were using different software, it's also one of the difficulties we encountered."* ***(CS-02-PS05)***

> *"Another challenge is the cost of involving the entire project team members in the early stage because the client was hesitant regarding the cost."* ***(CS-02-PS12)***

Incentives and motivation encourage performance for people, not having any such scheme served as a barrier to the implementation of TVD, most of the team members wanted some sort of commitment to ensure their loyalty or full participation in the project. One of the features of the target value design is the number of changes that occurred during the design stage, respondents complained that it was difficult to track these changes especially when they were verbal. The analysis shows that the respondents believed that TVD was time-consuming, especially because of the designing and redesigning to get to the set target, some of the respondents even thought of the whole process as a waste of time until they started to identify problems and find solutions to them. Another barrier to the implementation of TVD was the need for extensive training, most of the team members had not heard of TVD so there was a need for intensive training and workshops.

> *"There weren't incentives. The cost of my early involvement was borne by me. My feeling was why should I do that when I have not gotten the contract? At least during initiation there should be some money to augment our logistics."* ***(CS-02-PS08)***

> *"We had difficulty in tracking the changes made. Some of the changes were verbal and by email, so we have to come back again and re-document it, it takes time"* ***(CS-02-PS10)***

> *"TVD needs extensive training for someone to understand TVD because this is a new practice for some professionals"* ***(CS-02-PS01)***

6.4.3.4 Drivers of TVD Implementation

The drivers of this case study as stated by its respondents were compiled and characterised in Figure 6.51 the drivers are those factors that prompted the use of TVD on the project.

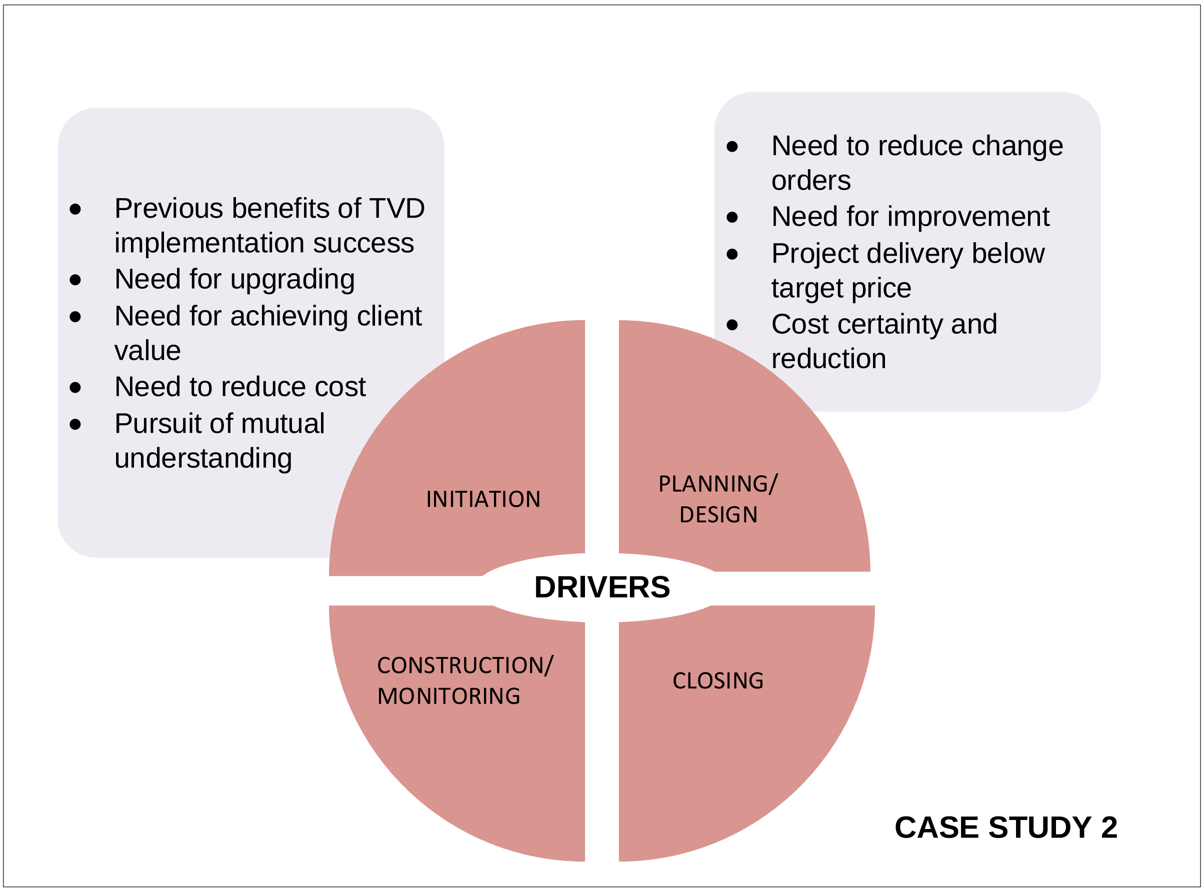


Figure 6.51 Drivers of TVD implementation

6.4.3.4.1 Drivers of TVD Implementation at the Project Initiation Stage

This study shows that the previous successes recorded from the implementation of TVD in other projects encouraged the members of this team to adopt TVD practices, seeing that the practice succeeded on another project made participants more willing to apply its principles. TVD was implemented to improve on the traditional construction process that the project team had been accustomed to. The need to achieve the client value prompted the implementation of TVD, a practice that ensures that the client is satisfied. An analysis of the respondents' replies shows that cost reduction was a key goal on the project and since TVD offered a means to reduce cost without compromising quality, the team decided to implement TVD.

> *"The reason why we agreed with TVD is that, first, due to the presentation and the workshop that you did and the awareness you gave us on the TVD and the success in the previous project in other countries, that is what made us say let's try it, for now, let's see how far it will take us"* ***(CS-02-PS05)***

> *"And again, because the company asked us to try and reduce the initial tender submission cost without affecting overall efficiency. I proposed that TVD is a practice that will achieve that"* ***(CS-02-PS05)***

Another driver the respondents reported was that of a quest towards a common understanding and goal, the need to have all stakeholders sharing and understanding a common goal. Analysis of the interview responses also shows that the need to gain an edge over the market necessitated the implementation of TVD. Competition and recession with markets also prompted TVD implementation.

> *"the need to understand a set target, common understanding of the goals was an important driver."* ***(CS-02-PS04)***

> *"Based on competition in the market, it gives us more light on what is happening in the market and be able to deliver below the market price."* ***(CS-02-PS03)***

6.4.3.4.2 Drivers of TVD Implementation at the Project Planning/ Design Stage

Change orders and variations usually cause delays to projects and increase costs. The team implemented TVD because of the need to reduce change orders and variation. The need to deliver the project below market price and the target was another driver that prompted the implementation of TVD. Respondents reported that the need for cost reduction and cost certainty was another reason for implementing TVD. Some respondents said:

> *"from the previous project, there were about 82 changes, but for this Kaduna project the TVD drove us to reduce and avoid future changes."* ***(CS-02-PS11)***

> *"At the planning stage, the driver was that we were hoping to achieve a cost lower than the market price"* ***(CS-02-PS11)***

> *"The quest for cost certainty and reduction. TVD gave us a clue about what is expected in terms of the financial commitment of the client."* ***(CS-02-PS09)***

6.4.3.5 Success Factors of TVD Implementation

These are the factors that need to be in place for the implementation of TVD to be successful, some of them as reported by the respondents of the case study are shown in Figure 6.52

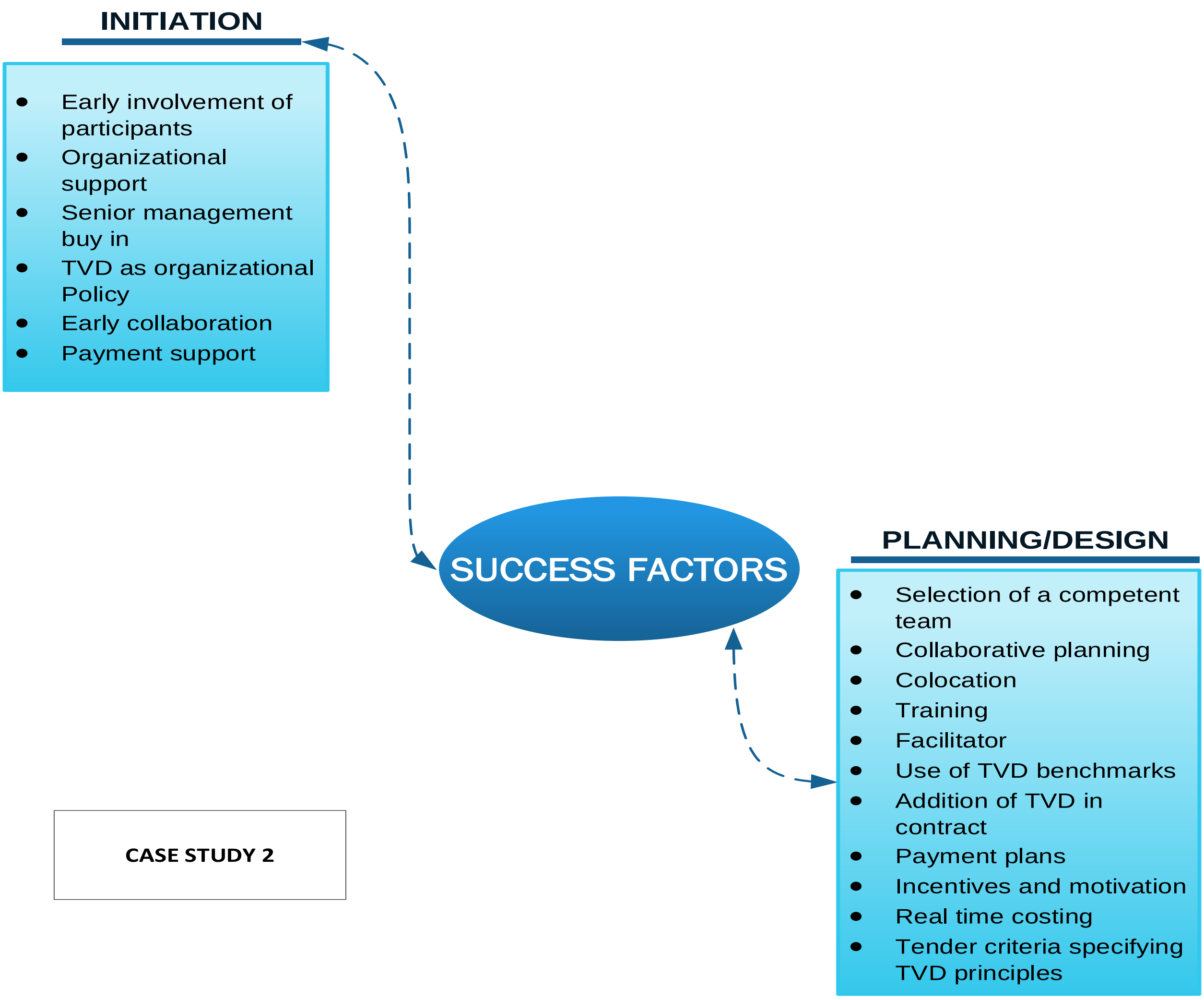


Figure 6.52 Success factor of TVD implementation

6.4.3.5.1 Success Factor of TVD Implementation at the Project Initiation Stage

The questions in this category were asked to determine the respondents' opinion of what was in place and what they thought should be in place for TVD to be implemented effectively

The respondents said that the early involvement of all key stakeholders will ensure that implementation of TVD will succeed. Interview analysis revealed that most of the respondents believe that early collaboration of stakeholders will enable the success of TVD. Most of the respondents believe that having a facilitator will make implementation successful, it will ensure that the project team has an experienced person guiding them through the process. Adoption of the TVD benchmarks is a sure way to ensure implementation is successful especially by including it in the organisation's policy and contracts to team members and for tenderers, this will guide the stakeholders on how to carry out the practice. The interviewees noted:

> *"Early collaboration is really important. it is important to involve the stakeholders on time especially the clients and project team. once everybody understands the objective that will be a major critical success factor."* ***(CS-02-PS11)***

> *"We need to create awareness through presentation workshop, frequent meeting with the stakeholders that will bring collaboration, the involvement of key stakeholders in what we are doing"* ***(CS-02-PS10)***

> *"The addition of TVD practice as part of the organisational policies, it should be included in procurement contracts so that sub-contractors, tenderers and everyone involved will know this is how to behave."* ***(CS-02-PS04)***

Majority of the respondents believe that having a payment plan at the beginning of the project will improve the performance of the team members and ensures that the TVD succeeds. Another success factor for the implementation of TVD is the buy-in of the senior management of the organisation, if they do not agree with the implementation, the project team will not be able to apply TVD, respondents held that:

> *"The payment terms should be flexible and upfront funds should be given to help improve team performance and at the same time secure the time of delivery"* ***(CS-02-PS05)***

> *"Client and senior management buy-in, that is them accepting TVD in the beginning. I think that is very important because if you were not senior management, nobody would have even accepted it"* ***(CS-02-PS09)***

6.4.3.5.2 Success Factor of TVD Implementation at the Project Planning/ Design Stage

Having a team that understands what is required and works well together is one of the things that need to be in place for TVD to succeed, respondents thought that having an integrated competent team will help TVD to be successful. Collaborative practices including virtual teams are another practice that is required for the successful implementation. Co-location, although not possible in this case study, was another thing that the respondents believed will enable TVD implementation to be successful on any project. Intensive training ranks top on the list of things majority of the respondents believed should be in place for the successful TVD implementation. Just like in the initiation stage, the respondents believe that having an experienced facilitator to oversee the implementation of TVD in the planning stage is essential to the success of the project. The use of the TVD benchmarks is one of the ways one can be certain that they are implementing TVD, so the clients viewed it as vital to the success of TVD. If the management of an organisation does not support the TVD implementation it will not be implemented, so this is a critical factor of success of the TVD implementation in any project. The interviewee declared:

> *"The degree of collaboration, integration; a team together will help target value design to succeed."* ***(CS-02-PS12)***

> *"Co-location is very important. Where that is not possible, the need to have Real-time software to communicate with team members is very important."* ***(CS-02-PS04)***

> *"Training and use of TVD facilitators will increase our degree of competence and the team should have a supportive organisation."* ***(CS-02-PS04)***

The addition of TVD to the contract promoted the success of TVD because all the parties involved were bound by the contract to implement it and were forced to learn it. The respondents opined that having a payment plan for members of the team including the tenderers will motivate the team to perform better, the tenderers to reduce their profits due to upfront advance payment and the implementation of TVD will be successful. Steering of design to target is the major principle of target value design and must be done for TVD implementation to be successful. Real-time costing is also essential to the success of TVD implementation, as the team designs, the cost changes should be updated, this will ensure that the whole team can keep track of the cost. interviewees said:

> *"Addition of TVD practice in organisation policy, tender criteria and contract, like the way they included it in our tender agreement."* ***(CS-02-PS08)***

> *"Cost data should be available and current for real-time cost modelling, then, improvement of design approach helped to achieve target cost"* ***(CS-02-PS05)***

6.4.3.6 Impacts of TVD on the CS-02

This category measures the effect that TVD implementation has had on the project and the project team members, some of them have been recorded in Figure 6.53

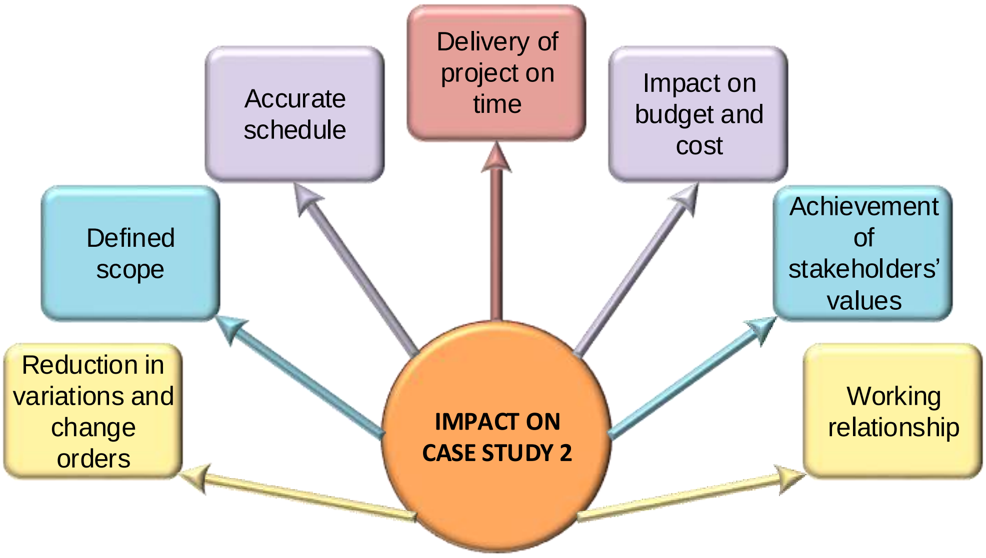


Figure 6.53 Impact of TVD implementation.

6.4.3.6.1 Impact of TVD Implementation at the Project Initiation Stage

Implementation of TVD ensures that there is a more defined scope as is evident with the responses from one of the interviewees:

> *"We have a more defined scope, by 95%. The scope is clear from the beginning. We are sure of the market prices before we go to procurement."* ***(CS-02-PS10)***

6.4.3.6.2 Impact of TVD Implementation at the Project Planning/ Design Stage

There is a more realistic schedule (or program of work) for a project when TVD is implemented. TVD implementation ensures timely delivery because of a more realistic schedule. One of the major impacts TVD has is on the budget and cost of the project, the whole practice is centred on the reduction of costs right from the initiation stage through to closing. Respondents believed that an important impact of TVD on the project is the reduction of variation and change orders which in turn reduced the cost of the project without affecting the quality which is the goal of TVD. Another impact is that there were stakeholder's satisfaction and values, the team understood the needs of the stakeholders and worked to achieve them.

One of the other impacts was that of a good working relationship between members of the team, not just for this project but for other projects they work on. Respondents reported that:

> *"Accurate programme of work. Because we have all the stakeholders, everybody has made their input, and all the missing items have been imputed which gives us a more realistic program of work."* **(CS-02-PS01)**

> *"There was cost certainty and savings. Remember I Gave 7% Discount and I am still under the target cost, so I think we saved over 30% from the market price from our own cluster of the electrical team"* (**CS-02-PS08**)

> *"It has reduced potential variation problems that could occur in the future, the client is sure he won't have surprises"* (**CS-02-PS01**)

6.4.3.7 Support Needed for the Implementation of TVD

The support required for the successful implementation reported by the respondents of this case study is represented in Figure 6.54

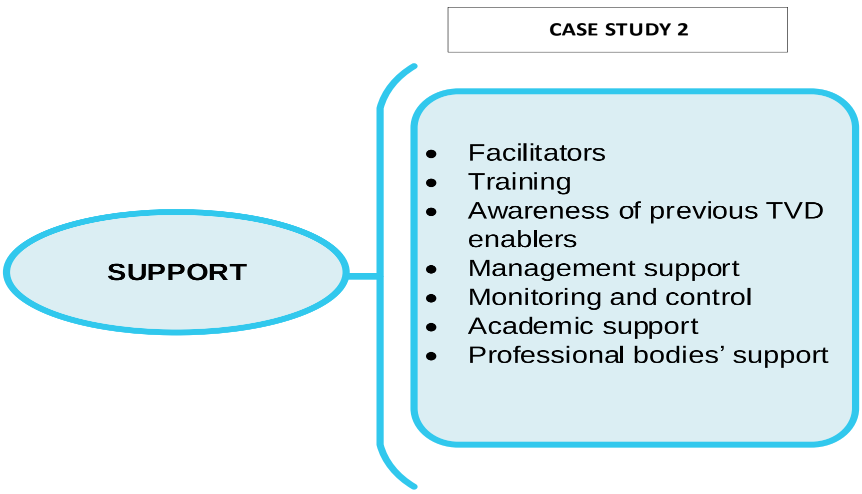


Figure 6.54 Supports needed for TVD implementation

6.4.3.7.1 Supports Needed for TVD Implementation at the Project Initiation Stage

Most respondents see having a facilitator as the major support needed for the implementation of TVD, having someone that is knowledgeable and dedicated to making it work, this can be seen in the analysis of the interview

"Early involvement of key stakeholders is important and involving a facilitator that puts everyone on the same page." ***(CS-02-PS04)***

6.4.3.7.2 Supports Needed for TVD Implementation at the Project Planning/ Design Stage

Analysis of the interview revealed that the respondent believes that certain things need to be in place to support the implementation of TVD, the supports needed for TVD in the planning and design stage listed by respondent are; training, awareness, management support, monitoring and control, motivation and incentive schemes, academic support and professional body support. Some of the respondents were reported to have said;

"Promote collaboration practice and add TVD to contract and tender document, the involvement of facilitators, early definition of project values, accurate and adequate pre-planning before meetings." ***(CS-02-PS09)***

"Awareness must be created for TVD benchmarks and practices through conducting training" ***(CS-02-PS08).*** *"Educational and institutional support in the industry is important. Also, if motivation and incentive are not defined at this stage, it can be demoralising"* ***(CS-02-PS04)***

"Support from the client or senior management, if you were not a management staff, TVD would have been hard to implement" ***(CS-02-PS11)***

6.4.4 Case Study Two Survey

The participants of the project were also given a survey to assess the implementation of TVD benchmark, the impact of implementing TVD and level of collaboration on the project. The demography of the respondent is presented in Table 6.11

Table 6.11 The demography of the survey respondents

CODE	POSITION IN ORGANISATION	YEARS OF EXPERIENCE	PROFESSION
CS-02-PS01	Head of Structural Cluster	14	Civil/Structural Engineer
CS-02-PS02	Head of Electrical cluster	15	Electrical Engineer
CS-02-PS03	Client	25	Civil Engineer

CS-02-PS04	Head of Mechanical	9	Mechanical Engineer
CS-02-PS05	Cost Estimator	25	Quantity surveyor
CS-02-PS07	PM	3	Civil Engineer
CS-02-PS08	QS/PM	16	Quantity Surveyor
CS-02-PS09	Head of Architectural team	12	Architect
CS-02-PS10	Electrical design team member	30	Electrical Engineer
CS-02-PS11	Electrical Sub contractor	24	Electrical Engineer
CS-02-PS12	Civil Cluster team member	27	Civil Engineer

6.4.4.1 TVD Benchmark Implementation

The respondents in this case study (CS-02) were asked to rate the level of implementation of the TVD benchmarks on their project. All the respondents believe that there was full implementation of Benchmark 11. Benchmark 6 showed 92% full implementation and 83% of full implementation was recorded in Benchmarks 4a, 7b, 8, 15 & 16b. 75% of respondents reported full implementation and 25% partial implementation for Benchmarks 5a and 5b, 75% of respondents also reported the full implementation of Benchmarks 7a, 9a with 17% partial implementation and 8% not implemented. While BM 14 showed 75% full implementation, 8% partial implementation and 17% no implementation. The project recorded 67% full implementation of Benchmarks 2a, 4b & 13 all with 33% partial implementation. Benchmarks 9b experience 67% full implementation but recorded 25% and 8% and 10 also experience 67% full implementation but recorded 0% and 33% of partial implementation. Benchmark 1 and 3 both recorded 58% full implementation and 25% partial implementation. Benchmark 4c also experience 58% full implementation but showed a partial implementation of 33%. 50% of the respondents say that Benchmark 16a was fully implemented with 33% saying it was partially implemented.

Benchmark 2b was partially implemented by 58% and only 42% of respondents agree that it was fully implemented. 75% respondents believe that Benchmark 17 was not implemented and 17% say it was partially implemented, leaving only 8% of respondents saying that it was fully implemented. 75% of the respondents believe that Benchmark 12 was not implemented and the remaining 25% claim that it was partially implemented. Figure 6.55 presents the level of TVD implementation in the case study.

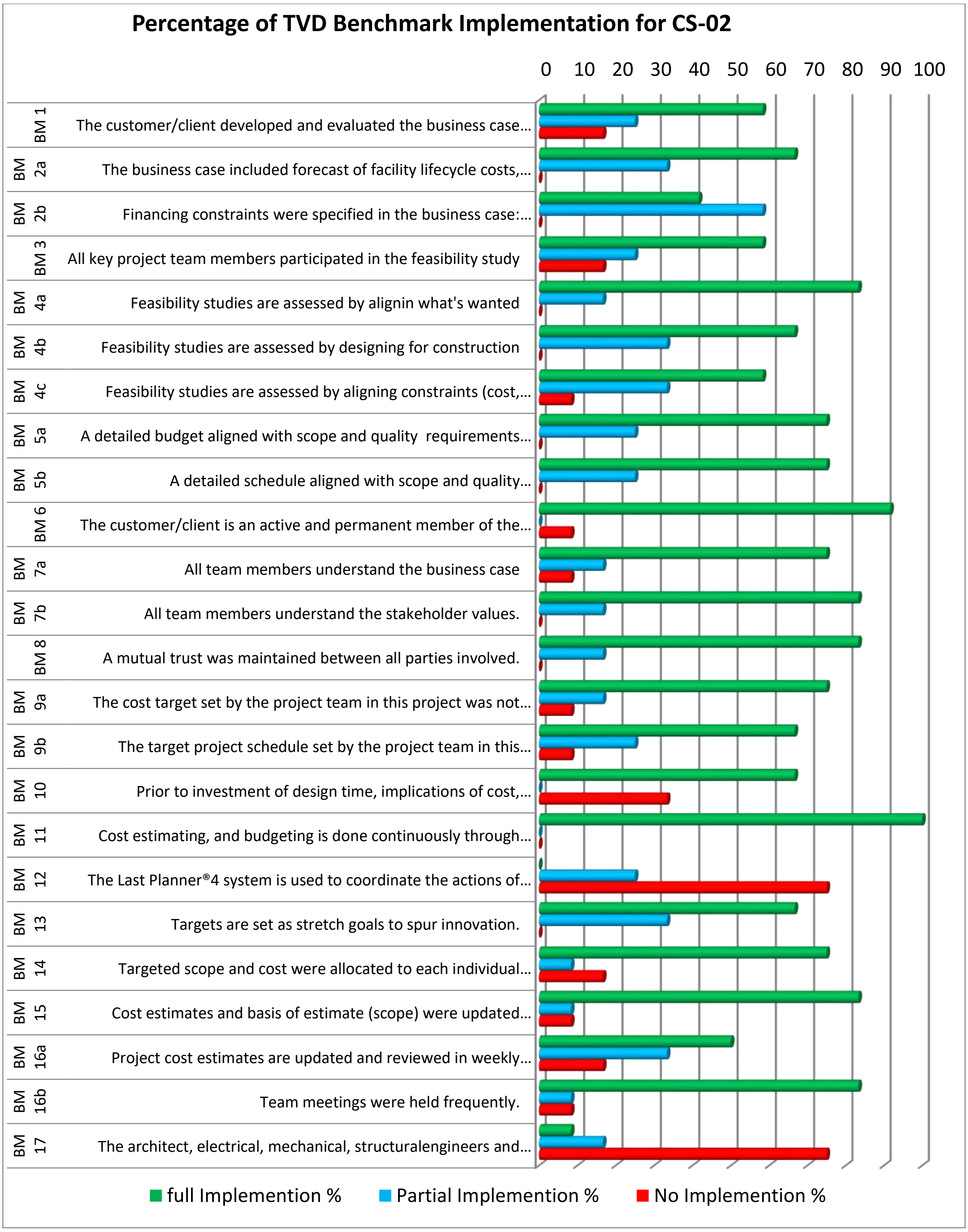


Figure 6.55 Percentage of TVD benchmark implementation for CS-02

6.4.4.2 Measuring levels Collaboration on CS-02

The levels of collaboration were measured in CS-02, these levels are collaboration, coalition, coordination, cooperation and networking.

A. Collaboration

The analysis of the survey questionnaire indicates that the team members were not located at the same place during the design stage of the project as revealed by the majority (77%). Majority of the respondent (about 75%) disagreed that the team members belong to a single system, this is so because the project was planned and designed by a combination of professionals from different organisations. There was high level and frequency of sharing information characterised by mutual trust among team members, this was indicated by about 69% of the respondents while about 30% of the respondents disagreed.

There was a sharp division among the respondents about how decisions were made in this case study. While a total of about 54% agreed that "all decisions are taken with the mutual agreement of all team members before implementation", the other 46% of the respondents disagreed. About 76% of the respondents believed that a feeling of teamwork is in place within the workgroup.

The result also shows that 62% of the respondents believed that "the opinions and ideas of all team members are considered in my workgroup". The result analysis also shows that "85% of the respondents believed that "data was shared in real-time among team members". There was a high level of trust in the workgroup as all the respondents disagreed with the question that "team members are distrustful of each other in my workgroup". Figure 6.56 shows the level of collaboration in the case study.

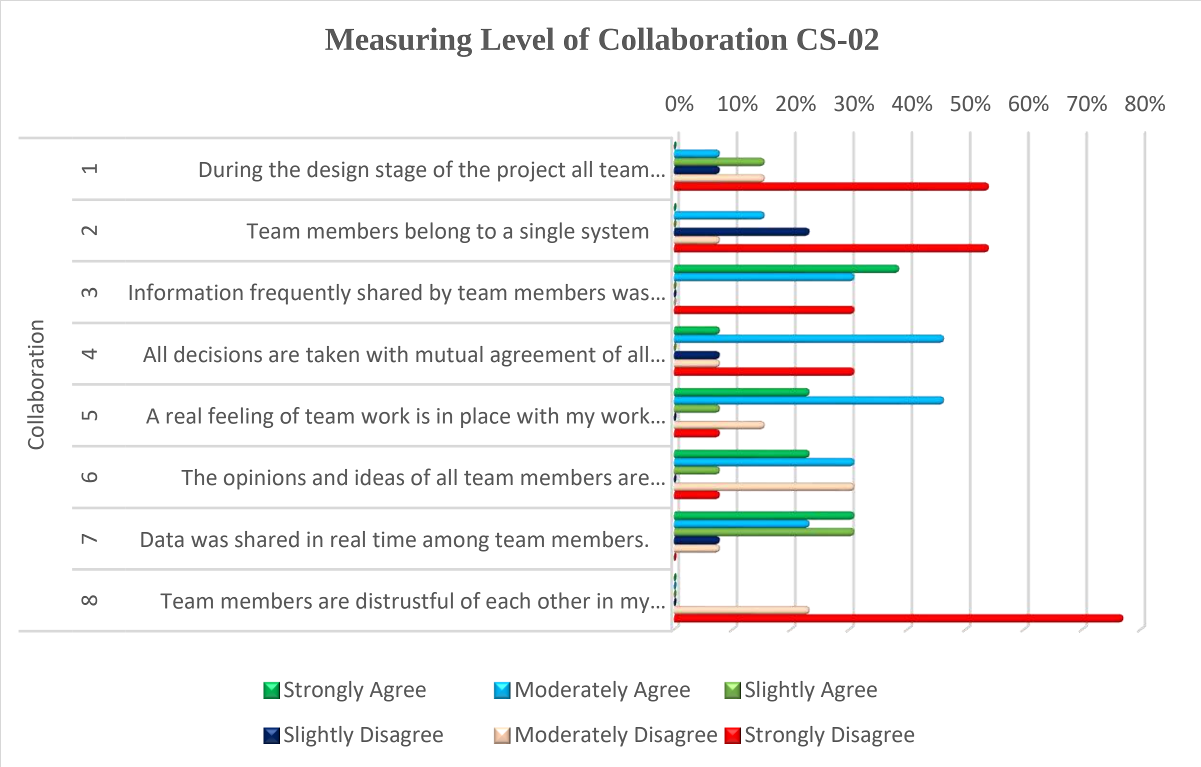


Figure 6.56 Measuring level of collaboration CS-02

B. Coalition

These questions were designed to demonstrate how members share information and how they arrive at decisions during the TVD implementation. From Figure 6.57, 85% of the respondents agree that team members had frequent prioritised communication. Results also show that 53.8% of the respondents indicated that all team members had a vote in the decision making while 46.2% believed otherwise.

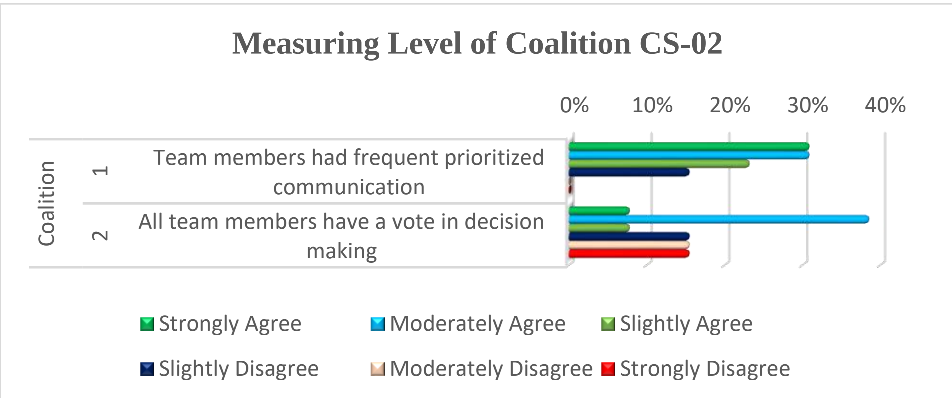


Figure 6.57 Measuring coalition in CS-02

C. Cooperation

These questions were designed to illustrate the type of communication, the definition of the roles, and how resources are exchanged during TVD implementation. 61.5% of the respondents believe that all team members had somewhat defined roles, while 38.5% believe otherwise. 84.6% agreed that there was just formal communication; the remaining 15% disagreed. All the respondents agreed that information was provided by team members to each other. This can be seen in Figure 6.58.

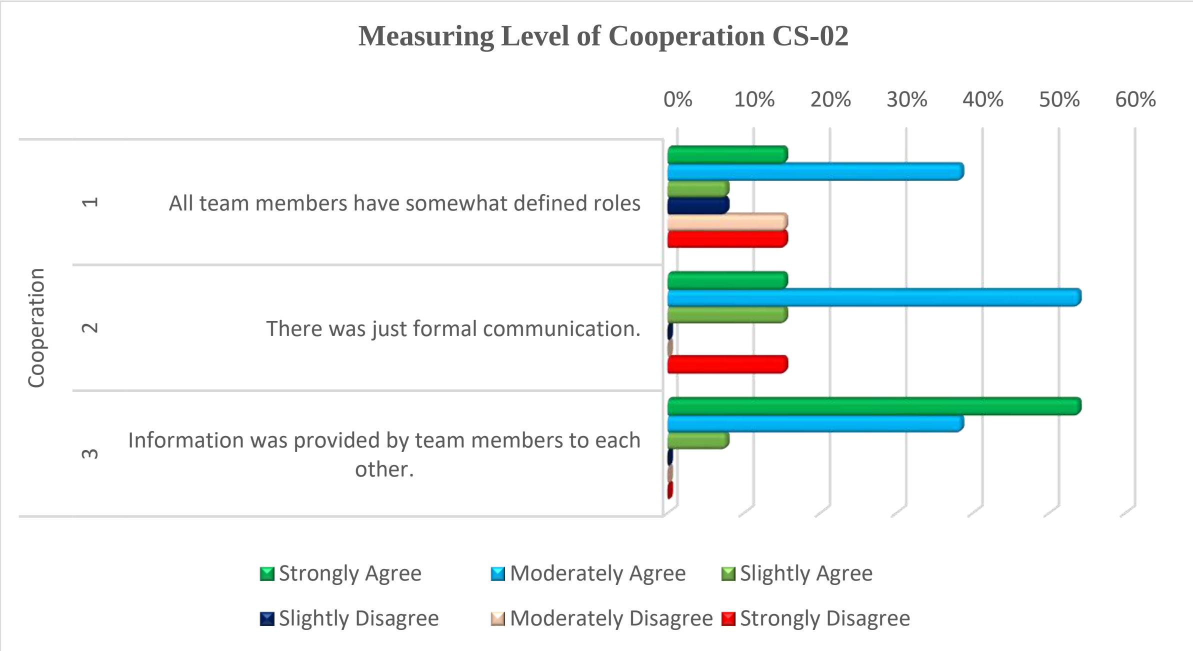


Figure 6.58 Measuring level of cooperation CS-02

D. Coordination

The questions in this category were designed to assess the level of coordination in CS2, the questions were based on team members' roles, how decisions were made, and resources and ideas were shared. The resulting analysis in Figure 6.59 shows that 92% of the respondents believed that team members have clearly defined roles and 92% believed that the team shared resources and ideas frequently. In a similar manner, 77% of the respondents believed that there was shared decision making among team members and only 23% do not share the belief.

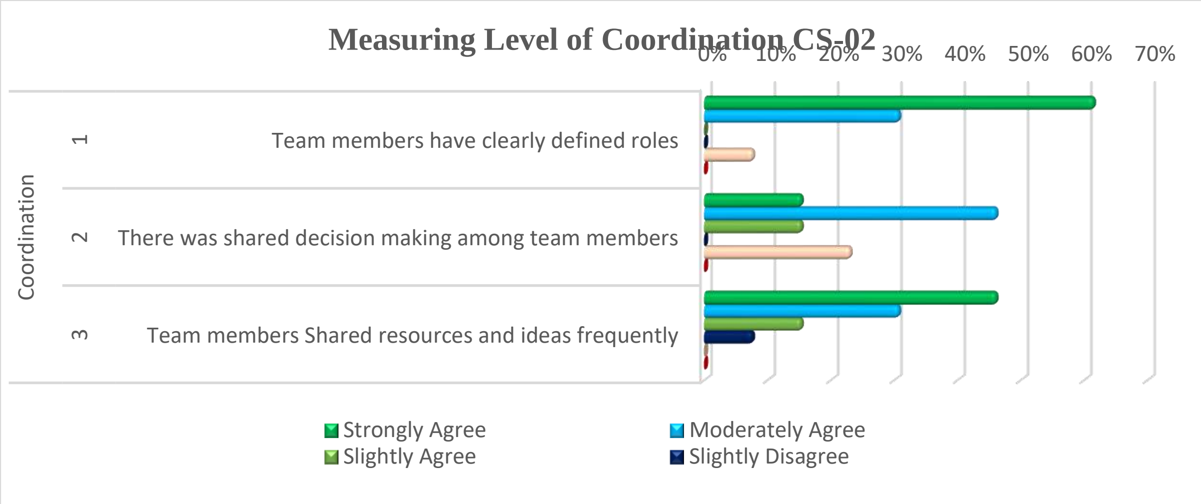


Figure 6.59 Measuring level of coordination CS-02

E. Networking

The analysis reveals in Figure 6.60 show that 84% of the respondents disagreed with the question "there was little communication". Another 69% of the respondents also disagreed with the question that team members have loosely defined roles while 31% of them agreed. 62% of respondents disagreed with the question "all decisions were made independently". Most of the respondents (84%) disagreed with the question 'there was frequent communication without trust'.

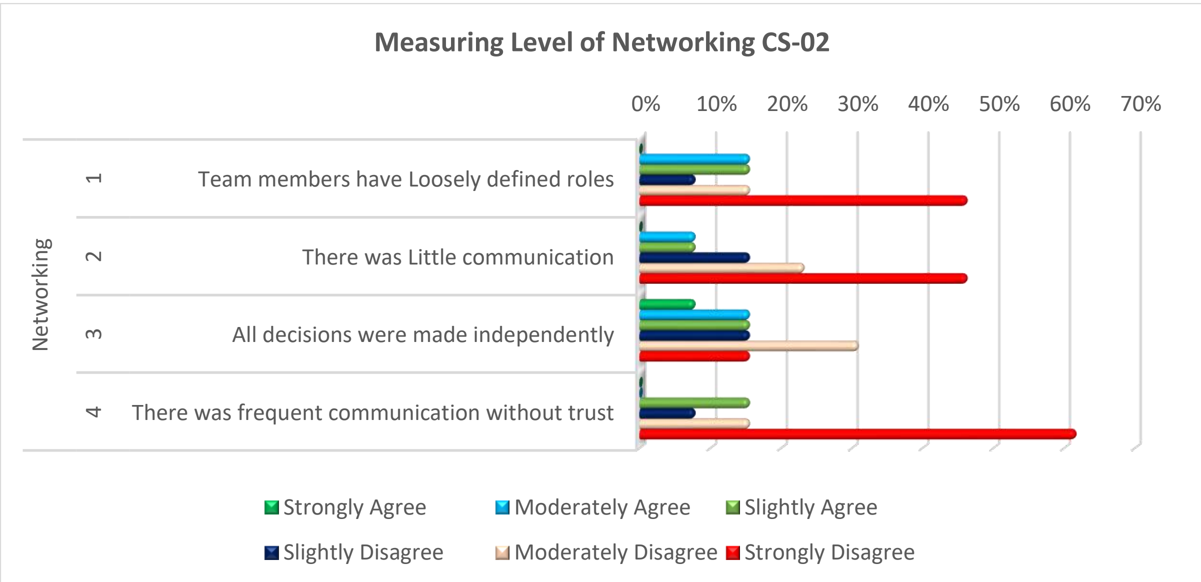


Figure 6.60 Measuring level of networking CS-02

6.4.4.3 TVD Post Implementation Impact

This section focuses on the impact TVD implementation had on the project; CS-02. We identified areas that the application of TVD has impacted/ benefited, and we categorised them into four, they are; Cost, time, quality, working relationship and stakeholder value.

A. Impact on cost

The respondents were questioned to determine the impacts of the application of TVD on the cost of the project. 92% of the respondents reported that target cost benchmarking helped control cost overruns; the remaining 8% were undecided. 83% reported that outcome cost is substantially below market price - both achieved without sacrificing scope or quality, only 17% could neither agree nor disagree. 75% agreed that TVD reduces uncertainty on projects which in turn reduces the contingency required to absorb variability, 17% were unsure and 8% disagreed. 75% also agreed that TVD has lowered the project cost by reducing waste and adding value while 25% were undecided (see Figure 6.61).

Results show a positive impact of TVD implementation on the cost in this project. The implementation of TVD in this case study enabled the team to gain about 35.4% savings from the allowable cost. (see Table 6.9)

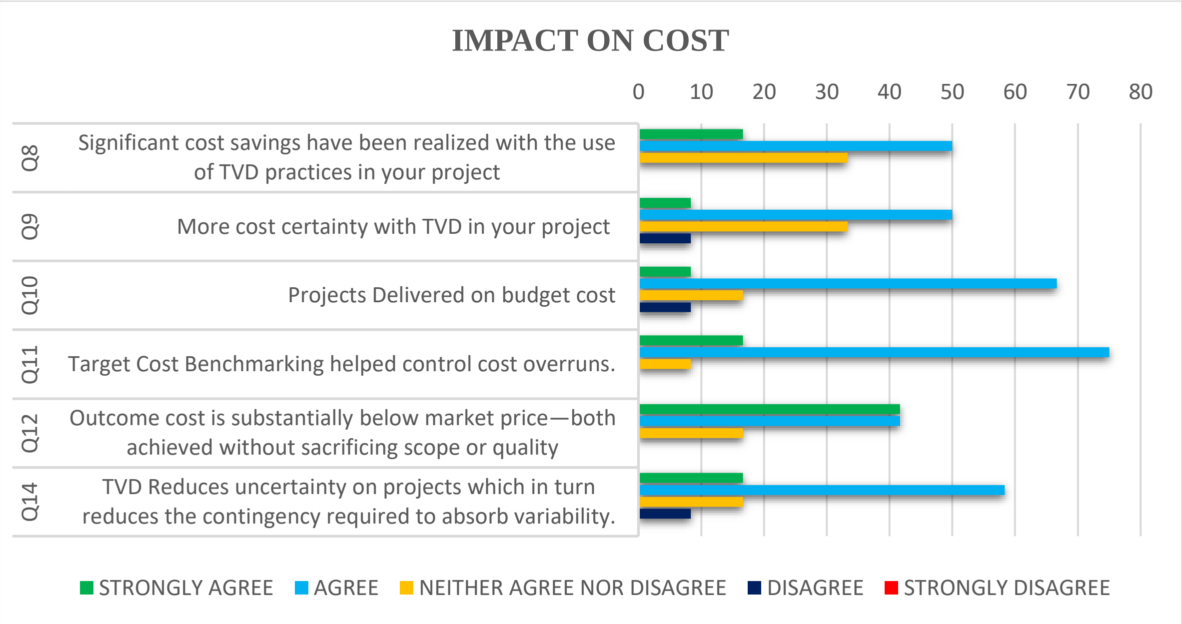


Figure 6.61 Impact on cost for CS 2

B. Impact on Quality

The questions in this section were geared towards finding the impact of TVD implementation has on the quality of the project product. All the respondents in this case study agreed that better target value was achieved by engaging with the client, designers and end-users. 92% of the respondents agreed that results from TVD did not compromise quality and best quality was achieved despite designing to target. Better stakeholder value was achieved with the implementation of TVD and its process and tools created the conditions for identifying and delivering the target value from the design process during the planning stage. The remaining 8% were undecided.

The question “the TVD process has enabled us to reduce the level and number of re-works on this project significantly” recorded agreement from 83% of the respondents, uncertainty from 8% of the responsibility and disagreement from 8% of the respondents. 75% of respondents agreed that engaging the client and other stakeholders as key performers reduced change orders and variations. while 17% neither agreed nor disagreed and 8% disagreed. 75% also agreed that TVD process brings more quality for the product delivered considering all stakeholder interests, the remaining participants were undecided. This is presented in Figure 6.62

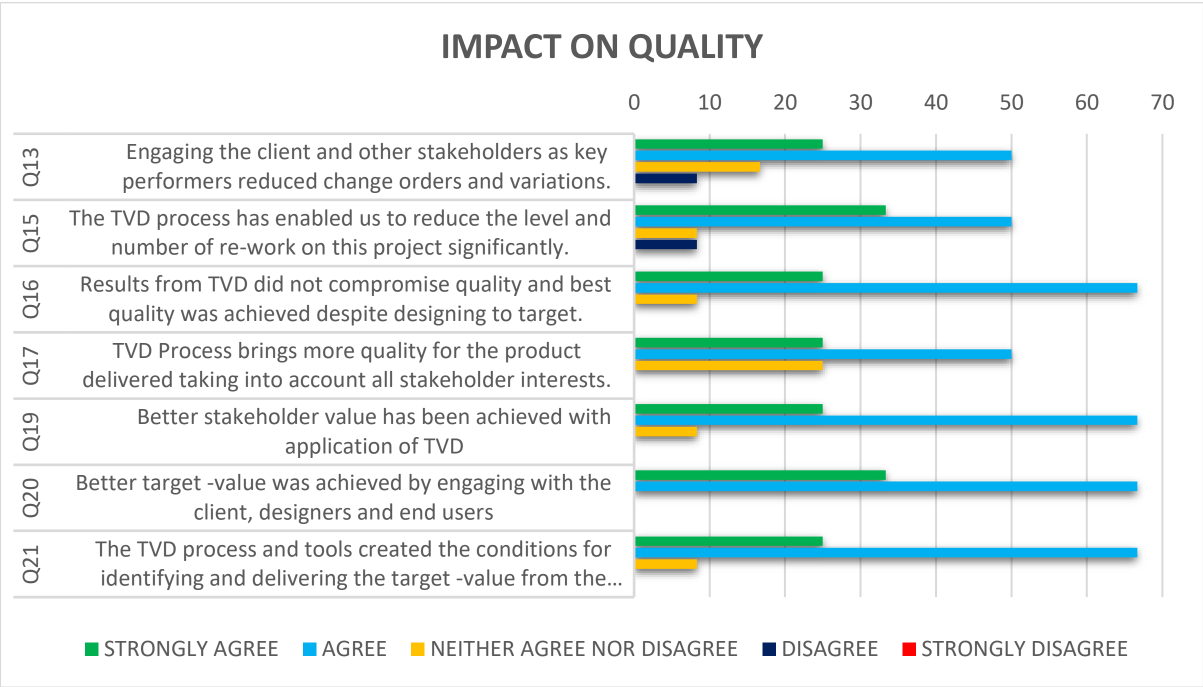


Figure 6.62 Impact on quality for CS 2

C. Impact on Working Relationship

This section's questions were chosen to assess the impact of TVD implementation on the working relationship of the participants of the project. All respondents agreed to the questions "Harmonious working relationship are maintained which encourages a teamwork approach to innovative ideas in problem-solving", "Collective planning was important in implementing TVD in your project" and "Stakeholder collaboration helped in setting targets". A large percentage of respondents (92%) said that the use of cross-functional or cluster teams increased the efficiency of the TVD project. 75% of respondents liked working in this manner (implementing TVD) while 25% were not sure how they felt about the approach.

Furthermore, respondents in this study were equally divided on "Co-location improves communication and facilitates consensus decision making among stakeholders", one half agreed, the other was undecided. 42% believed that with co-location as practised in TVD, their confidence and trust in other project team members has been enhanced greatly. 42% was uncertain while 17% disagreed (see figure 6.63).

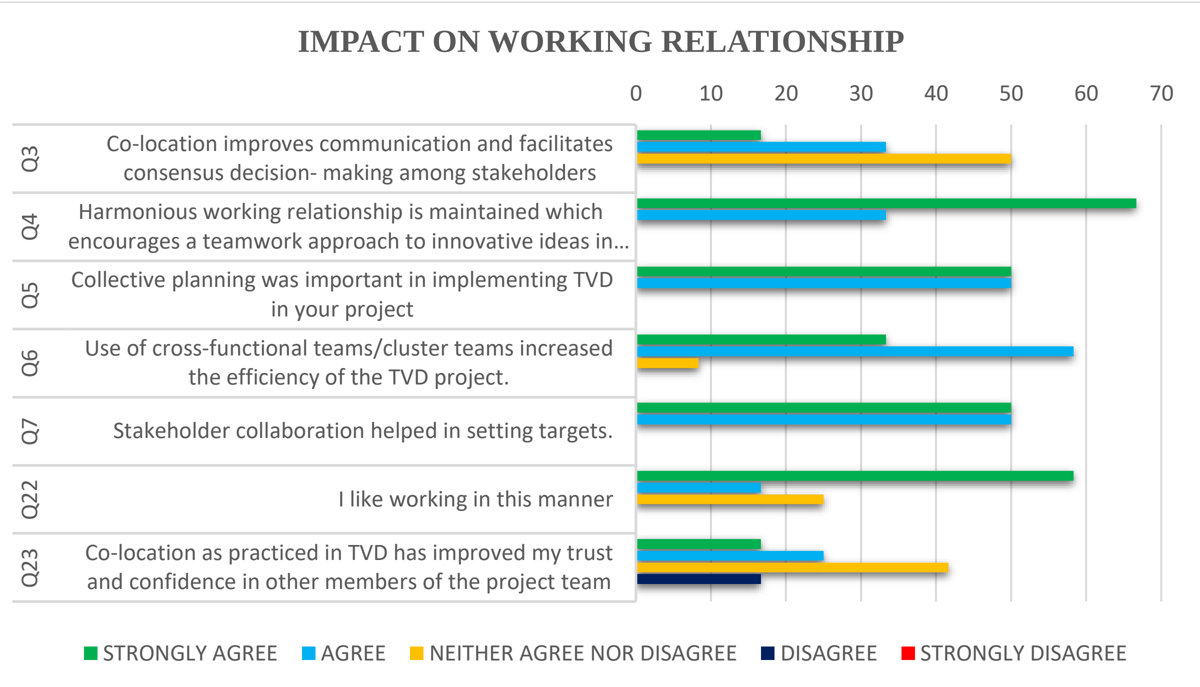


Figure 6.63 Impact on the working relationship

D. Impact on Time

The questions in this section were asked to help ascertain the impact of TVD on time. 67% of the respondents agreed that the TVD process consumed time in the planning stage, but they believe that it will help them gain more speed when the execution stage commenced, 17% neither agreed nor disagreed and 17% disagreed. Half of the respondents agreed to the statement: “We were able to deliver the project on or before the scheduled time with TVD” while 33% were uncertain and 17% disagreed. Figure 6.64 presents the impact of TVD on time in case study 2.

Due to the scope of the project and the number of professionals needed for the project, the project team had scheduled five months for the planning and design of the project, especially considering that the team members were in different parts of the country. The implementation of TVD enabled the team to complete the planning and design of the project in four months. Which is one month ahead of planned delivery time.

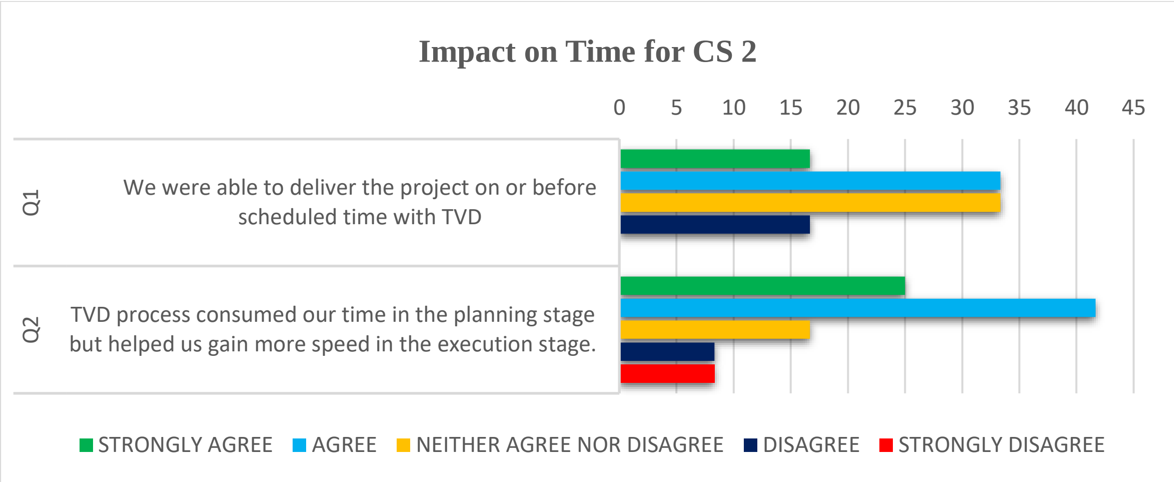


Figure 6.64 Impact on time for CS 2

6.4.4.4 Impact of Procurement Route on TVD in CS-02

CS-02 is a private company that engaged in the traditional procurement route for the construction of a commercial filling station. The traditional procurement route used selective tendering and competitive bidding instead of open bidding to choose the preferred contractors. During the selective tendering process, those that qualified to participate were notified of a criterion for bidding which was that all the selected interested tenderers must participate in the planning and design process; and their participation and contribution during the planning and design will serve as part of the assessment of their competences.

The impact of the procurement route on TVD in CS-02 is noticeable at the early stage because the design team and contractors were involved early in the project through the process of selective and competitive bidding. The response of the electrical subcontractor/tenderer also underscores the point by saying;

"The TVD implementation worked very well with the traditional procurement system. If the designs were already done and I was just called in at the level of implementation, those contributions I made would not have come in and that would have increased the cost in form of variation and extra work, but because I came in early as part of the team I contributed my best knowing that my contribution will help me to secure the contract" ***[*****CS-*****02*****-PS08, Electrical Sub contractor*****]***

6.5 Case Study Three: Description of Case Study Project (CS-03)

6.5.1 Case Background

The case study was carried out at an army barracks located at Abuja, the north-central region of Nigeria. The project was a public project and used the traditional procurement route where a design was produced, and contractors had to tender. The projects were awarded to three contractors to handle three prototype fire stations, each contractor had the same scope for construction and a time frame of 8 months. The project was located approximately 45 minutes' drive from the city centre; this came with the challenge of distance to and from regular suppliers. Another challenge that arose is access to workers (labour) because of solders restricting civilians' access to the site.

The researcher approached the site representatives of the three contractors before construction commenced and presented TVD to them, but only one contractor's site representative introduced the researcher to his MD/CEO. After a presentation of TVD and its benefits/successes to the MD/CEO, he bought into the idea, appointed the researcher as his project manager/facilitator and allowed the researcher to implement TVD. For this project, TVD was applied only during construction.

Data gathered were in phases comprising of interviews, participant observations and survey questionnaires. The project details are stated in Table 6.12.

Table 6.12 Project information

CLIENT:	**PUBLIC GOVERNMENT PROJECT.**
Building Project:	Fire station building comprising of Two floors and a watchtower.
Ancillary:	External works
Procurement route :	Traditional (Tender process).
Duration of the project:	**6** months.
Application of TVD:	Applied from project Execution (construction stage) to closing (Handover).

6.5.2 Application of TVD

During the presentation, previous successes of TVD were discussed and the drivers for implementing TVD on this project were established, they were to deliver the project within the set of targets which were the awarded contract prices and specification agreed by the contractor during the tender process. The contractor had already collected advance payment and signed the contract documents.

Observation

In addition to interview and survey used in obtaining data, observation of record and physical condition were conducted to find out how to apply TVD at the stage of the project where the contractor and project team were not involved at the project initiation. During the document analysis, the contract documents were critically analysed, and the business case for the project reviewed. Also, the document analysis revealed that some items in the contract did not have detail designs but had only prime cost sum and provisional sums. During the implementation of TVD, the physical condition of the construction was analysed, the researcher observed a weekly meeting, communication, collaboration, progress reports, TVD training, and all the processes of implementing TVD.

6.5.2.1 Project Execution Stage:

The project phase started at the execution stage, so the initiation which comprised of the business case, feasibility and planning stage were all carried out without TVD. TVD started with identifying key stakeholders for the project.

6.5.2.1.1 Business Case Review

The business plan of the project was not done with TVD, but the facilitator insisted on reviewing the existing business plan to align the execution with the plan. But the researcher was not privy to the business case because the project was a government project. The researcher focused on the contractor's business plan to achieve his proposed profit mark-up of 25%. The researcher requested the MD/CEO (contractor) to submit the signed contract documents for the project for assessment. At first, the MD was hesitant because he did not want staff or the team to know his contract price. The researcher convinced him that in order to achieve success all documents had to be examined by the team.

The document analysis revealed that there were about 13 items with provisional and prime cost sum without drawings/designs in the project. The case study only reported the studies carried out on the provisional and prime cost sum items without drawings that were identified in the contract documents and feasibility study was carried out on provisional sums and prime cost sums. Also, some items of work, mainly external works were missing. Based on the findings of the document analysis the researcher pointed out that there were vital items missing from the document that needed to be designed. The company policy was restructured to align with TVD benchmarks and an integrated team who will design to the cost below the provisional sums provided and construct to targets set was hired.

6.5.2.1.2 Construction Stage

A. Contractual Structure

The researcher who was the facilitator reviewed the existing company policy of the contractor to include TVD benchmarks and practices. The benchmarks/practices of TVD were handed to new staff. Although it was difficult for the contractors' existing team to accept the new culture at first, they were more open-minded after they saw the contribution of other stakeholders.

B. Selection of integrated team for construction.

An integrated team was selected to join the client's resident representative, site engineer and foreman that the contractor already employed. Others were the planning/monitoring team who comprised of civil/structural engineer, architect, electrical and mechanical engineers, client, sub-contractors and suppliers. Roles and responsibilities and transparency were emphasised. Some of the team members were not located in the same state or at the site. The training was conducted for all members at the PM's office during the first face to face meeting and subsequently virtual meetings were held with those that were not on site.

C. TVD training workshop

The training was conducted in the form of a workshop which lasted 50 minutes where TVD was presented to all team members. The training was facilitated by the researcher with slides showing previous projects where TVD was implemented, its benefits and challenges. The TVD simulation presentation in the workshop helped to explain what TVD is. But there was no time to carry out the simulation itself. The training ended up with questions and answer session.

D. Stakeholder and Project Value

The big room meeting enabled the researcher to discuss and collect all the stakeholders' value requirements and document them.

E. The expected cost of PS and PC SUMS During Construction

The expected cost was lower than the target cost after the team's first estimate during design, the contract awarded provisional sum (PS) and prime cost sum (PC) of about ₦31 million (USD86,111). The contractor's allowable cost was about ₦27 million (USD 75,000). While the estimated price of PS and PC sums during design was about ₦25 million (USD 69,444).

F. Target Setting

i. Setting Cost targets

In order to achieve the provisional sums, we had to handle the provisional sums items as if we were at initiation stage which was to design, plan and execute during construction. The target cost which was lower than the allowable was set to about ₦25 million (USD 69,444) with all team members. The contract price was set as the benchmark price. According to the client representatives, all additional or missing items were to be funded within the approved contract price only. The design team was tasked to innovate and design to or lower than the target cost without affecting scope, functionality, quality and stakeholder value. The project cost model is presented in Figure 6.65 and Table 6.13 shows the project cost model dashboard

Table 6.13 Case study-03 project cost model- dashboard

SN	Provisional & Prime Cost Sums	Market Price/ Contract Awarded Provisional & Prime Cost Sums	Contractor Allowable Cost	Target Cost Set by Project Team	Project Team Estimated Price During Design	Actual Cost Before Construction	Actual Cost After Construction
A	External Civil work (Additional Works)	$0.00	$0.00	$0.00		$0.00	$4,553.06
B	Substructure Work	$16,614.96	$14,122.71	$12,004.31	$16,599.64	$16,599.64	$11,754.17
C	L20 Door Security	$2,777.78	$2,361.11	$2,243.06	$11,892.05	$1,027.78	$625.00
D	Timber Door	$2,777.78	$2,361.11	$2,243.06		$1,069.44	$923.61
E	Ironmongery	$2,777.78	$2,361.11	$2,243.06		$0.00	$0.00
F	Wall Tiling Material only	$6,944.44	$5,902.78	$5,607.64	$5,925.00	$862.50	$506.94
G	Floor Tiling Material only	$4,166.67	$3,541.67	$3,364.58	$4,666.67	$5,062.50	$4,409.44
H	Window Aluminium	$15,277.78	$12,986.11	$12,336.81	$22,483.72	$9,794.83	$6,874.93
I	Electrical Installation including Builder's work	$9,166.67	$7,791.67	$7,402.08		$9,101.61	$6,275.38
J	Mechanical Installation including Builder's work	$9,166.67	$7,791.67	$7,402.08		$8,328.33	$7,227.50
K	Overhead Water Tank	$9,722.22	$8,263.89	$7,850.69	$14,114.03	$7,532.08	$6,211.81
L	Ground surface tank	$6,944.44	$5,902.78	$5,607.64	$9,101.61	$5,331.94	$4,861.11
M	Ground water tank base	$1,388.89	$1,180.56	$1,121.53	$8,328.33	$1,250.00	$2,554.58
N	Handrailing	$833.33	$708.33	$672.92	$31,543.98	$4,666.67	$3,388.89
	Total	$88,559.40	$75,275.49	$70,099.45	$70,627.33	$70,627.33	$55,613.37
						Actual cost savings %	**37.20%**

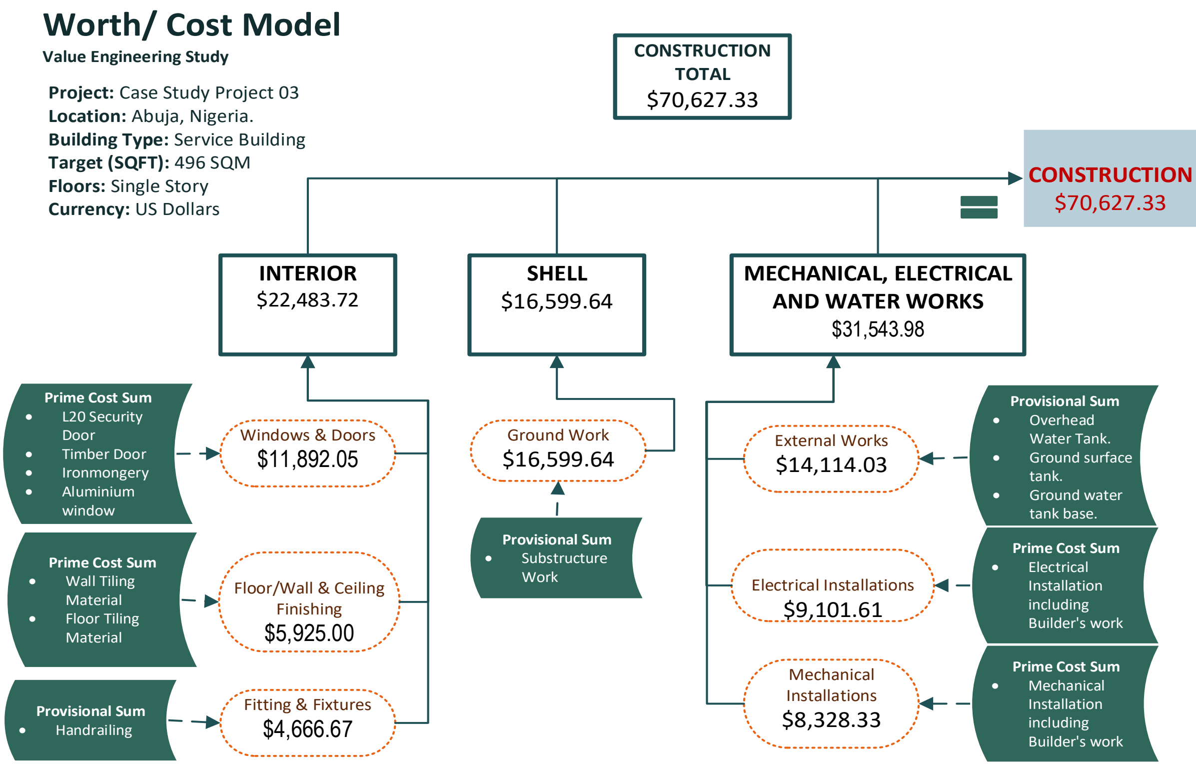


Figure 6.65 Construction cost model

ii. Setting Project Timeline

The timeline for the project set on the awarded contract between the client and the contractor was for 8 months. During TVD the team set a target of 6 months for the project and planned the construction process towards achieving it. Figure 6.66 shows the project timeline.

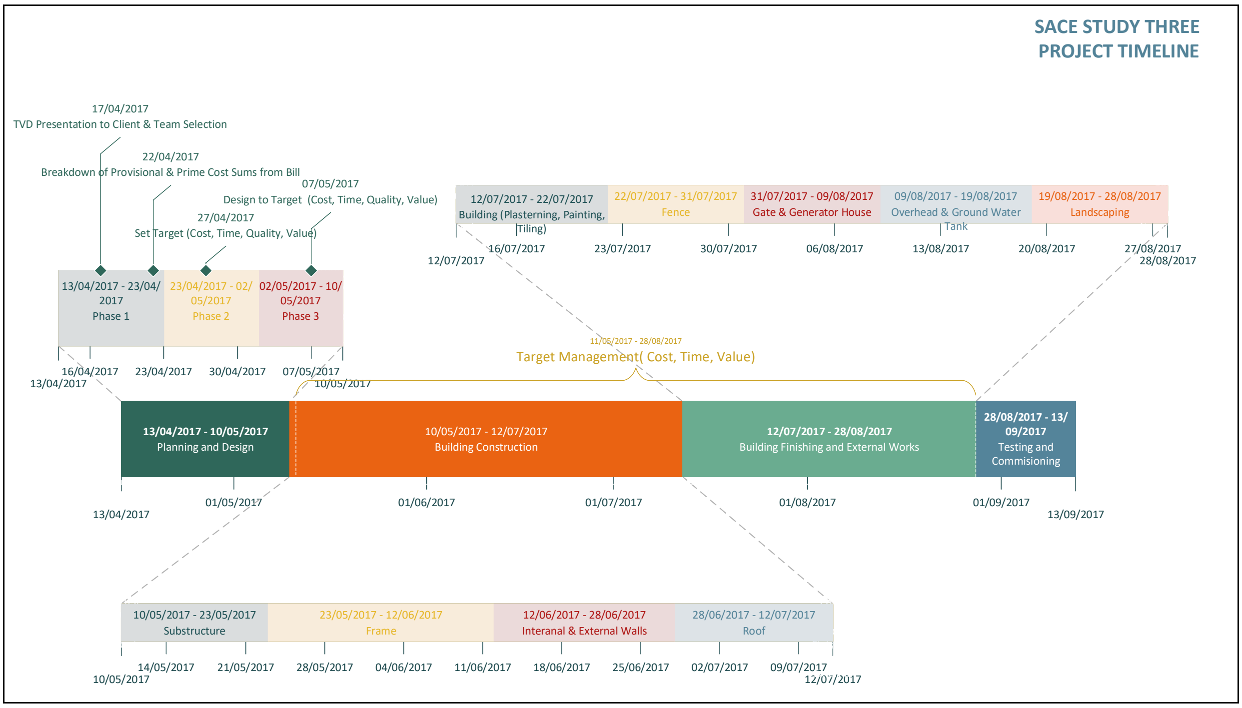


Figure 6.66 Project Timeline

iii. Setting Quality Standards

Quality specifications were set to conform with standards set for the construction of fire stations. Quality reviews were carried out by the monitoring team who designed the specifications. They had to sign off on the quality before the execution team can raise any payments for the sub-contractors or trades.

iv. Setting Value propositions

The value requirements were identified by all stakeholders from the contract documents as well as from a focus group brainstorming session.

6.5.2.1.3 Pre-Construction Planning

Aligning targets to site conditions: Confirmatory surveys and soil tests were carried out to compare initial drawings with existing site conditions. The findings made the team change the positions of the building to accommodate the external tank positions. The geophysical test results revealed that there was no yield at the proposed point, so the team had to relocate the borehole position to about 300 metres away. Soil tests were carried out at the location of the building.

A. Steering to Targets for Designing PS & PC Sums during Construction.

i. Cross-functional Teams for Construction

Product level targets were set and distributed into small component targets representing individual items comprising of costs, quality, time and value requirements. Cluster groups were formed, and components targets were allocated to these groups. These groups were tasked with examining their targets and finding innovative solutions with lower cost, better designs, more quality specifications and better value requirements than the targets allocated.

Cluster teams comprised of the planning/design core, project execution core and project closing/handover core group. The cluster leaders were the client representative, TVD facilitator, contractor, end-users and project manager. While clusters group comprised of consultants, sub-contractors, suppliers, quantity surveyors, designers and site engineers. the team that formed the design cluster also moved to the execution cluster. The design and execution clusters had sub-clusters comprising of civil works, material and labour/equipment, electrical works, mechanical works and administrative expenses preliminaries (initial cost, running cost and terminal cost). The teams were guided by cluster leaders who integrated all findings and facilitated the collaborations between clusters. A few team members were not collocated with the team on site, this prompted cluster leaders to handle communication and interface with all members through emails and video calls. They superimposed the designs to remedy clashes, updated designs with cost and relocated savings from cluster to cluster. Figure 6.67 shows the cluster grouping of the project.

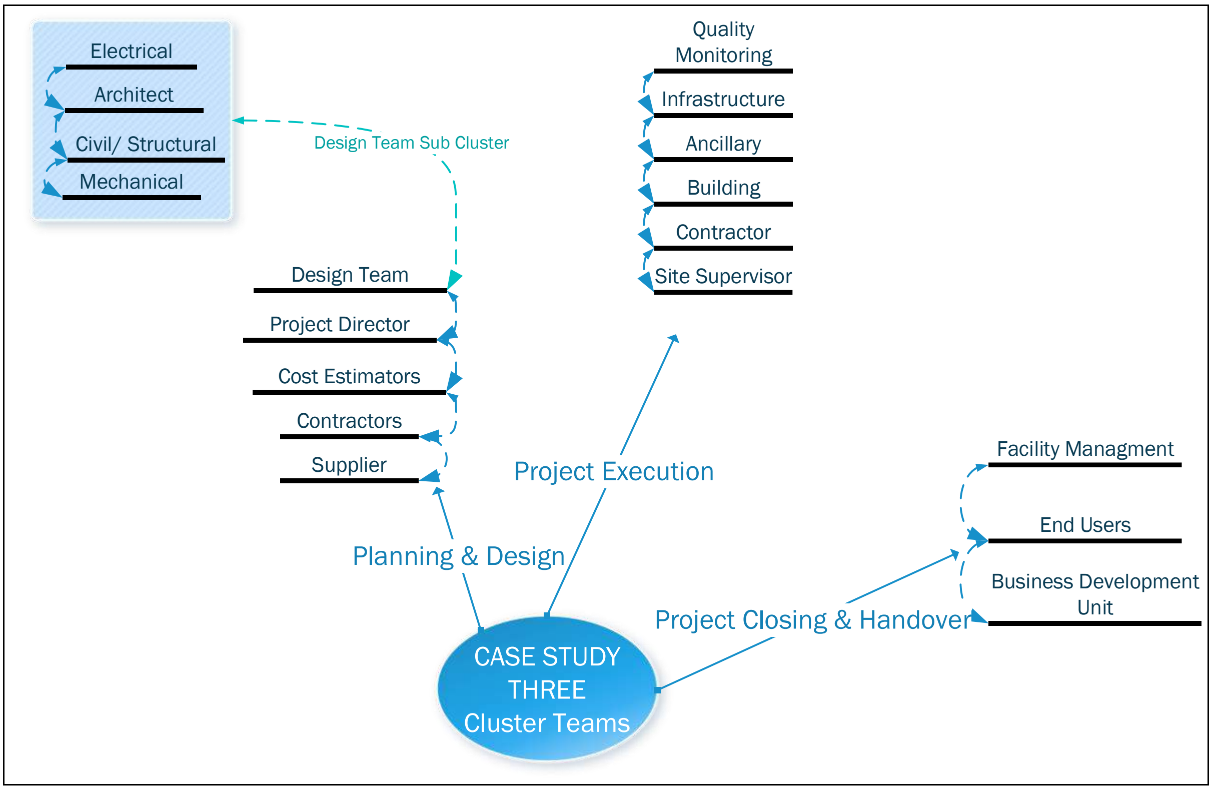


Figure 6.67 Project cluster teams

ii. Co-location and big room

Most of the meetings were held in a big room because this was the construction stage and most of the team members were on-site, very few members required virtual meetings.

iii. Integrated and collaborative conversation

The project team members arranged weekly site meetings during designing and construction of the provisional sums to reflect and discuss issues arising and agree on a way forward.

Value Engineering Exercise:

The concept of VE was very useful as designers did not see the contributions of better designs from other members as a threat. Lower cost items that did not affect functionality and quality were identified and substituted with higher value and cost items during design. Also, a better design layout was used to reposition items for more efficiency, thereby reducing cost.

iv. Cost Modelling and cost tracking

Costs were continuously updated during exercise to reflect new estimates and to indicate if costs of elements were more than the set target. Real-time costing was done to report the cost implications of different options proposed by the team. The cost was monitored during the weekly site meeting.

B. Steering to Targets During Construction.

During construction, the researcher was able to steer the construction to target and make more savings by monitoring the operating cost of the project, progress of work was monitored and discussed during the site meeting. All materials were inspected to ensure that they met the specifications agreed upon. The project budget was monitored using a spreadsheet checking actual cost against the planned cost. The team was able to further reduce the actual cost of the project to about ₦20 million (55,556 US Dollars) during construction. This included additional work of about ₦ 1, 639,100 (4,553 US Dollars) that was not in the contract and was funded from the savings of the cluster groups.

6.5.2.2 Closing Stage

The project concluded with the testing and commissioning of all items constructed or installed in the project, the researcher collected and documented all the lessons learned from the project and reported impacts.

6.5.3 Semi-structured Interviews

6.5.3.1 Demographic Information of Respondents on CS-03

The interview was administered to seven participants in this case study, the main contractor and two subcontractors participated in the study. Most of the respondents (43%) are civil engineers; this could be because TVD was implemented during the construction (execution) stage of the project. All the respondents have over 10 years of construction experience and had key roles in the project. (see Table 6.14)

Table 6.14 Demography for CS-03

SN	ROLE CATEGORISATION ON THE PROJECT	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.
1	Project Manager	CS-03-FS01	Civil Engineer	14
2	Client Representative	CS-03-FS02	Architect	15
3	Head Estimator	CS-03-FS03	Quantity Surveyor	22
4	Sub-Contractor	CS-03-FS04	Contractor	23
5	Main Contractor	CS-03-FS05	Civil Engineer	22
6	Project Supervisor	CS-03-FS06	Civil Engineer	15
7	Electrical Sub-Contractor	CS-03-FS07	Electrical engineer	15

6.5.3.2 Benefits of TVD Implementation

The respondents of the case study were asked to mention the benefits they observed during the implementation of TVD on the project and they listed various benefits they observed during the construction stage. The project is the construction of a prototype fire station for a government agency and thus follows the traditional procurement route. This means that most of the team members that executed the project were not involved in the project initiation stage. Their answers, therefore, border mainly on the construction and closing stages of the project. (see Figure 6.68).

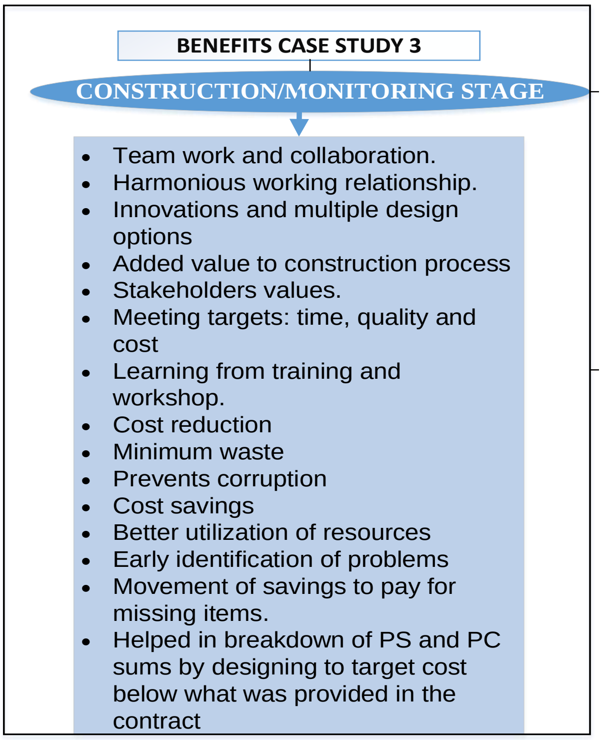


Figure 6.68 Benefit of TVD implementation at the construction stage

Analysis of the interview responses from participants of this study reveals that respondents believe that teamwork and collaboration were some of the benefits of TVD implementation during the construction phase of the project, they all agreed that the implementation of TVD created a harmonious working relationship between the team members, the collaboration fostered the relationship between team members. Designing to target, which is the fundamental principle of TVD, is one of the benefits of TVD that was observed by the respondents during the breakdown of PS and PC sums, TVD enabled them to have direction and a focus that helped achieve the team's goal. Analysis of the interview responses from participants of this study also reveals that respondent believes that innovations and multiple design options are benefits of TVD implementation during the construction phase, they believe that TVD implementation ensured that there was added value to the construction process. TVD improved on the existing construction process and the quality of the product. Some of them said:

> *"TVD promotes a platform for collaboration with the team resulting in a good working relationship." **(CS-03-FS02)***

> *"There was a fixed contract figure, so, we had to come up with innovative ideas of how to tackle that, redesign provisional sums to targets. TVD added value in the*

*construction, a typical example was we had the provision for a 600-diameter spiral staircase which was inadequate, so we had to redesign to make it adequate for people to pass through conveniently." (CS-**03-FS05)***

Stakeholder values were better understood by the team members because of the implementation of TVD, everybody on the team understood what needed to be achieved and they knew the roles they needed to play to ensure that the targets were achieved. The interview responses from participants of this study show that respondents agreed that the team meeting its target was a benefit of TVD implementation during the construction, the target cost and time were not exceeded, and the quality of the product was not compromised. A respondent mentioned that learning was a major benefit of the implementation of TVD, this was possible because of the training and workshop on TVD to create awareness for the team members. The respondents from the case study all agreed that the implementation of TVD helped minimise waste in the construction process. Respondents recorded the prevention of corruption as another benefit of TVD implementation, this is possible because the whole team was aware of every aspect of the project and possibilities for waste or embezzlement was eliminated. A few said:

"Better identification of shareholder values and it made me learn so many new things" ***(CS-03-FS02)***

"TVD made the project to maintain costs lower than awarded cost, thereby controlling cost overrun. It helps avoid scope creep and there was a minimum waste in the delivery process." ***(CS-03-FS05)***

*" TVD helped us to prevent any kind of corruption and misappropriation of funds in our project because every item in the provisional list was broken down into details with the suppliers present" (CS-03-**FS07)***

Analysis of the interview responses from participants reveals that respondents believe that cost saving was a major benefit of the implementation of TVD during the project, another benefit of TVD implementation is the better utilisation of cost savings. The implementation not only saved cost but ensured that saving from one part of the project was diverted to other parts instead of being kept. Another major benefit of TVD implementation is the early identification of problems, the respondents claim that with the TVD, problems are identified early and can be resolved before the need for rework. Some respondents agreed by saying:

*"There was a lot of cost savings. And the savings we got, we used it for other things that were not in the bill like the generator, the pump machines all these things" (**CS-03-FS06)***

*"Early identification of problems was a key benefit. TVD signalled the items that were omitted during design and we were able to tackle it at this stage prior to commencement of construction." (**CS-03-FS05)***

6.5.3.3 Barriers to TVD Implementation

Figure 6.69 shows the barriers encountered in the case study.

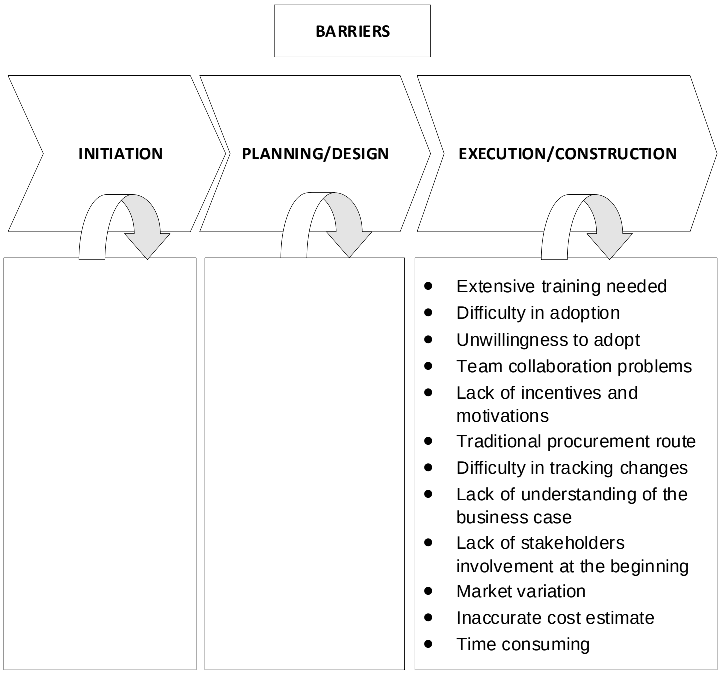


Figure 6.69 Barriers of TVD implementation at the construction stage

Participants of this study were asked to report the barriers they encountered during the implementation of TVD in the construction stage, the following are some of the barriers noted. Majority of the respondents complained that they were not conversant with the concept of TVD which made intensive training a necessity. There was some difficulty in the adoption of TVD because most of the project team members had not practised TVD before, it was a new concept to them and they were sceptical about it, some respondents reported that some team members were even unwilling to adopt TVD because of a fixedness of mind, they were set on participating in the traditional method of construction, this was a major barrier to the implementation of TVD. Respondents recognised team collaboration problems as one of the major barriers to the implementation of TVD, not all members understood the practice and felt like collaboration was a way for others to interfere and criticise their work. This is evident in a respondent's statement:

> *"Difficulty in adoption by team members; we had to conduct training and workshop for them because they were not aware of this new technique," (**CS-03-FS07)***

The analysis of the interviewed revealed that the lack of incentives and motivations was a major barrier to the implementation of TVD. Members of the project believe that if there was an incentive scheme, the team would be motivated to put in their best to achieve the required results. The respondents also complained that the project started using the traditional procurement route, which made the implementation of TVD very difficult during the project. Co-location was another challenge faced by some members of the team in implementing TVD in the construction stage of the project, team members were in different places and this put a strain on their collaboration. Respondents also complained that the difficulty in tracking changes was a barrier to the implementation of TVD, especially because it was in the construction phase and work had to continue as some of the changes were being made.

Some opined:

> *"There was lack of commitment by some team members because of no incentive. "There was difficulty in the tracking of changes because the construction was ongoing. So, while we were redesigning, we were mindful with the fact that some of the design might have already been executed so it was difficult." (**CS-03-FS05)***

> *"Some of the team members were not co-located in the same office, that was a challenge," (**CS-03-FS07)***

The respondents also recognised the lack of stakeholder involvement at the beginning as another major barrier to the implementation of TVD. Inaccurate cost estimating was another major barrier to the implementation of TVD that was recognised by the participants of this survey, the mistakes made in cost estimating could lead to setting unrealistic targets frustrating the team members. Another challenge reported by the team was that even with the real-time costing, market fluctuation still affected the cost of some items required for the project. The analysis shows that the participants of the study believe that the implementation of TVD at this stage was time-consuming and therefore served as a challenge to them. They said:

"We had an inaccurate cost estimate from the tender agreed as well as variations, missing items and market fluctuations. So, we had to look for savings to cover that." ***(CS-03-FS03)***

"TVD was time-consuming: as the design cycle increases TVD becomes more complex." ***(CS-03-FS07)***

6.5.3.4 Drivers of TVD Implementation

The drivers reported by the respondents are presented in Figure 6.70. Evidence of previous benefits and successes of TVD shown during the workshops and training served as a driving factor to implement it. The need to improve the organisation's modus operandi motivated the team's implementation of TVD, trying to find a more efficient system. TVD implementation was prompted by the quest for a common understanding and goal by all the members of the team, Achieving the client's goal and reduction of costs was another major driver for the implementation of TVD on this project.

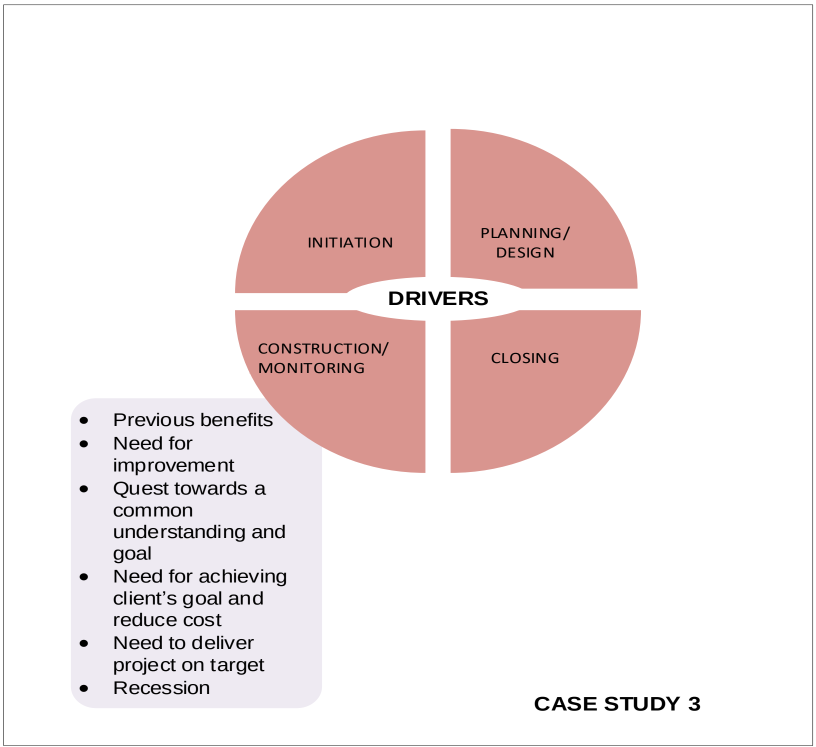


Figure 6.70 Drivers of TVD implementation at the construction stage

The need to deliver the project on target, which has been a major challenge in the construction industry in Nigeria especially public sector projects, was one of the driving factors for the implementation of TVD:

> *"From previous benefits of TVD from other projects we were able to convince the contractor to put TVD into consideration in this particular project." **(CS-03-FS05)***

> *"Because we wanted improvements in our organisation, that was why we did TVD; and TVD brings innovations on different alternatives methods of doing the work" **(CS-03-FS06)***

> *"We needed to maintain project cost certainty and control the overruns of the project. TVD has made it possible for us to achieve that." **(CS-03-FS07)***

6.5.3.5 Success Factors of TVD Implementation

The success factor recorded by the respondents are presented in Figure 6.71.

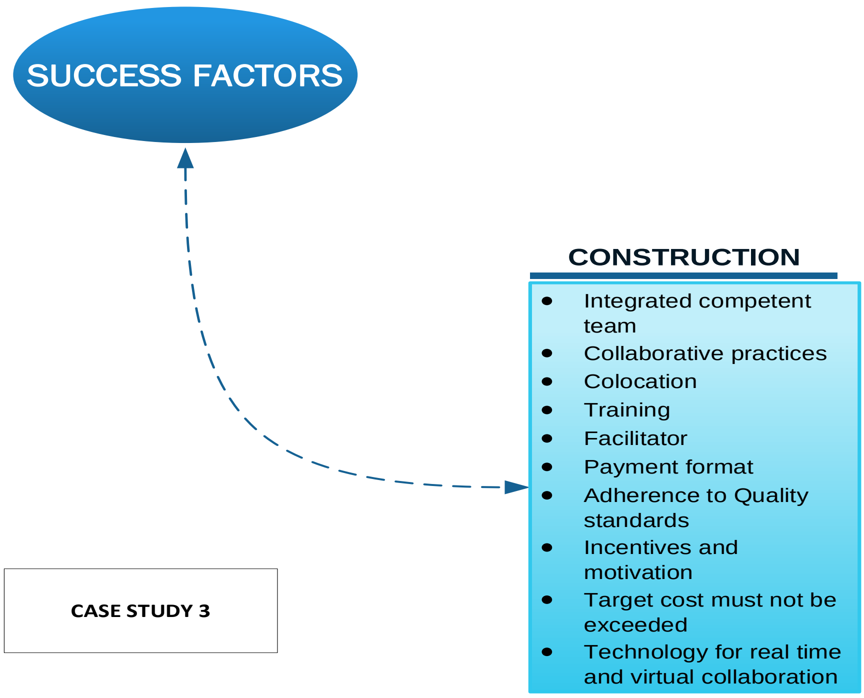


Figure 6.71 Success factors of TVD implementation at the construction stage

6.5.3.5.1 Success Factors of TVD Implementation at the Project Planning/ Design for Provisional/prime cost sums in the constructing stage

Having an integrated team is key to the success of the implementation of TVD, if the team is not integrated there will be no harmonious working relationship, and this will affect the productivity of the team. Co-location also plays a major role in the success of TVD implementation but for teams that are not in the same place real-time technology for virtual collaboration is vital, having the team together will foster collaborative practices and in turn the efficiency of the team. TVD implementation will be successful if training is conducted to create awareness of TVD and it will enable the team to understand how to go about it. Having a facilitator is paramount to the success of TVD, this will ensure that the procedures are followed diligently. Having the support of senior management aids the success of TVD because if they do not support the implementation, the team will not be able to implement TVD.

> *"Collaboration improvement, the support from the organisation and end-users and early involvement of key stakeholders will make TVD work better." (**CS-03-FS03)***

> *"Training and learning through simulation and workshop is needed to be done as it would motivate people to learn." (**CS-03-FS02)***

> *"The use of a facilitator, somebody that will be in charge to help explain what TVD means" (**CS-03-FS07)***

The adoption of TVD benchmarks will ensure its success alongside the addition of TVD into the contract of all stakeholders will ensure that they all practice TVD effectively, this will make its implementation successful. For TVD implementation to be successful, it is essential that the client has secured funding for the project and has a payment plan for how to disburse the funds. Steering to target is the core principle of TVD, the ability to steer to target is a success in implementing TVD

> *"TVD practice should be added in organisational policy, adoption of TVD benchmarks is all-important." (**CS-03-FS05)***

> *"Upfront payment plan, I think that would make TVD work so that they would be able to secure prices within the target price." (**CS-03-FS05)***

> *"Reviewing all the work was vital to see if we're on target" (**CS-03-FS02)***

6.5.3.5.2 Success Factors of TVD Implementation During Construction and Monitoring Stage

Co-location and collaborative practices are key essentials for the success of TVD implementation especially at the construction stage of the project as they will bring about productivity in the process, training is also essential for the success of TVD to enable the team to fully understand what is expected. It is important to have a source of funding for the project to ensure that TVD implementation succeeds

> *"Co-location is the best way to practice TVD but where that is not possible, internet or real-time software will aid with virtual collaboration. Also, if payment is made up front, prices could be locked down in advance and avoid fluctuations in the market"* ***(CS-03-FS05)***

> *"Workshop and training was very important and added a lot of value to my company staff, me and the project team."* ***(CS-03-FS07)***

A major way to ensure the success of TVD implementation is to ensure that quality standards are adhered to, the team should monitor the progress of work done and ensure that quality is not compromised. This can be done by frequent review of work done and ensuring targets are not exceeded, TVD is sure to be a success if these are done, respondents said:

> *"Adherence to quality standards. Constant review. Project target must not be exceeded. All this will make TVD better."* ***(CS-03-FS03)***

6.5.3.6 Impacts of TVD on the CS-03

The impact of implementing TVD reported by the participant of the study is shown in Figure 6.72.

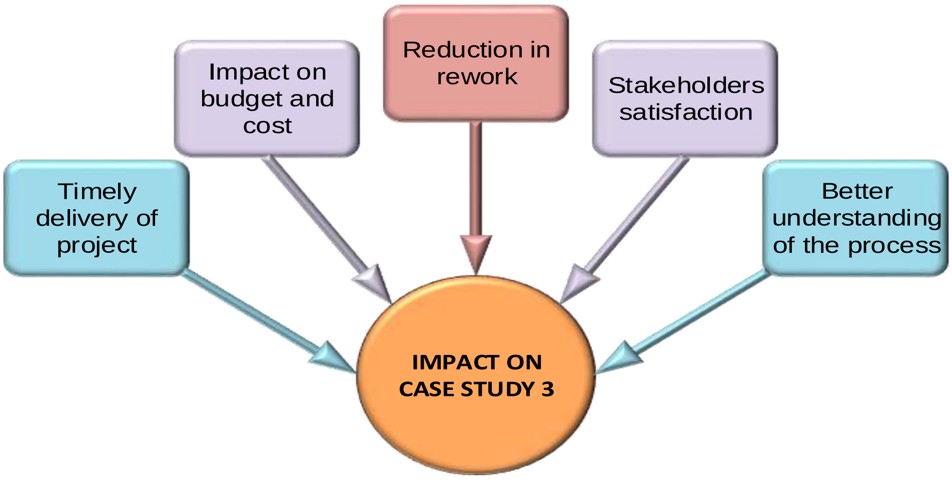


Figure 6.72 impact of TVD implementation at the construction stage

Most respondents of this case study were of the opinion that the timely delivery of project was the most noticeable impact the implementation of TVD on the project, most of them reported that they were able to deliver the project on time, another impact the implementation of TVD had on the project was on the budget and cost of the project, there were cost savings for the contractor. Another major impact recorded by the respondents during the construction phase of this case study is the reduction in variation and rework on the project, because of the implementation of TVD the amount of rework on the project was minimal. The analysis of the responses revealed that TVD implementation had a great impact on the project by providing stakeholders satisfaction, most of the participants expressed satisfaction with the outcome of the project, the working relationship between the project team was impacted positively by the implementation of TVD, collaboration helped the team build trust for each and in turn a harmonious working relationship, a respondent expressed this saying:

> *"We were able to deliver the project within the target cost and time frame. We were the first to deliver our project."* **(CS-03-FS05)**

> *"The client was pleased with our project because we improved on the initial design and did not spend the contingency sum. We had time to implement TVD rather than going in blindly and have a lot of changes/variations on site."* **(CS-03-FS05)**

6.5.3.7 Support Needed for the Implementation of TVD

The supports needed for the implementation of TVD reported by the participant of the study is shown in Figure 6.73.

Figure 6.73 support of TVD implementation at the construction stage

Analysis of the interview shows that when respondents were asked what supports they thought were needed to be in place for the implementation of TVD to be successful, they listed; training, facilitator, TVD awareness, senior management support, organisational policy, motivation and incentive scheme, academic support/ partnership and professional bodies' support and real-time technology for both face to face and virtual collaboration. A few of them said:

> *"Awareness of TVD benchmarks, strategies and benefits at all levels, training, workshop and simulations are all very important. Also, there should be support from organisation management (client and project group) and Industry and academic partnership support are required"* ***(CS-03-FS07)***

> *"Having a facilitator and adding TVD to contract and organisational policy is something that is a very key thing that has helped us."* ***(CS-03-FS03)***

> *"Motivation and incentive scheme must be set out from the onset and for all permanent and key staffs."* ***(CS-03-FS05)***

6.5.4 Case Study Three Survey

The participants of the project were also given a survey to assess the implementation of TVD benchmark, the impact of implementing TVD and level of collaboration on the project (see Table 6.15 for the demography of the survey participants).

Table 6.15 Demography of the survey respondents

S/NO	ROLE CATEGORISATION ON THE PROJECT	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.
1	Project Manager	CS-03-FS01	Civil Engineer	14
2	Client Representative	CS-03-FS02	Architect	15
3	Head Estimator	CS-03-FS03	Quantity Surveyor	22
4	Sub-Contractor	CS-03-FS04	Contractor	23
5	Project Supervisor	CS-03-FS06	Civil Engineer	15

6.5.4.1 TVD Benchmark Implementation

The level of TVD benchmark implementation was measured for CS-03 after the implementation of TVD in the project, the result of the analysis of the survey questionnaire shows that the following benchmarks recorded 100% full implementation: Mutual trust was maintained between all parties involved (BM 8), The cost target set by the project team in this project was not exceeded. Only the client/owner changed the target scope and quality during the project (BM 9a and 9b), Targeted scope and cost were allocated to each individual design team member (structural, mechanical, electrical, exterior, interiors.) during design (BM 14), Cost estimates and basis of estimate (scope) were updated frequently (BM 15), Team meetings were held frequently (BM 16a). While benchmark 16a recorded 60% full implementation, Benchmark 16b 'project cost estimates are updated and reviewed in weekly team meetings which were open to all project team members' recorded 100% full implementation, this is because the project cost estimate updating was not done on a weekly basis but when necessary. Cost estimating, and budgeting is done continuously through intimate collaboration between members of the project team (Benchmark 11) and targets are set as stretch goals to spur innovation (Benchmark 13) recorded 80% full implementation and 20% partial implementation.

The following benchmarks were not implemented in this project: The business case included forecast of facility lifecycle costs, allowable cost and specifications of the project (BM 2a), Financing constraints were specified in the business case: limitations on the customer's ability to fund the investment required to obtain life cycle benefits (BM 2b), the Last Planner® system is used to coordinate the actions of team members (BM 12), as they all recorded 80% not implementation with 20% partial implementation each. These sets of benchmarks with low implementation were closely followed by Benchmark 1 with 60% not implemented.

The partially implemented benchmarks with 60% partial implementation include; all key project team members participated in the feasibility study (BM 3), a detailed schedule aligned with scope and quality requirements was produced from the feasibility study (BM 5b), feasibility studies are assessed by aligning what is wanted (BM 4a), feasibility studies are assessed by designing for construction (BM 4b), feasibility studies are assessed by designing for construction (BM 4c). The low implementation of the benchmarks was probably because TVD started at the construction stage and the current benchmarks mostly concentrated on the project initiation and design stage and less on construction and closing stage of projects. Figure 6.74 presents the level of benchmark implemented.

Figure 6.74 Percentage of TVD benchmark implementation for CS-03

6.5.4.2 Measuring Collaboration on CS-03

Five levels of collaboration were measured in the CS-03, they include collaboration, coalition, coordination, cooperation and networking. The questions in this section attempted to show the level of collaborative working practices in the project.

A. Collaboration

These questions were designed to demonstrate how members are connected, how resources are leveraged and exchanged and the levels of trust as a result of collaboration. Figure 6.75 shows that in the first question, a total of 60% agreed that all the team members were located at the place during the designing to targets of PS and PC sums during construction.

All the respondents agree that:

i. The opinions and ideas of all team members are considered in my workgroup
ii. Data was shared in real-time among team members.

From the questionnaire analysis, it can be deduced that there is high level of trust within the project team as all the respondents disagree with the statement that “team members are distrustful of each other in my workgroup”, they all also disagreed with the statement “team members belong to a single system”. 60% of the respondents disagreed with having a real feeling of teamwork is in place with their workgroup and information frequently shared by team members was characterised by mutual trust. 60% of the respondents believed all decisions are taken with mutual agreement of all team members before implementation.

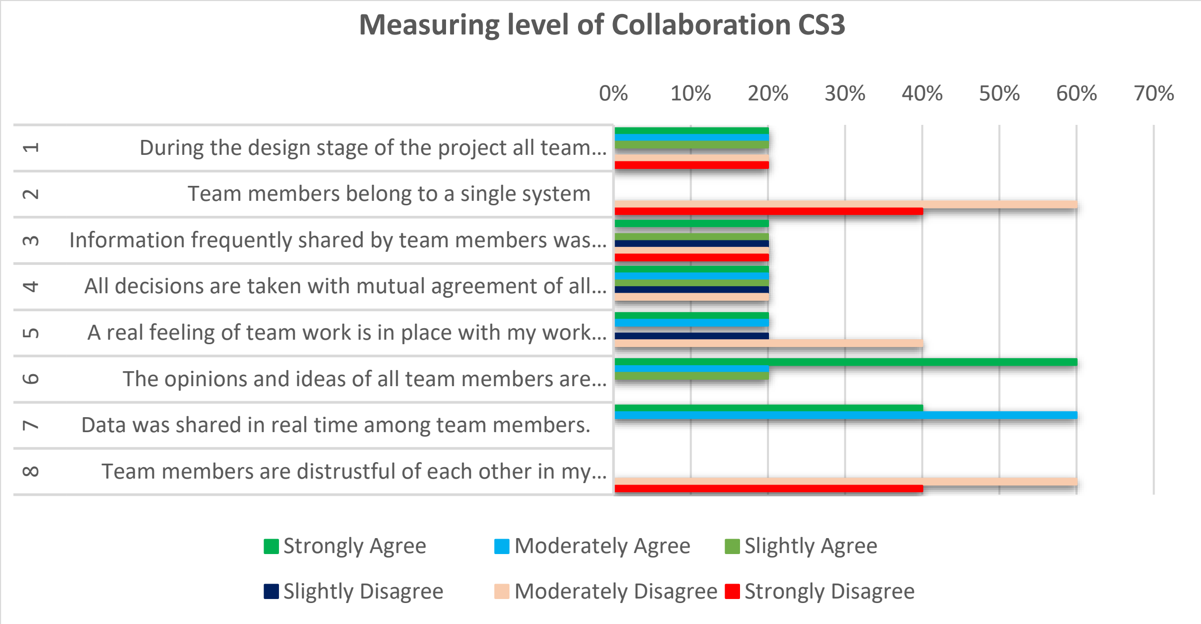


Figure 6.75 Measuring collaboration in CS3

B. Coalition

These statements were designed to demonstrate how members share information and how they arrive at decisions during the TVD implementation. From Figure 6.76 and all the respondents agree that team members had frequent prioritised communication. It also shows that 40% of the respondents indicated that all team members had a vote in the decision making.

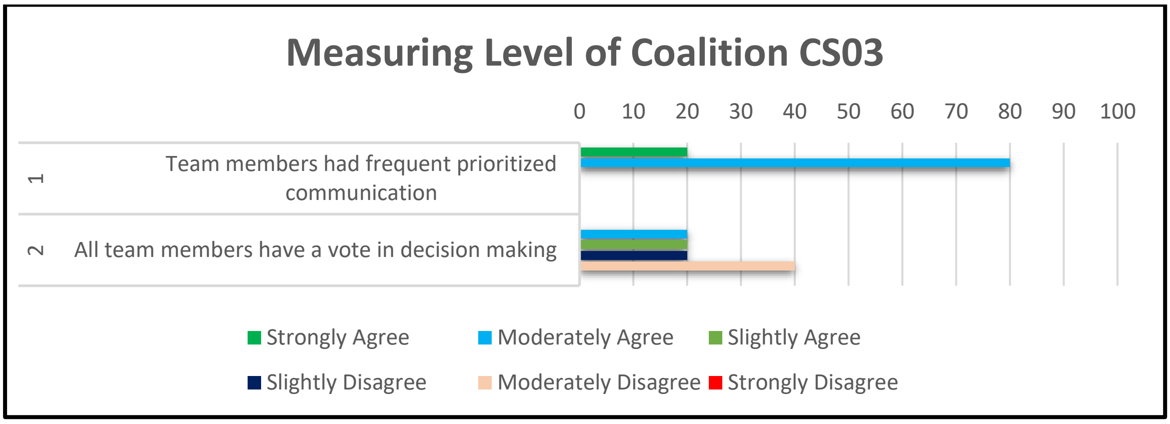


Figure 6.76 Measuring coalition in CS-03

C. Cooperation

These statements were designed to illustrate the type of communication, the definition of the roles, and how resources are exchanged during TVD implementation. 80% of the respondents believe that all team members had somewhat defined roles, same 80% of the respondents also agreed that there was just formal communication and that information was provided by team members to each other. This can be seen in Figure 6.77.

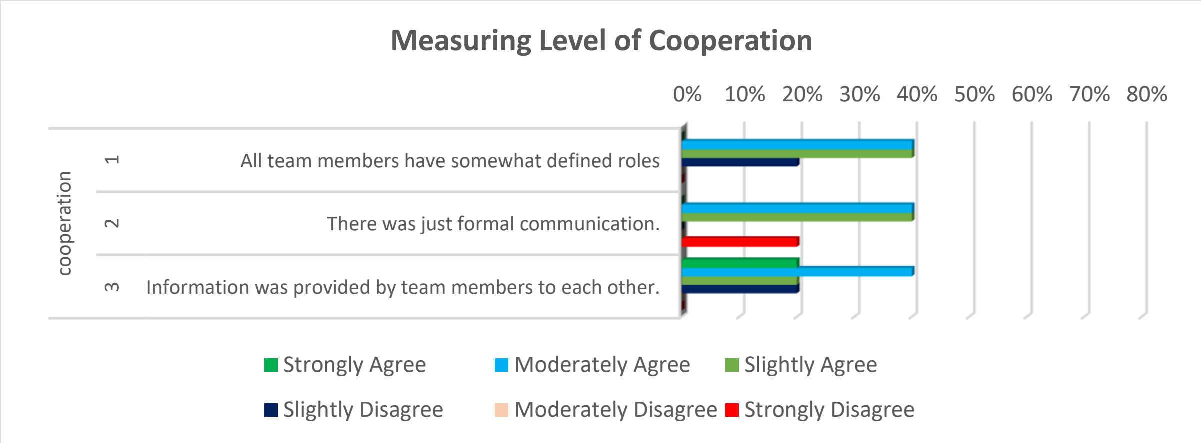


Figure 6.77 Measuring the level of cooperation

D. Coordination

The questions in this category were designed to assess the level of coordination in CS3, the questions were based on team members' roles, how decisions were made, and resources and ideas shared. The resulting analysis in Figure 6.78 shows that all the respondents believed that team members have clearly defined roles, that there was shared decision making among team members and team members Shared resources and ideas frequently.

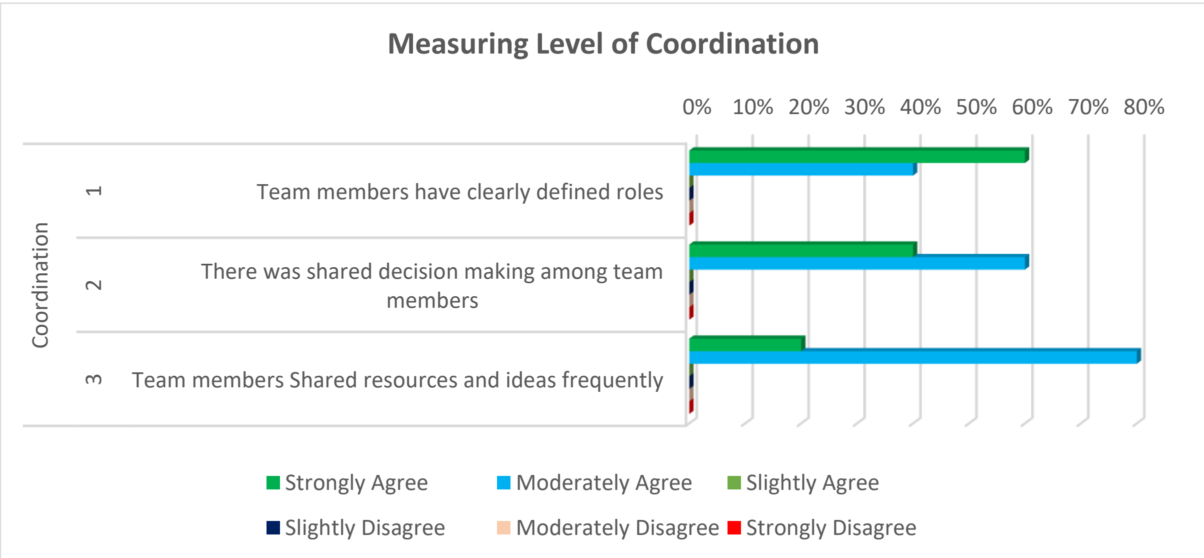


Figure 6.78 Measuring level of coordination

E. Networking

The result in Figure 6.79 reveals that all the respondents disagreed with the questions "there was little communication", "team members have loosely defined roles" and "all decisions were made independently". Most of the respondents (80%) disagreed with the question 'there was frequent communication without trust'.

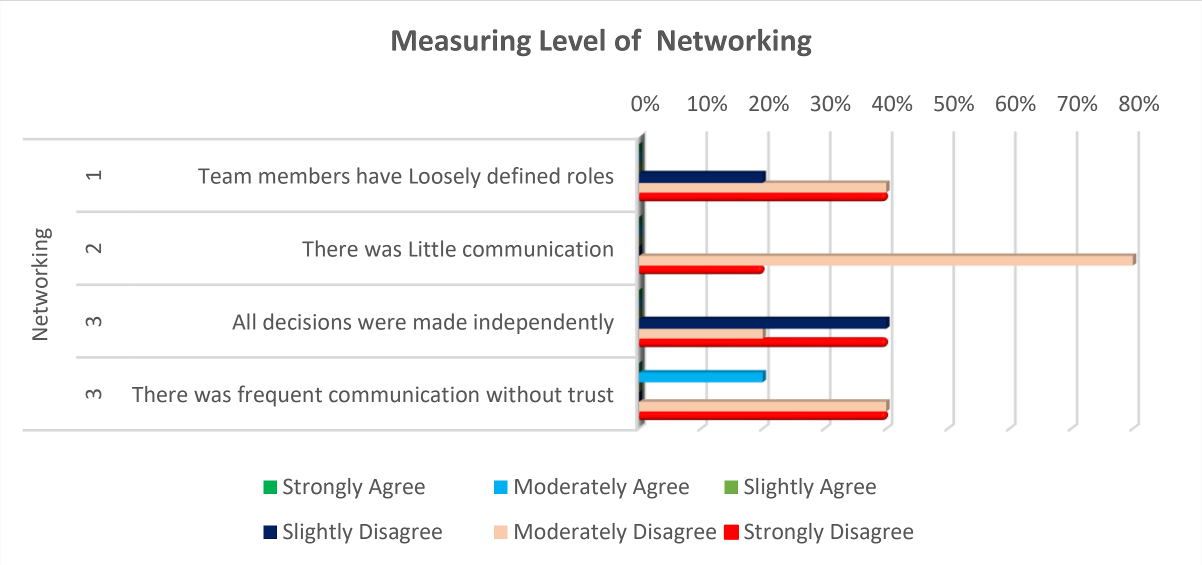


Figure 6.79 Measuring Level of Networking

6.5.4.3 TVD Post Implementation Impact

This section focuses on the impact of the implementation of TVD has on the project; CS-03. We identified areas that the application of TVD has impacted/ benefited, and we categorised them into four; cost, time, quality and working relationship.

A. Impact on Cost

The respondents were asked questions to determine the impact of the application of TVD on the cost of the project. 100% of the participants agreed that significant cost savings were realised with the use of TVD practices in the project. 80% of the respondents believe that more cost certainty was achieved with TVD on the project, while 20% were undecided.

All the respondents agreed that the project was delivered on a budget cost. They all also agreed that TVD has lowered the project cost by reducing waste and adding value and that TVD reduces uncertainty on projects which in turn reduces the contingency required to absorb variability.

Majority of the respondents (80%) agreed that the target cost benchmarking helped to control cost overruns in the project, while 20% of them neither agreed nor disagreed. Only 40% of the respondents agreed that the outcome cost was substantially below market price—both achieved without sacrificing scope or quality, another 40% were undecided while 20% of the respondents disagreed. (see Figure 6.80).

The implementation of TVD on CS-03 enabled the team to obtain a 37.2% savings from the awarded contract sum of the provisional and prime cost sums. (see Table 6.13).

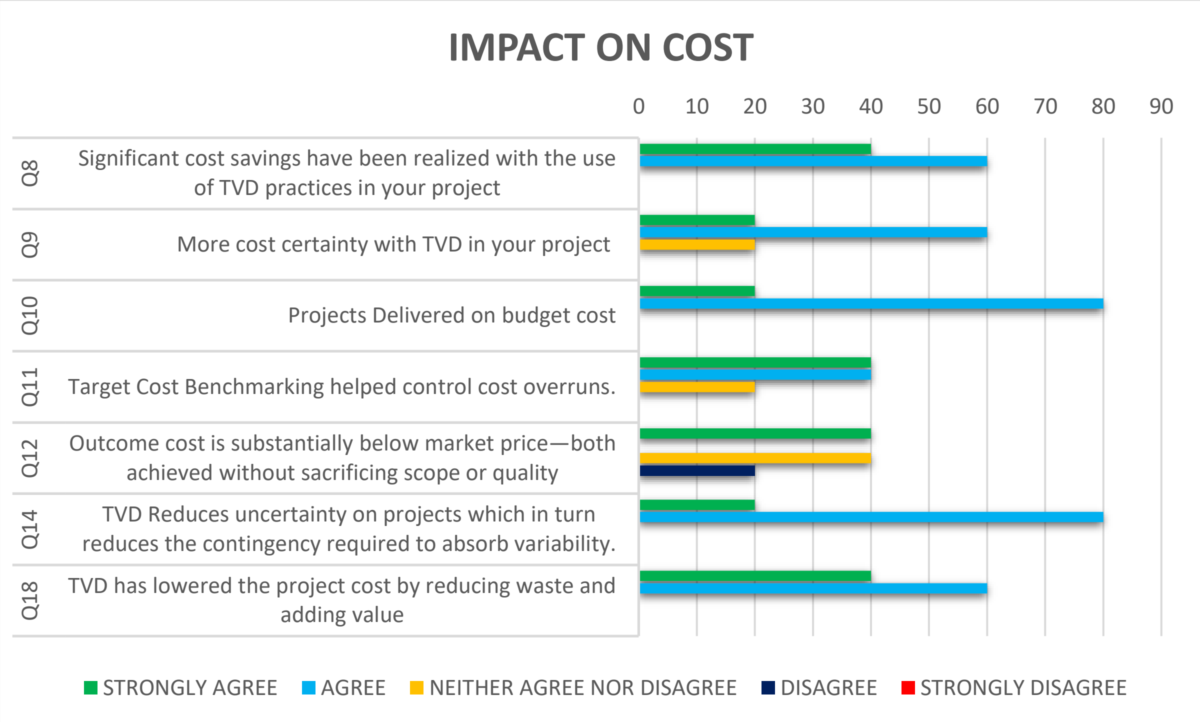


Figure 6.80 Impact on cost CS 3

B. Impact on Quality

The questions in this section were geared towards finding the impact that TVD implementation has on the quality of the project product. Questions asked included:

a. Engaging the client and other stakeholders as key performers reduced change orders and variations
b. TVD has enabled us to reduce the level and number of re-works on this project significantly
c. Results from TVD did not compromise quality and best quality was achieved despite designing to target.

d. TVD Process brings more quality for the product delivered considering all stakeholder interests
e. Better stakeholder value has been achieved with the application of TVD
f. The TVD process and tools created the conditions for identifying and delivering the target value from the design process during the planning stage

All the respondents (100%) agreed that the implementation of TVD on the project had a positive impact on the quality of the project. This is illustrated in Figure 6.81.

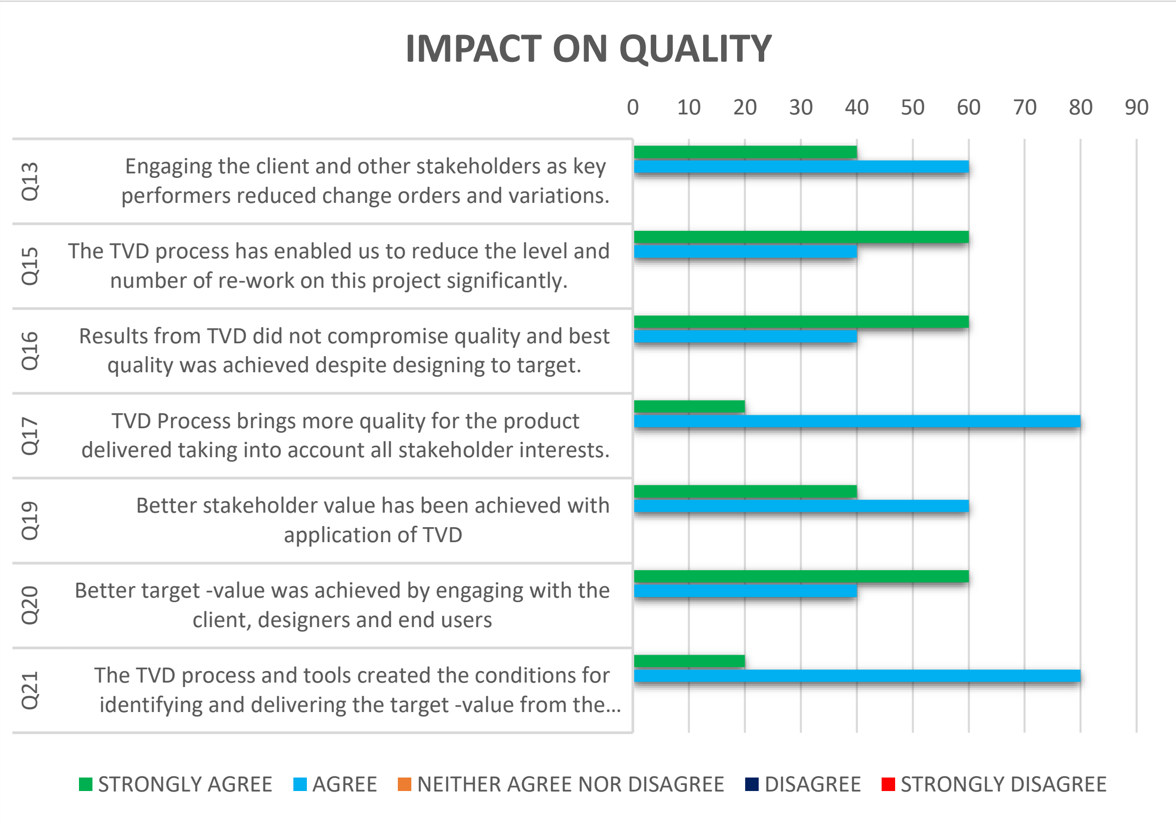


Figure 6.81 Impact on quality CS-03

C. Impact on Working Relationship

The questions in this section were chosen to assess the impact of TVD implementation on the working relationship of the participants of the project. While 60% of the respondents believed that co-location improves communication and facilitates consensus decision making among stakeholders, the other 40% neither agreed nor disagreed.

All the respondents agreed that a harmonious working relationship was maintained which encouraged a teamwork approach to innovative ideas in problem-solving. This can be attributed to the fact consensus decision making was maintained during the project. 100% of the respondents believed that collective planning was important in implementing TVD in the case study project.

The use of cross-functional/cluster teams increased the efficiency of the TVD project; this was corroborated by all the respondents of the questionnaire that agreed. Also, they all agree that stakeholders' collaboration helped in setting targets. More importantly all the participant agreed that they like working in this manner and finally, the result shows that co-location, as practiced in TVD, improved the trust and confidence that team members have for other members of the project team. This is presented in Figure 6.82.

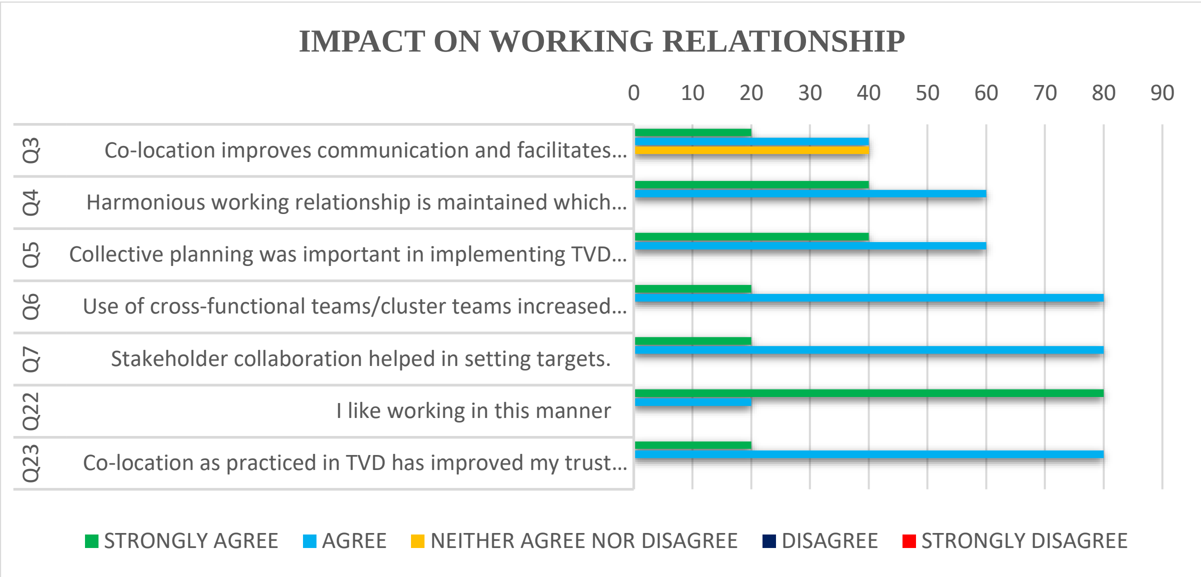


Figure 6.82 Impact on the working relationship

D. Impact on Time

The questions in this section were asked to help ascertain the impact of TVD on time. 100% of the respondents agreed that the TVD process consumed their time in the planning stage but helped them gain more speed in the execution stage. 80% of the respondents agreed that they were able to deliver the project on or before schedule time with TVD, while 20% neither agreed nor disagreed. (see Figure 6.83).

The Government had requested that the prototypes be completed in eight months while the project team set a target of 6months, the implementation of TVD on the project enabled the team to finish in 5 months, which was ahead of time with one month and ahead of the project teams delivering the other prototypes with about three months.

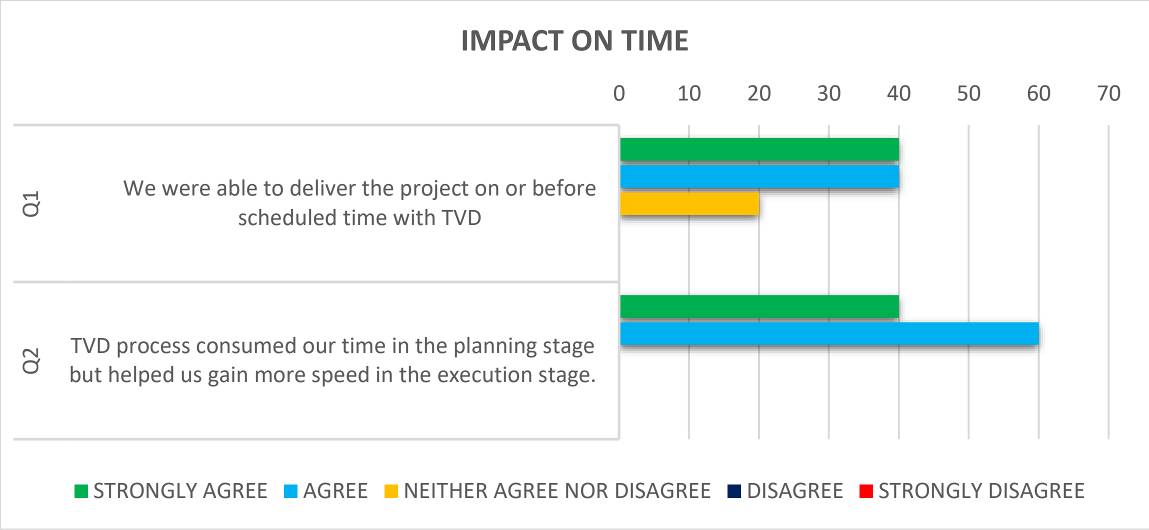


Figure 6.83 Impact on time

E. Impact on procurement route

In CS-03, the main contractor secured a public contract for the construction of a public fire station through the traditional procurement route. The contract was awarded without a detailed design of some key components of the project that had provisional sums and prime-cost sums. This means that the contractors and the execution team did not participate in the project initiation stage due to restrictions of the traditional procurement route and the fact the government was the client. This is collaborated by the response of the project manager and main contractor of the project;

> *"One of the challenges of TVD implementation is the traditional procurement route where the design was done in isolation [***CS-03-FS05**, Main Contractor*]*

The traditional procurement route was a challenge to TVD implementation as it did not allow the design and execution team to participate early in the project. Nevertheless, the team was able to overcome this challenge in the construction stage when the prime cost sum and the provisional sum of components without design were broken down using TVD (co-location and collaboration). The provisional sums were used to allocate cost targets to cluster\execution teams, who then engaged in another round of designing and estimations before the commencement of construction. This process helped to improve the working relationship of the execution team.

6.6 Cross Case Study Analysis and Discussion

The different case studies and their results have been discussed individually in the preceding sections, this section, therefore, focuses on comparative analysis and discussion of the three (3) case studies. In this comparison, emphasis will be laid on the case study background, TVD benchmark implementation, measuring the levels of overall collaboration, measuring of overall impact and interview analyses.

6.6.1 Case Study Descriptions

Table 6.16 shows a comparison of the attributes of the three case studies

Table 6.16 Comparison of the attributes of the three case studies

ATTRIBUTES	CS-01	CS-02	CS-03
Nature of project	Construction / infrastructure project	Construction project	Construction project
Location of project	Abuja, Nigeria	Kaduna, Nigeria	Abuja, Nigeria
Nature of works	Construction of housing estate	Construction of filling station	Construction of fire service station
Type of client	Private developer	Private	Public
Project duration	14 months	5 months	6 months
Stage of project	Completed to semi-finished	Completed	Completed
Procurement method	Design and build	Design and build	Traditional method
Contract sum	N2.3 Billion (USD 6.39million)	N85 million (USD 236,111)	N31 million (USD 86,111)
Stage of TVD implementation	All stages	Initiation and planning/ design	construction

6.6.2 Cross Case Comparison of Interviews

Although TVD was implemented on all the case studies, it was implemented on all the stages in CS-01 but only in the initiation and planning stages of CS-02 and only on the construction stage of CS-03

6.6.2.1 Cross Case Comparison of Benefits of TVD Implementation

Benefits of TVD were reported by the respondent of all case studies at the different stages that they were observed.

A. Benefits at Initiation

Table 6.17 shows the benefit in the initiation stage as recorded by respondents of case studies CS-01 and CS-02, this is because TVD was not implemented at the initiation stage of CS-03.

Table 6.17 The benefit in the initiation stage

CS-01	CS-02	CS-03
Early Collaboration	Collaboration	
Integrated Team Selection	Team Selection	
Better identification of stakeholders' values	Better identification of Clients values.	
Clients engagement and buy-in	Early Identification of Problems	

Analysis of the interview results reveal that CS-01 and CS-02 respondents observed early collaboration of the project stakeholders because of the implementation of TVD, their respondents believe that the selection of an integrated team was possible and there was better identification of stakeholder value all as a result of the implementation of TVD. CS-02 revealed an additional benefit of early identification of problems in the initiation stage.

B. Benefits at the Planning/Design stage

Table 6.18 shows the benefits that were recorded at the planning/design stage of CS-01 and CS-02.

Table 6.18 Comparison of the benefits of TVD across the case studies

CS-01	CS-02	CS-03
Teamwork	Collaboration.	
Harmonious working relationship.	Harmonious working relationship.	
Team selection	Competence assessment	
Innovations and multiple design options	Designing to target cost.	
Cost reduction	Cost savings	
Stakeholders values	Informed clients	
Real-time costing	Real-time costing	
Maintaining the target budget	Added value to the design process	
Learning from training and workshop.	Learning from other professionals as a result of collaboration.	
Life cycle costing	Reduction of change and variation	
Minimum waste	Prevention of corruption	
Prevents corruption	Project lower than the target price	
Project lower than the market price	Breaking down the whole to details	
Early identification of problems	Prevention of corruption	
Better utilization of savings and resources		
Reduction of the change order and variation		

The two case studies when analysed showed that the implementation of TVD brought about better teamwork and collaboration, harmonious working relationships, competent team selection and learning from training and workshops and collaboration with other professionals. Both also observed that TVD enabled them to deliver a budget less than market and target prices, ensured real-time costing, cost savings and prevention of corruption.

It was observed in CS-01 that the implementation of TVD was beneficial to the stakeholders because their value was identified, the target budgets was maintained, problems were identified early, waste was minimized and cost savings that where gotten were better utilized, while in CS-02 it was observed that the client was better informed, there was added value to design, a huge reduction in change orders and variation and the breaking down of the whole into details was easier owing to the implementation of TVD.

C. Benefits at the Construction stage

The benefits observed across the case studies were observed from CS-01 and CS-03 because the implementation of TVD terminated at the planning/design stage in CS-02. Table 6.19 reports the benefits that were observed in the construction stage;

Table 6.19 Comparison of the benefits of TVD across the case studies

CS-01	CS-02	CS-03
Effective communication		Harmonious working relationship.
Creation of innovative ideas		Innovations and multiple design option
Prevents waste of resources		Minimum waste
Prevent cost overrun		Cost reduction
Maintaining the target budget		Meeting targets: time, quality and cost
Learning from other professionals as a result of collaboration.		Learning from training and workshop.
Cost savings		Cost savings
Better utilization of savings and resources		Better utilization of resources
Added value to the construction process		teamwork and collaboration.
		Design and construct to target cost.
		Stakeholders values.
		Prevents corruption

D. Benefits at closing

The benefit observed at the closing stage was obtained from CS-01 only (see Table 6.20), they are captured in the table. It was reported that the benefits accrued as a result of the implementation of TVD are teamwork and collaboration and a harmonious working relationship. The stakeholders' values were realised, waste was minimised, the target was maintained, cost overrun was avoided, and the team was able to come up with innovative ideas and improve the overall construction process of the organisation and finally TVD impacts were measured.

Table 6.20 Cross case study comparison of benefits

CS-01	CS-02	CS-03
Achieved Teamwork and collaboration.		
Achieved a Harmonious working relationship.		
Realised Client's/ stakeholders value		
Minimum waste		
Innovations and better construction process		
Maintaining the target budget		
Prevention of cost overrun		

6.6.2.2 Cross Case Comparison of Barriers of TVD Implementation

The barriers were also analysed across the case studies noting the different stages where TVD was implemented in all the case studies.

A. Barriers at initiation

Table 6.21 shows the barriers that were observed by the participants of the survey during the initiation stage across CS-01 and CS-02.

Table 6.21 Cross case study comparison of barriers

CS-01	CS-02	CS-03
Teamwork problems	Collaboration problems	
Little incentives	No incentives and motivations	
Reluctance to adopt	Difficulty in adoption	
Colocation issues	Colocation issues	
Lack of understanding of the business case	Lack of understanding of the business case	
Lack of stakeholders' involvement at the beginning	Lack of key participants involvement at the beginning	
Resistance to Change	Unwillingness to adopt	
Inflation/ recession	Lack of awareness of TVD	

The two case studies report that collaboration problems were experienced at the beginning of their projects, this could be attributed to the fact that both cases studies had outsourced sub-contractors. Both case studies also identified little or no incentives and co-location issues as challenges faced during the implementation of TVD. They both reported that there were some difficulty and unwillingness to adopt TVD stemming from their lack of awareness of the TVD practices. The lack of involvement of key stakeholders at the beginning of both projects also posed a challenge to the implementation of TVD; this led to the lack of understanding of the business case by some stakeholders on both case studies. Resistance to change or a general unwillingness to adopt TVD also posed challenges according to the respondents of the interviews.

In CS-01, the respondents named inflation/economic recession as the challenge peculiar to their case study while CS-02 respondents reported the general lack of familiarity with the concept of TVD as one of the challenges to the implementation of TVD in the initiation stage.

B. Barriers at the Planning/ design stage

The implementation of TVD during the planning/design stage, just like in the initiation stage, were observed only in CS-01 and CS-02, the analysis of the interview results shows that the traditional mindset and way of practice served as a barrier to both case studies. They also complained about the use of different software and the difficulty in converting some of the work tools used by team members. Both case studies reported that they faced the collaboration problems with the team member that was outsourced. Other challenges faced by the two case studies were; the time-consuming nature of TVD practice, most respondents on both case studies revealed that they thought that the process was time-wasting because of the constant redesigning to get to the set targets until they started to see the benefits.

The respondents of CS-01 complained that the delay in cost data, inaccurate cost estimation, problems moving cost saving between clusters and difficulty tracking changes were barriers to the implementation of TVD on their project. CS-02's respondent said that they faced serious co-location issues because most of their team members were located in different parts of the country, one said;

> *"I think another barrier was that a lot of the team members were not together, they were not co-located, they were in different states"* **[CS-2-PS12 PM]**

They also reported a lack of the scope of engagement and the cost of involving all stakeholder at the beginning of the project as a barrier to their project. This can be seen in Table 7.22

Table 6.22 Cross case study comparison of barriers at the planning/ design stage

CS-01	CS-02	CS-03
Traditional mindset and practice	The traditional method of construction	
Problems with integrating outsourced team	Team collaboration problems	
Differing work tool and process	Working with different software	
Lack of understanding of the business case	Lack of understanding of the business case	
Time-consuming	Time-consuming	
The opinion of time-wasting	Perception of time-wasting	
Cost data delay	Colocation issues	
Inaccurate cost estimation	Lack of understanding of the scope of engagement	
The problem of moving cost savings	Cost of early involvement of stakeholder	
Difficulty to track changes		

A. Barriers to the TVD implementation at the Construction stage

In the construction stage, TVD was implemented only on CS-01 and CS-03. Both case studies' interview analysis revealed that they both experience barriers to the implementation during the construction stage of their projects, as seen in Table 6.23.

Table 6.23 Cross case study comparison of barriers to TVD at the construction stage

CS-01	CS-O2	CS-03
Market fluctuation		Market variation
Difficulty in tracking the target		Difficulty in tracking changes
Complexity in choosing contractors		Extensive training needed
Trust issues		Team collaboration problems
Contingency set too low		Difficulty in adoption
Changes in design		Unwillingness to adopt
		Lack of incentives and motivations
		Traditional procurement route
		Inaccurate cost estimate
		Lack of understanding of the business case
		Lack of stakeholders' involvement at the beginning
		Time-consuming

Both case studies reported that market fluctuations were a barrier to the implementation of TVD in the construction stage when it was time for procurement the cost of some items planned for had increased. They both complained of some trust issues between team members, they also complained about difficulty in tracking the numerous changes that came as a result of the designing and redesigning to targets. Respondents of CS-01 complained that there was some complexity in choosing a contractor and that is a barrier to the implementation of TVD, they said that setting the contingency too low as well as too many changes in design can also be barriers to implementation.

CS-03 experienced more challenges in this stage, this could be because this was the only stage in the case study that TVD was implemented, the interviewees here stated that difficulty in adoption and an unwillingness to adopt TVD by the team members was a barrier to the implementation of TVD, this could be attributed to their traditional mindsets of using the traditional procurement method. They also report facing the challenges implementing TVD because of team collaboration issues, lack of involvement of key stakeholders at the beginning of the project and a lack of understanding of the business case. Lack of incentives and the time-consuming nature of TVD also served as barriers to the implementation of TVD on their project.

6.6.2.3 Cross Case Comparison of Success Factors of TVD Implementation

A. Success factors at the initiation stage

In this section, the respondents were asked about the factors that ensure that the implementation of TVD will be successful. Their responses are captured in the Table 6.24.

Table 6.24 Cross case study comparison of success factors at the initiation stage

CS-01	CS-02	CS-03
Early participation of stakeholders	Early involvement of participants	
Organisational support	Organizational support	
Management buy in	Senior management buy in	
Management policy	TVD as organizational Policy	
Addition of TVD in the project contract	Early collaboration	
Adoption of TVD benchmarks	Payment support	

The respondents of both case studies suggest that early involvement of key stakeholders on the project will ensure the success of TVD implementation, this is because all the stakeholders will understand their scope of engagement and deliver what is required of them. Another success factor in both case studies is when the project team has organisational support and senior management buy-in, this is essential because, without the support and buy-in from the management, the team will not be allowed to practice TVD on the project. A major success factor noted by both case studies is the inclusion of TVD in the management or organisational policies, this will ensure the participants are mandated to implement TVD.

The respondents of CS-01 say that the addition of TVD to the project contract will also mandate the contractors to practice TVD which will make its implementation successful. Adopting the TVD benchmarks will enable TVD implementation to succeed, this is because the benchmarks will serve as a guide to ensure that procedures are adhered to. The respondents in CS-02 say that early collaboration and a payment system should be given to the initial participant from the beginning to encourage them to give their best even with the knowledge that they might not have been given the contract.

A. Success factors at Planning/ design

As earlier mention, only CS-01 and CS-02 had TVD implemented in the planning stage, they were asked about the success factors required for TVD in the planning stage, their responses are captured in the Table 6.25

Table 6.25 Cross case study comparison of success factors at planning/design

CS-01	**CS-02**	**CS-03**
Integration competent team selection	Selection of a competent team	
Collaborative practices	Collaborative planning	
Big room Collaboration	Colocation	
Extensive Training	Training	
Facilitator	Facilitator	
Incentives and motivation	Incentives and motivation	
Real-time costing	Real-time costing	
TVD as a management policy	Addition of TVD in contract	
Management support	Use of TVD benchmarks	

The respondents in CS-01 and CS-02 agree that the selection of a competent integrated team is key for the success of TVD implementation, they both believe that co-location together with collaborative practices will ensure an efficient team that will ensure the success of TVD implementation. They also agree that for the success of TVD in the planning stage of projects, it is essential to have an experienced facilitator that can oversee the TVD implementation process and conduct training that will further educate the project team about TVD. The respondents from both case studies also believe that having incentives and motivations will enable TVD to succeed. Real-time costing done with the current market price and not with estimates will also enable TVD to succeed.

The CS-01 respondents report that including TVD in the management policy and support from the management are factors that will ensure the success of TVD. While the CS-02 respondents made to their observation stating that to ensure the success of TVD is the addition of TVD to the engagement contracts of team members and the use of TVD benchmarks during the process.

A. Success factors at Construction

In construction, only respondents from CS-01 and CS-03 participated, this is because TVD was not implemented in the construction stage of CS-02, Table 6.26 shows the views of the respondent of the case studies

Table 6.26 Cross case study comparison of success factors at construction

CS-01	**CS-02**	**CS-03**
Incentives and motivation		Incentives and motivation
Maintaining Quality standards		Adherence to Quality standards
Review of work done		Collaborative practices
Use of TVD benchmarks		Training
		Facilitator
		Payment format
		Integration competent team
		Colocation
		Target cost must not be exceeded

The success factors common to the two case studies in the construction stage are incentive and motivation. Respondents of both case studies believe that having incentives will boost the morale of the team members and enable the implementation of TVD to succeed. Maintaining quality standards will also enable TVD to succeed. CS-01 respondents mentioned the use of TVD benchmarks and review of work done as success factors they believe are needed for TVD implementation.

CS-03 respondents had more success factors they considered necessary for the successful implementation of TVD. They emphasised the need for selecting an integrated competent team working with collaborative practices, stating that it will ensure good quality;

"*We looked for competent teams that will make us get the true quality that we need.*" ***[CS-3-FE-05 Project Supervisor]***

The respondents in the third case study also emphasised the importance of having a facilitator and conducting extensive training to ensure the success of TVD on a project. The respondents also stated that having a payment format will also encourage the team members to work hard at achieving success in TVD. Co-location and ensuring that target cost is not exceeded were also responses given by participant of the study as success factors required for TVD implementation to thrive.

6.6.2.4 Cross Case Comparison of Drivers of TVD Implementation

A. Drivers at the Initiation Stage

The factors that drive the need for TVD implementation were assessed across the three cases, Table 6.27 presents the cross-case study comparison of the drivers of TVD implementation in the case studies. At the project initiation stage, CS-01 and CS-02 reported that the previous benefits of TVD implementation success were one of the major drivers of TVD implementation. The need for improvement and upgrading the procedure of work was one of the reasons that necessitated the implementation of TVD at the initiation stage as recorded in CS-01 and CS-02. Because of the adversarial nature of the construction, there was a need for a paradigm shift to a more collaborative working relationship.

The analysis of the interview of CS-01 and CS02 suggests that the quest for a common understanding and goal was another driver of implementing TVD at the initiation stage. Having a clear understanding of the project goals and also the client's values is a prelude to successfully execution of the project, the respondents were of the opinion that when the team members are not having a common understanding and goals, the team could be working at cross-purposes.

Table 6.27 Cross case study comparison of TVD drivers.

CS-01	**CS-02**	**CS-03**
Previous benefits	Previous benefits of TVD implementation success	
Need for improvement	Need for upgrading	
The quest towards a common understanding and goal	The pursuit of mutual understanding	
Need to reduce cost	Need to reduce cost	
Need for achieving the client's goal	Need for achieving client value	
Competition and recession		
Need to deliver the project on target		

The need to reduce cost and achieve the client's values were another set of drivers that necessitated the implementation of TVD in CS-01 and CS-02. The competition in the market and the recession experienced in Nigeria which significantly affected especially the construction industry was another driver that precipitated the TVD implementation in CS-01.

A. Drivers at Planning Stage

Table 6.28 presents the cross-case study comparison of the drivers of TVD at the planning/design stage. The need to reduce variations and change orders were one of the drivers of TVD implementation in CS-01 and CS-02. The need to deliver the project below market price was another reason for the implementation of TVD especially on CS-01, because of the competition in the market, if the houses are not below market price the company will not break even, for example the budget officer of CS-01 argued this fact by saying that:

*"one of our competitors is our neighbour who is another estate development company and we had to beat their own prices". **[CS-1-EDO6 Budget Officer]***

Being certain of the cost to be incurred in any project is very important, and as such achieving cost certainty was viewed as another major driver of TVD implementation in CS-01 and CS-02. In the same vein, cost reduction was recorded as another driver.

Table 6.28 Cross case comparison of drivers at the planning stage

CS-01	CS-02	CS-03
Need to reduce variations	Need to reduce change orders	
Project delivery below market price	Project delivery below the target price	
Cost certainty and reduction	Cost certainty and reduction	

B. Drivers at the Construction

Table 6.29 presents the cross-case study comparison of the drivers at the construction stage. From the table, it is evident that the drivers were observed only on CS01 and CS-03.

The need for collaborative practices and improving the working relationship of the team members was one of the drivers of TVD implementation on CS-01. Also, the need for motivation and incentive scheme was yet another reason for implementing TVD on CS-01.

It was also noticed that the drivers observed during the initiation and planning stage of CS-01 were the same drivers for the construction stage of CS-03. This was because the planning and design were all done at the construction stage of CS-03 and the contractors and the researcher were not involved during the project initiation stage. The drivers already discussed include previous benefits, need for improvement, the quest towards a common understanding and goal, need to reduce cost, need for achieving client's goal, recession and need to deliver project on target.

Table 6.29 Cross case study comparison of drivers at construction

CS-01	CS-02	CS-03
The need for Collaborative practices		Previous benefits
Maintain predictable cost and cost overrun		Need for improvement
Motivation and incentive scheme.		The quest towards a common understanding and goal
		The need for reducing cost
		Need for achieving the client's goal
		Recession
		Need to deliver the project on target

6.6.2.5 Cross Case Comparison of Support for TVD Implementation

The respondents of all three case studies were asked about the supports they thought were needed for the effective implementation of TVD, an analysis of their replied was done and documented in Table 6.30

Table 6.30 Cross case comparison of support of TVD implementation

CS-01	**CS-02**	**CS-03**
Training	Training	Training
Facilitators	Facilitators	Facilitators
Awareness of previous TVD enablers	Awareness	TVD awareness
Management support	Management support	Management support
Monitoring and control	Monitoring and control	Monitoring and control
Academic support/ partnership	Academic support	Academic support/ partnership
Professional bodies' support	Professional bodies' support	Professional bodies' support
Motivation and incentive schemes		Motivation and incentive schemes
Organisational policy		Organisational policy
Adequate preparation		
Competent team selection		

All the respondent across the three case studies said that proper training is an important factor that will support the implementation of TVD, they said that this is important because most of the participants of the study are not familiar with it, they also claim that creating awareness especially with training and workshops will go a long way to support implementation. It was observed that having a facilitator that will help with TVD implementation and monitor and control the process and the project will support its implementation. This was reported across the three case studies, other supports mentioned by respondents of all case studies are management from their individual organisations, academic and partnership support from institutions. This is as well as supports from professional bodies, these will help educate people about TVD and provide further research and improvements to the TVD process.

Respondents from case studies CS-02 and CS-03 believe that having an incentive and motivation scheme to team members will boost their morals and in turn support the implementation of TVD, one of them said;

"I think motivation and incentive schemes will be of support" ***[CS-1-ED10 Team Head]***

They also believe that including TVD in companies' organisational policy will enable the effective implementation of TVD. CS-01 respondents stress that proper preparation or planning and the selection of a competent team are essential supports that will support the implementation of TVD.

6.6.2.6 Cross Case Comparison of Impact of TVD Implementation

A. Cross case study comparison and discussion on the impact

Table 6.31 presents the cross-case comparison of the impact of TVD implementation on the three case studies. The table shows a summary of the responses of the participants in the case study projects. As shown in the table, it is evident that the implementation of TVD has a positive impact on all three case studies. On the time of project delivery, the three case studies reported a timely delivery of project. For instance, the MD of the main contracting firm of the CS-03 stated that:

> *"TVD has given us a very wonderful result because out of the three contractors that were awarded the same projects in three different locations, my company was able to be successful in becoming the best quality and fastest to complete the project. Which was a very big plus to us.*" **[CS-3-FS04 Main contractor]**

Across the three case studies, there was evidence of the positive impact of implementation on budget and cost. This was because the analysis of the interview shows significant cost savings on the project cost. The initial budget of the case studies before TVD implementation was significantly and positively affected at the end of the implementation of TVD. There was also the achievement of stakeholders' values across the three case studies. All the stakeholders of the case studies were very satisfied with the outcome of the TVD implementation on the projects.

The implementation of TVD produced a realistic and accurate work schedule on CS01 and CS02 studies. Also, TVD implementation improved the working relationship among the team members and engender a robust collaboration and teamwork on the two case studies. This contrasts with the usual adversarial working relationship characteristic of the construction industry.

Table 6.31 Cross-case study comparison of the impact of TVD implementation

CS-01	**CS-02**	**CS-03**
Timely delivery of project	Delivery of project on time	Timely delivery of project
Impact on budget and price	Impact on budget and cost	Impact on budget and cost
Stakeholders satisfaction	Achievement of stakeholders' values	Stakeholders satisfaction
Realistic schedule	Accurate schedule	Reduction in reworks and variations
Reduction in variations and change orders	Defined scope	A better understanding of the process
A better understanding of the process	Working relationship	
Working relationship	Reduction in change orders and variations	

There was a drastic significant reduction in variations, change orders and rework in CS01 and CS03. It is normal for reworks, change orders and variations to attract additional time and additional costs on both materials and labour, this, in turn, increases the schedule and budget of any project; therefore, the reduction of rework on CS01 and CS03 positively affected the time and cost of the projects.

As a result of the training and workshop carried out across the three case studies, CS01 and CS03 reported a better understanding of the TVD process, while for CS02, there is still need for more training for better understanding of the process. CS02 also reported the realisation of a more defined scope of the project. This might be attributed the fact that TVD was implemented only at the initiation and planning/design stage of the case study.

6.6.3 Case Study Comparison of Surveys

The different case studies and their results have been presented and discussed individually in the preceding sections, this section, therefore, focuses on comparative analysis and discussion of the three (3) case studies. In this comparison, emphasis will be laid on the case study background, TVD benchmark implementation, measuring the levels of overall collaboration, measuring of overall impact and interview analyses.

Attributes

Table 6.32 shows a comparison of the attributes of the three case studies

Table 6.32 Attributes of the three case studies

ATTRIBUTES	CS-01	CS-02	CS-03
Nature of project	Construction / infrastructure project	Construction project	Construction project
Location of project	Abuja, Nigeria	Kaduna, Nigeria	Abuja, Nigeria
Nature of works	Construction of housing estate	Construction of filling station	Construction of fires service station
Type of client	Private developer	Private	Public
Project duration	14 months	5 months	6 months
Stage of project	Completed	Completed	Completed
Procurement method	Design and build	Design and build	Traditional method
Contract sum	N2.3 Billion (USD 6.39million)	N85 million (USD 236,111)	N31 million (USD 86,111)
Stage of TVD implementation	All stages	Initiation & Planning/ Design	Construction

6.6.3.1 Cross Case Comparison of TVD Benchmark Implementation

Demography

There were 34 respondents across the three case studies, research participants included a client, two contractors, three sub-contractors and many senior managers, this indicates that key stakeholders were part of the research. CS-01 had the most participants. All the participants of the research were professionals in their various field with 70% of them having more than 10 years of experience in construction. This means that they are knowledgeable about the workings of the industry.

TVD Benchmark Implementation

The overall levels of implementing the individual TVD benchmarks on all three case studies were assessed, this was achieved by measuring the average for each benchmark across the three case studies. The result shows that Benchmark 14 which states that "targeted scope and cost were allocated to each individual design team member (structural, mechanical, electrical, exterior, interiors.) during design" was found to have the overall highest level of implementation of about 83%. Also Benchmark 11 which states that cost estimating, and budgeting is done continuously through intimate collaboration between members of the project team was another benchmark that recorded a very high level of implementation across the three case studies with 81% agreement by the survey respondents.

Also, seven (7) other benchmarks recorded over 70% implementation. These benchmarks include: Benchmark 15, 16b, 9a, 9b, 13, 6, 8, 7a and 7b (Figure 6.84).

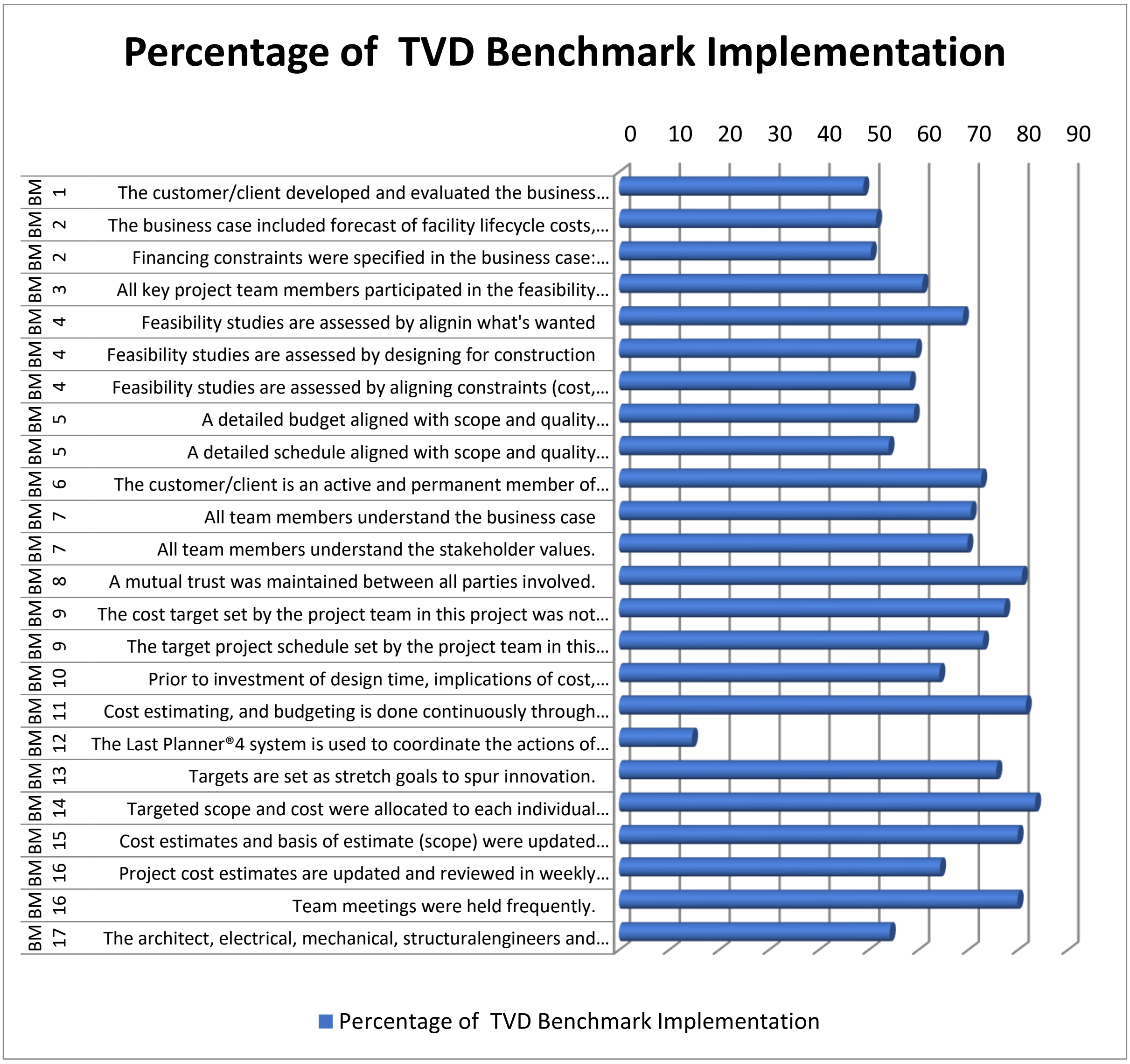


Figure 6.84 Percentage level of TVD Benchmark implementation

Benchmarks 1 and 12 recorded the least level of implementation across the three case studies. Last planner system was not used to coordinate the actions of the team members, that was why Benchmark 12 recorded a very low level of implementation of about 15%. Figure 6.85 presents the overall level of implementation across the case studies.

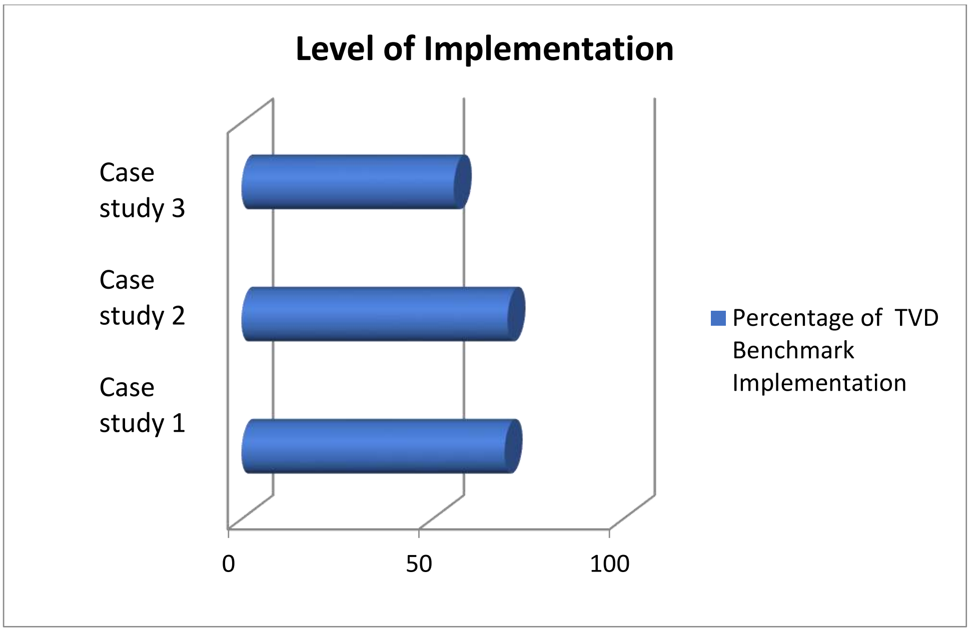


Figure 6.85 Level of benchmark implementation across the three case studies

The third case study appears to have the least TVD benchmark implementation at 56%, this could be attributed to the fact that TVD was implemented only at the construction stage of the project while the TVD benchmarks focus on the initiation and planning stages of projects. CS-01 and two recorded overall TVD benchmark implementation of 69% and 70% respectively. CS-01 started the implementation of TVD benchmark right from the project initiation to the closing while CS-02 had only project initiation stage, planning and design stage.

6.6.3.2 Cross Case Comparison of Measuring Collaboration Across TVD Implementation

The analysis shows that CS-01 recorded the highest level of collaboration (86%) while CS-02 recorded the least level of collaboration (47%), this could be attributed to the fact that not all the participants of CS-02 were in the same place. CS-01 also recorded the highest level of coalition with 76% while CS-02 and CS-03 both record the same level of coalition 64%. For cooperation CS-01 rank topmost with 75% followed by CS-02 with 71% and case study 3 coming in least with 64%.

Networking was the least observed of all the levels collaboration across the case studies, the participants of CS-02 were seen to have practised networking most with 27%, followed by CS-01 with 21% and finally CS-03 with 19%. Coordination was most observed across the case studies with 88%, 83% and 79% coordination observed in CS-03, CS-01 and CS-02 respectively. The overall levels of collaboration were measured across the three case studies by computing the average levels of collaborations for each of the levels of collaboration.

Generally, CS-01 showed the most overall collaboration with 68% while CS-02 and CS-03 showed the same level of collaboration with 59% each (see Figure 6.86).

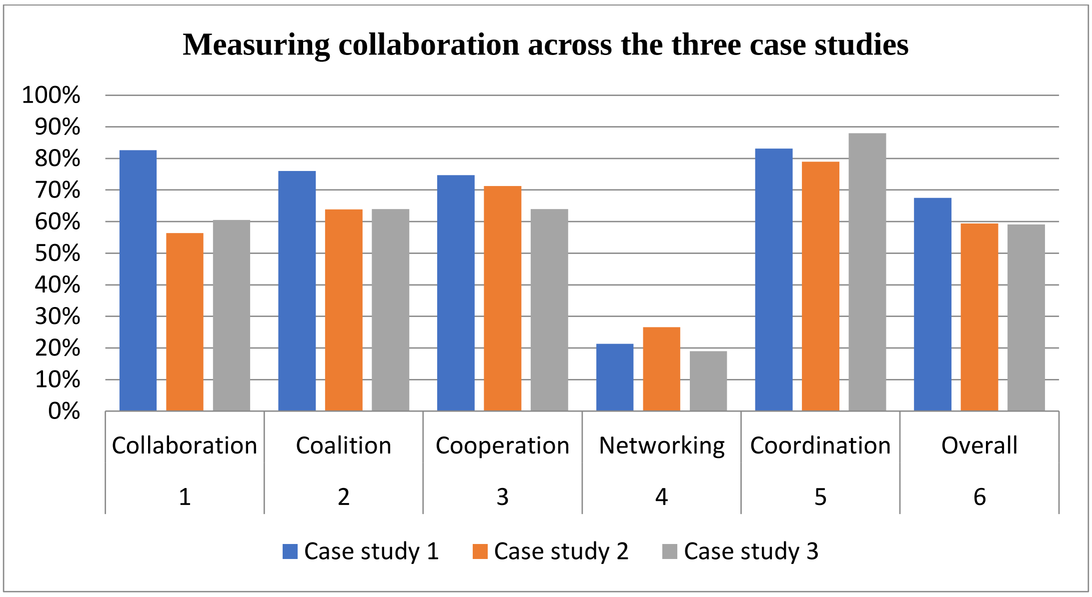


Figure 6.86 Measuring collaboration across the three case studies

6.6.3.3 Cross Case Comparison of the Impact of TVD Implementation

This section focuses on the impact that the implementation of TVD has on the three case studies projects. The areas that the application of TVD has impacted were identified and categorised into four, they are; cost, time, quality and working relationship. The result of the analysis of the post-implementation of TVD impact survey as presented in Figure 6.87 revealed that CS-01 demonstrated the highest impact on cost of 70% followed by CS-03 and then CS-02 with 63% and 58% respectively. The implementation of TVD was done from the beginning to the end of CS-01, while the implementation on CS-03 was from the construction to closing stages of the project and on CS-02; TVD was implemented only up to the planning and design stage of the project.

The impact of TVD implementation on quality was 68% on CS-01, 62% in CS-02 and CS-03 recorded the most impact on quality with 69%. The analysis also revealed that the working relationships of the participants of all three case studies were most positively affected as CS-

01 reported a 79% impact on their working relationship and 74% and 77% for case studies 2 and 3 respectively.

CS-03 recorded the highest impact on the time of 66% followed closely by CS-01 with 65% and least impacted among the case studies is CS-02 with 52%. The high impact recorded in CS-03 could be attributed to the fact that TVD was implemented in its construction stage where the actual execution was going on and the impact on time could be measured.

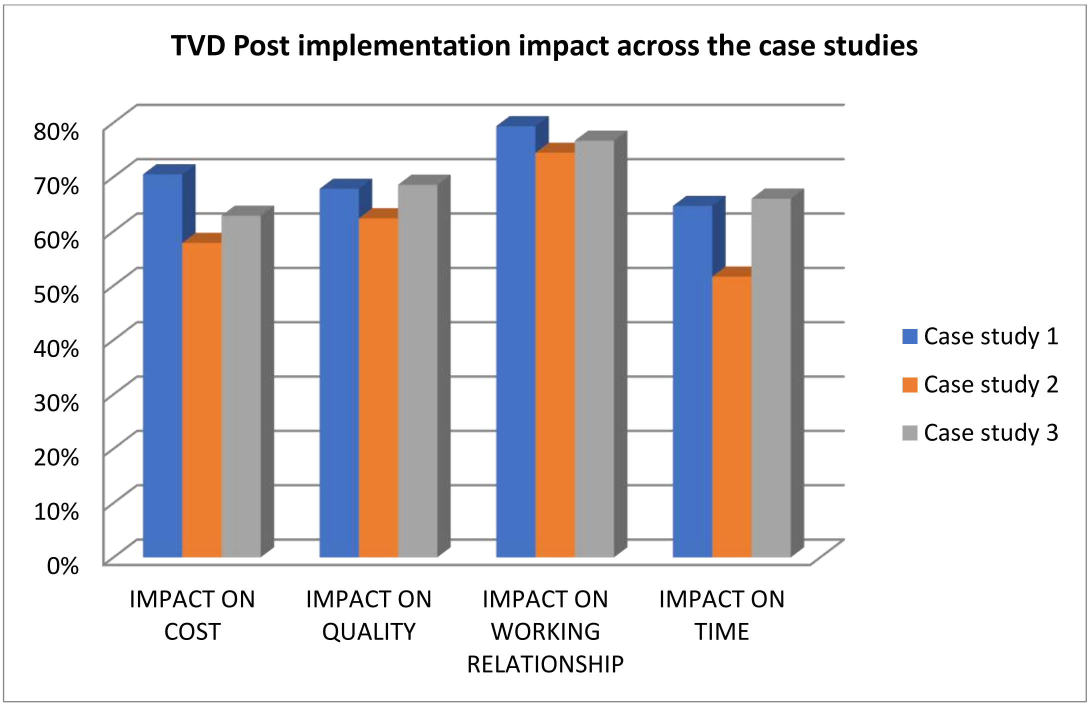


Figure 6.87 TVD post-implementation impact across the case studies

6.7 Chapter Summary

This chapter presented the findings of the implementation of TVD practices in the three case studies undertaken in this research in line with phase 5 of the study. The case studies identified the benefits, barriers, impacts, level of collaboration, the influence of procurement route, conditions of success, support needed for successful implementation of TVD in NCI and levels of TVD benchmark implementation. TVD was implemented on all the case studies for this thesis in varying degrees, it was implemented at all stages for CS-01 but only in the initiation and planning stages of CS-02 and on the construction stage of CS-03.

This chapter showed the benefits of TVD at initiation, planning/design, construction and closing stages of the projects. Some of the benefits observed that cut across all project stages include better identification and realisation of stakeholders' value, better teamwork selection and collaboration, harmonious working relationship, better ability to maintain targets.

Secondly, the chapter identified the barriers of TVD implementation across the project stages. The main challenges observed across all project stages include resistance to change/general unwillingness to adopt TVD practices stemming from lack of awareness of them, traditional mindset and way of practice, lack of early involvement of key stakeholders, the time-consuming nature of TVD, co-location and collaboration problems, market fluctuations.

Thirdly, the chapter highlights the success factors needed for TVD implementation across the project stages. These include the early involvement of key stakeholders, organisational support and senior management buy-in, adoption of the TVD benchmarks, having an experienced facilitator and conducting extensive training workshops, proper incentives and motivation, having an integrated and well collaborated competent team.

Fourthly, the chapter also highlighted the drivers of TVD implementation. The common drivers at the initiation stage include the previous benefits of TVD implementation, the need for improvement, the need to reduce cost and achieve client values. For the CS-01, the market competition and recession experienced in Nigeria which adversely impacted the construction industry was an important drive. For the planning stage, the main drivers included the need to reduce variations/change orders and deliver the project below market price, cost reduction and achieving cost certainty. For the construction stage, the main drivers included improving the working relationship of team members, the need for collaborative practices, the need for the motivation and incentive scheme.

This chapter also identified the nature of support required for a more successful implementation of TVD. These include creating awareness through training and workshops, having a facilitator who will monitor and control the process, having a proper incentive and motivation scheme to boost morale of team members and the inclusion of TVD in company's organization policy.

Furthermore, this chapter clearly demonstrates the positive impact of TVD implementation on all three case studies in terms of favourable impact on the budget, cost and timely delivery of the projects. A more realistic and accurate work schedule was highlighted on CS-01 and CS-02, significant reduction in variations, change orders and reworks were recorded as well as improved working relationship and more robust collaboration and teamwork in contrast to the usual adversarial relationship attuned to the construction industry. CS-01 and CS-03 reported better understanding of the TVD process, while CS-02 reported the realisation of a more defined project scope which could be attributed to the fact that TVD was only implemented at the initiation and planning/design stage of the case study.

This chapter also identified the levels of the implementation of the individual TVD benchmarks. From the results, some of the benchmarks with the highest level of implementation include Benchmark 14 (83%), Benchmark 11 (81%), with 7 other benchmarks with over 70% implementation. Benchmarks 1 and 12 recorded the least level of implementation across the 3 case studies. Last planner system was not used to coordinate the actions of team members seen in the 15% level of implementation for Benchmark 12.

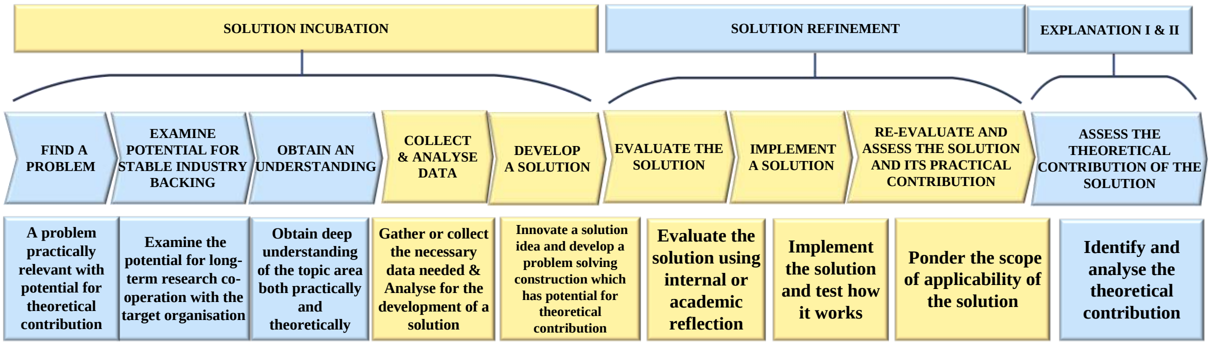
This chapter also provided an analysis of the 5 different levels of collaboration that was measured across the case studies. CS-01 was found to have the highest level of collaboration (86%), coalition (76%), cooperation (75%), with CS-02 having the least level of collaboration attributable to the fact that not all participants were collocated. Networking was the least observed of all levels of collaboration, with coordination being the most observed.

From the TVD post-implementation survey, the areas that the application of TVD has impacted were categorized into four, namely cost, time, quality and working relationship. CS-01 demonstrated high impact on cost (70%), quality (68%), working relationship (79%) and time (65%). While CS-02 was (58%) on cost, (62%) on quality, (74%) on working relationship and (53%) on time and CS-03 was (70%) on cost, (69%) on quality, (77%) on working relationship and (66%) on time. Given that TVD was implemented in the construction stage for CS-03 where actual execution was ongoing and impact on time is more accessible, it is not surprising that it recorded the highest level of impact on time.

The subsequent chapter discusses the development, evaluation, testing and re-evaluation of the Framework for Implementing Target Value Delivery (FFITVD). It also presents the results of the interviews and surveys for the evaluations carried out.

CHAPTER SEVEN

DEVELOPMENT, EVALUATION, TESTING AND RE-EVALUATION OF THE FRAMEWORK FOR IMPLEMENTING TARGET VALUE DELIVERY (FFITVD)



7.1 Introduction

The preceding chapter discussed the application of TVD on three case studies and presents the results gotten from the interviews and surveys. It also presented the cross-case study analysis of the case studies. This chapter focuses on the development, evaluation, testing/ implementation and re-evaluation of the framework of implementing target value delivery. The framework was developed through an innovative process relying on the findings from the preceding chapters, with the collaborative efforts of the researcher and industry practitioners. This chapter also ponders on the scope of applicability of the framework and discusses the findings from the implementation of the framework. Participants' comments, criticism and recommendations obtained from the internal and external evaluation of the framework were used for its further improvement.

7.2 Rationale for TVD Framework Development

The fundamental reason for the development of the TVD framework was to create an outline that would:

a. serve as a guide to aid the implementation of TVD;
b. provide awareness and sensitize prospective users on the human behaviours required, the drivers of TVD, the tools and techniques required, the success factors that must be in place, the likely barriers that may be encountered, and the likely benefits inherent in its implementation.

7.3 Theoretical Overview of the FFITVD

The framework was developed based on various theories that have been used to explain the working of TVD in the construction industry. Studies on lean construction, collaborative working, and procurement were considered. The theories include: Project management theory (PMBOK by PMI), Game theory (Neumann and Morgenstern, 1944), theory of continuous improvement (Imai, 1986), the three distinct theoretical areas of management science viz: organisational learning, emotional intelligence, and relationship management (Smyth 2004); Transformation, Flow, Value Theory (Koskela 1999), First and Last Value Model Theory (F&LVM) by Salvatierra-Garrido and Pasquire (2011).

The F&LVM theory suggests that the delivery of value extends from value delivery at the project level to value delivery to the society. The theory also identifies the interface between production and delivery capacity, the stakeholders' perspective, and a social perspective. The application of the F&LVM theory in the framework development considers the impact of construction project on the society (end users). According to Jung et al., (2012), the game theory as applied to TVD, explains that stakeholders will collaborate to create the best solutions that will increase value while eliminating self-interest if the client provides an avenue for communication and trust them with incentives or contract. The main components of the developed framework are discussed in the following sections.

7.4 Framework Development

After an exhaustive literature review geared towards generating information on the concepts and practices of TVD in Nigeria and beyond, the 17 TVD benchmarks as outlined by Ballard (2011) and practices as outlined by Macomber, et al., (2012) were applied to three case study projects in Nigeria, after which a questionnaire and interviews were administered to some of the participants from each case study to assess the level of benchmark implementation, benefits, barriers/challenges and impact.

From the experiences gathered from the case studies, a framework was proposed to serve as a guide to the implementation of TVD in the construction industry. Responses from the questionnaires and interviews were analysed and used, together with the TVD benchmarks and practices, to establish the step-by-step procedures that formed the FFITVD. These steps were grouped according to the Project Management Institute (PMI) process groups. This framework identifies the life cycle of a project to be categorized into the project initiation, planning, execution, monitoring & control, and closing stages. The project initiation stage is where the idea of the project is conceptualized (project definition). Here the overall scope of the project is discussed, and values identified, the business case and feasibility study are done, and the legal framework of the project organised. The project planning is the stage where all the aspects of the project (cost, time, stakeholders, communication, risk, etc.) are planned in detail. The schematic and technical designs are taken care of at this stage, as well as the setting and designing of targets. The value proposition is expected at this stage.

The Execution stage is where the work that has been planned is done. This is where the value identified is delivered. Project execution happens simultaneously with the monitoring and control stage, which is where all the work that is being done is checked to ensure that the execution team does not deviate from what was planned. The project closing stage is the final stage of the project, where all that has been done is approved (signed off on) by the client, all legalities are confirmed, and the project comes to an end. Value is said to have been created at this stage.

7.4.1 Project Mindset Required for the Success of TVD Implementation

The framework recognized that certain mindsets are expected from project team members for the successful implementation of TVD. These include:

i. Responsibility for actions: all team members should know their roles and responsibilities and should take responsibility for their actions.
ii. There should be transparency within the team.
iii. The team members must be trustworthy and have mutual trust for each other.
iv. The team members should be allowed to make decisions freely; they must feel free to make contributions and take decisions for the success of the project.
v. The ability to use technology is another key requirement for the team members.
vi. Integrated working practices are also an important skill that the team members should have.

7.4.2 Drivers for TVD Implementation

From the interview, the framework also recognizes that there are certain needs that prompt the implementation of TVD on a project; these are referred to as drivers. These driving factors can be seen in Figure 7.1.

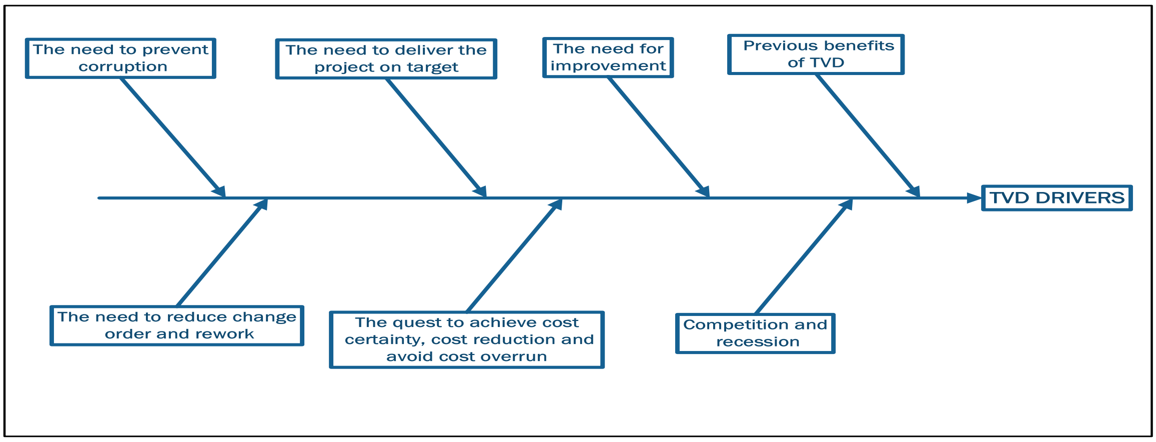


Figure 7.1 The drivers of TVD implementation

7.4.3 Likely Benefits of TVD Implementation

The framework also highlights the likely benefits that could be derived from the implementation of TVD at the various stages of the project. The co-location and involvement of all the key stakeholders from the beginning promotes better identification of stakeholders' value. Also, the inclusion of TVD in contracts improves organisational policies and prevents corruption.

The practice of big room collaboration coupled with frequent meetings promotes teamwork, collaboration, and builds harmonious working relationships. The implementation of TVD ensures stakeholders' satisfaction and promotes a better understanding of the process. TVD implementation also creates a more realistic schedule, reduces the budget and increases cost savings. It ensures early identification of problems, reduces variation and reworks, and ensures timely delivery of projects at lower than market and target price.

Furthermore, the implementation of TVD reduces waste during construction, reveals the capacity/competence of team members and promotes cost certainty, especially on operational expenses. The process reduces loopholes for embezzlement, thereby adding value to the construction process, and encourages learning from other professionals as a result of collaboration and working towards common goals. Ultimately, the implementation of TVD has a tremendous impact on stakeholder satisfaction, timely delivery, collaborative practices, budget and cost performance, change order, variation and rework, project value creation, and education/ knowledge.

7.4.4 Likely Barriers to TVD Implementation

The framework highlights and categorised the likely challenges that could impede the implementation of TVD. The barriers highlighted can be seen in Figure 7.2.

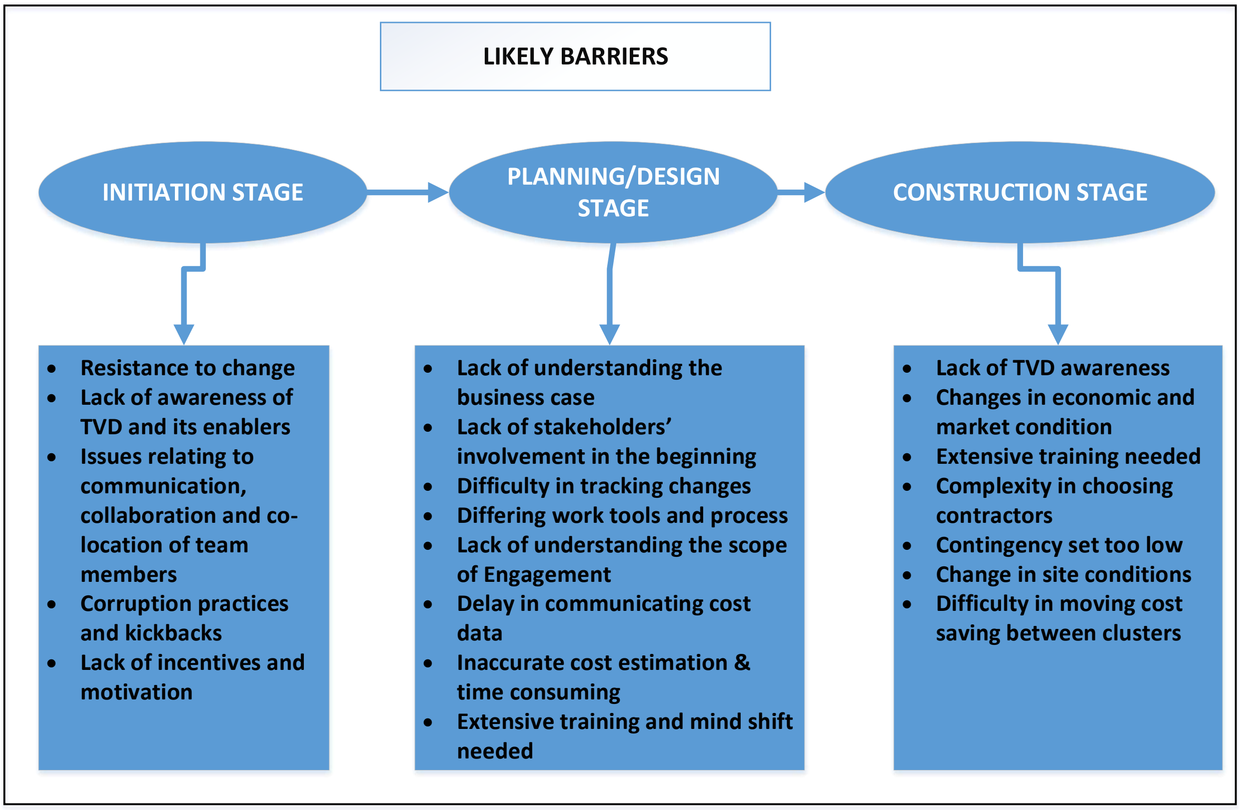


Figure 7.2 The likely barriers encountered at different stages of a project

The concept and practice of TVD are new and unfamiliar territory for many players in the NCI and as such, this causes resistance to change by some of the players. Some people are averse to change, and the rate of innovation diffusion is slow; this poses a challenge to the implementation of TVD in Nigeria. The traditional system, where most professionals work in isolation, is another serious challenge to the collaborative working proposed by TVD. Corrupt practices and kickbacks, which are largely associated with the NCI, also serve as a major barrier to the implementation of TVD. Lack of incentives and motivation can hamper TVD implementation in a developing economy like Nigeria's.

The barriers at the planning and design stage includes: lack of understanding the business case; a lack of stakeholder involvement at the beginning; difficulty in tracking changes; differing work tools and process; a lack of understanding the scope of engagement; delay in communicating cost data; inaccurate cost estimation; the perception of time-wasting; and the extensive training and mind shift needed.

The following are the barriers at the construction stage: a lack of TVD awareness; changes in economic and market conditions; extensive training required; complexity in choosing contractors; contingency set too low; a change in site conditions; and difficulty in moving cost saving between clusters. Incomplete records/documentation of work progress could serve as a major challenge to the closing stage of a project.

7.4.5 The Stakeholders Involved

The framework also identified all the stakeholders involved in the implementation of TVD and the stages at with they are most involved. The stakeholders involved may include but are not limited. to:

i. The client, who is usually involved throughout the project.
ii. Senior management, who are also involved throughout the project.
iii. The TVD facilitator, who is usually involved throughout the project.
iv. Suppliers/manufacturers, who are usually involved from the planning/design stage to the end of the project.
v. Contractors/subcontractors, who are also usually involved from the planning/design stage to the end of the project.
vi. The design team, who begin their participation from the planning/design stage.
vii. The construction team, which is made up of part of the design team and which becomes involved in the project at the execution stage.

7.5 Steps and Tools & Techniques Required for the Successful Implementation of TVD.

The framework highlights the steps that should be taken during the different stages of a project for the successful implementation of TVD.

7.5.1 Steps During the Initiation Stage

The initiation stage begins with the client buy-in; it is necessary for the client to agree to the implementation of TVD before its concept and practices can be implemented on their project. This is followed by the appointment of a TVD facilitator. The facilitator is expected to conduct a workshop for senior management, create awareness, and guide the team through the implementation of TVD. At this point, the key stakeholders are expected to choose either the traditional procurement route or the design and build procurement route. The client then develops and evaluates a business case with the help of key service providers to explain why the client should undertake the project. The allowable cost, which is the amount the client is willing and able to pay (P2SL 2016), is determined and secured, after which current market cost is benchmarked. The business plan is then evaluated and, if accepted, the client decides to fund and start a feasibility study. If the business case is not accepted, the team reviews and validates it before proceeding further. At this stage, the framework emphasized the inclusion of TVD in contracts and organisation policy

7.5.2 Steps During the Planning Stage

The planning stage commences with the active governance and leadership of the project, selecting and training an integrated competent team, and defining the team's roles and responsibilities. The project business ethics are then integrated by aligning the organisation's practices and mindsets with TVD practices to ensure its smooth and effective implementation. The stakeholder's values are determined and ranked using such tools as value proposition cards, amongst others. In determining the stakeholders' values, the ends (what is required), means (conceptual design) and constraints (cost, time, location, etc.) are assessed. Thus, the project proceeds to funding if the expected cost is lower than available funds (the allowable cost determined at the initiation stage) or if there is a supposed opportunity of achieving target cost during designing to targets. If this is not feasible, there should be scope modification. This is facilitated by frequent assessment meetings.

Scope, stakeholder value, quality, time and cost targets are established ensuring that the target cost is less than the expected cost. In addition, motivation and incentive schemes (such as pain and gain sharing) or alternative schemes are negotiated. During the pre-design meeting, the team is divided into smaller groups known as cluster teams; they also set their own targets. This is referred to as "decomposition of project-level target cost to component level target cost". Lean tools, such as Last Planner® System (or an alternative), are used to coordinate the actions of the team members. Site investigations are undertaken to align the site conditions with set targets. The next step is the collaborative design of product and processes while ensuring that targets are not exceeded: this is a key principle of TVD. This choice of procurement route made at the outset determines the next step. The traditional procurement route goes on to selective tendering and bids negotiations while TVD clusters frequently update cost estimates and the basis of estimate, whereas the design and build procurement route skips the tendering stage. The cluster updates are reflected in the project cost estimate. This process is done continuously throughout the project.

At the end of the design stage, three options of action are available. First, the team can proceed to the construction stage if the project cost estimate is below the target cost. Second, if the project cost is higher than the target cost, the team goes back to redesigning to target, considering the most responsive alternative. This is done using value engineering or other tools/techniques. Finally, the team can proceed to construction if the project cost is higher than the target cost but there is a perceived possibility of incremental reduction to achieve the target cost during construction.

7.5.3 Steps During the Execution Stage

Although some of the design team members will form the nucleus of the construction team, it is imperative to assemble and develop an execution team whose mindsets and organisational practices/business ethics must be aligned with TVD practices when considering their incentive schemes. The tradition procurement route also deviates a little at this point to identify contract prices for provisional sums and prime cost sums, to set them as allowable costs, and then to design to a newly-set target, as applied in the planning stage. The two procurement methods now proceed to form cluster teams involving all the project team members to ensure that corruption and project padding is prevented or minimised.

Resources are reviewed and renegotiated, together with administrative costs and overheads (OPEX/ CAPEX), to ensure further cost reductions at this stage. Processes and technology are also reviewed, and work is assigned to each team member for construction to commence. This is done to ensure that every team member knows their duties and can be held responsible for them. The next step is to identify how to improve workflow and sustain team performance. Cost savings from clusters can be allocated to other clusters with deficits. Work progress is then reviewed and reported to ensure that the project targets can be tracked and managed. This can be done using earned value management and A3 reports during frequent review meetings.

Issues that can derail the project, such as changes, risk, contract issues, communication issues and corruption, are properly monitored and controlled through the conduct of reviews of targets and audits. Efforts are made to manage and prevent waste and corruption.

7.5.4 Steps During the Closing Stage

To successfully close a project, the team needs to ensure that all the projects' activities have been completed and reviewed by testing and commissioning. The accounts should be audited using valuation and target performances (impacts) such as stakeholders' satisfaction, delivery on time, cost/budget, reworks/change orders, collaborative practices etc. are measured and reported. The lessons learned during the project should also be properly documented and then the project is formally handed over to the client.

7.6 Evaluation, Testing and Re-evaluation of FFITVD

The FFITVD was evaluated to determine its quality; the evaluation process included an internal validity, external validity and reliability test. Berry and Otley (2004); McKinnon (1988); Yin (2003) and Ekanayake (2014) noted that validity and reliability have been extensively used as the standards for defining the quality of qualitative research. Creswell (2014) observed that validity and reliability are important in research because they aid in determining the objectivity of the study and help to recognise if a solution is good enough to be used in another research.

Two types of evaluation methods were used for the evaluation of the framework. These are internal and external evaluations. The Indiana Dictionary (2018) states that internal evaluation refers to how well an experiment is done, especially if it avoids confusion: the less chance of confusion in a study, the higher its internal validity.

External validity is concerned with how well data and theories from one piece of research apply to another (Indiana Dictionary 2018). Saunders et al., (2009) wrote that it is a question of whether research findings can be equally applicable to other research contexts, or other organisations. This question can be asked about DSR artefacts: Does the artefact of the current research apply to another context? Can the solution be applied in another country?

Figure 7.3 summarizes external and internal validity and illustrates the connection between the two. The yellow ellipse represents internal validity, and the blue rounded rectangle around it represents external validity.

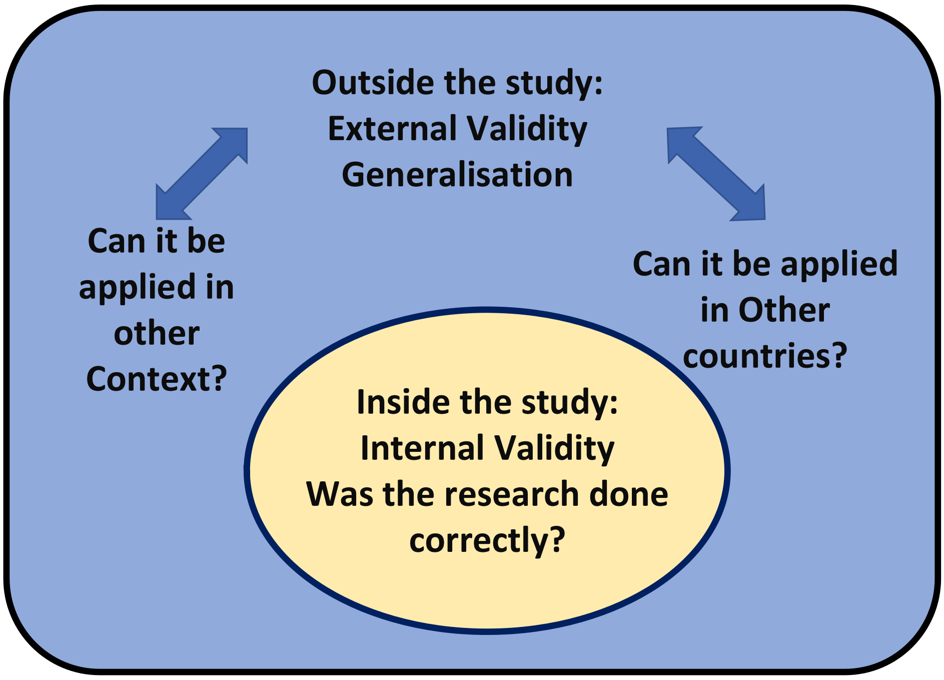


Figure 7.3 The difference between internal and external validity

Adapted from http://www.indiana.edu/~p1013447/dictionary/ext_val.htm

As noted in Section 4.7.6.2, the three levels of evaluation proposed by Rocha (2011) were adopted for the study, which are; evaluation by the researcher through academic reflection, evaluation by participants of the study, and evaluation by non-participants of the study. The first level of the evaluation was carried out after the development of the first version of FFITVD (see appendix 14 for the first version of the FFITVD), t after which it was implemented in a case study (CS-04) and then re-evaluated. The process and findings are reported in the following sections.

7.6.1 First-level Evaluation of the FFITVD

The researcher evaluated the first version of the framework (see appendix 14 for the first version of the framework) using the academic reflection method proposed by Ryan and Ryan (2010), which has been discussed in detail in section 4.7.6.2.

This was done by observing and comparing the FFITVD to the existing literature and the findings from the initial observation, interviews and survey on the implementation of TVD. The researcher recorded questions that arose from the critical thinking while observing the framework:

a. Does the framework reflect the principle and practices of TVD?
b. Are the steps aligned with TVD benchmarks?
c. Can the framework be implemented in the NCI?

The researcher observed that the NCI requires extensive training and a mindset shift for the successful implementation of TVD, and application of the developed framework. This led to refinement to the framework to generate the second version of the framework (see appendix 15 for the second version of the framework) which was done based on the recordings from the reflection. The following was added to the framework:

i. Necessary support required for the successful implementation of TVD was included in the framework.
ii. Intensive training and workshops were included in all stages of the framework.

7.6.2 FFITVD Implementation and Testing

7.6.2.1 Case Background

This case study entails the external electrification of about 640 units (121 blocks) of 3500 units of homes constructed in case study one (CS-01). The study was carried out with a combination of some of the team members in CS-01, and some new members. The blocks consist of different building types: one-bedroom, two-bedroom, three-bedroom, four-bedroom terraces, and four-bedroom terraces with boys' quarters, which were in the mixed-density residential district of Idu-Gwari, Abuja.

The case study was divided into two phases;

The first phase, which involved the planning and designing of the electrical equipment, adopted the traditional procurement route whereby contractors were selected and invited to tender for the contract.

The second phase of the case study was divided into two parts. Part 1 involved the execution/supply of the electrical equipment by the successful tenderers: this part also adopted the traditional procurement route.

Part 2 involved the breaking down of the provisional sum proposed for the design and construction of the civil/structural works of the powerhouse: this part adopted the design and build procurement route

7.6.2.2 Application of FFITVD

The company used in this case study for the implementation of the framework was the same company that implemented TVD in case study 01. The key stakeholders were already aware of TVD and its benefits and so the implementation of FFITVD was welcomed; this was the "client buy-in" as specified by the FFITVD. Some of the team members were part of the team who had already been trained on TVD, while others were new to TVD. There was, therefore, the need for training for the new team members, and a refresher workshop for the old team members. The main driver of this FFITVD implementation was to ensure that the cost of the external electrical works did not exceed ₦500 million (USD 1.39 Million) without compromising on function while considering the whole-life cost (running cost). However, to a greater or lesser extent, all the drivers listed on the FFITVD were the driving forces for its implementation. (see Appendix 15 for the framework used in implementing TVD on CS-04)

Observation

Record and physical condition analysis were carried out to ascertain the implementation of TVD framework. For document analysis, documents such as company policy documents, business plan, budget, project timeline etc. were reviewed. For physical condition analysis, the researcher observed contractual structure, business case, weekly meeting, training, feasibility study, progress reports and all the processes in implementing FFITVD, all which are discussed in subsequent sections.

7.6.2.3 Project Initiation Stage

A. Business case

This phase began with the identification of all stakeholders involved. The researcher served as the TVD facilitator as required by the FFITVD. The team agreed that the project would follow the traditional procurement and design and build procurement route. The team had several face-to-face meetings and visited several sites to see samples of similar projects in a bid to develop and evaluate the business case. The team determined the allowable cost of the client from the analysis made alongside the market selling prices of the houses.

The next step of the FFITVD was to secure funding (the maximum fund available). The source of funds to be used to carry out the project, which had already been isolated from the main project (CS-01), was made available by the board and treated as a special budget. All necessary parameters were assessed against the return in investment, which was the basis of the analysis. The company initially thought the government was going to extend the electricity supply to the housing estate, and the company would only need to undertake internal distribution to units. The government was not forthcoming, so the external electrification had to start from the nearest government source, which was about 7 km distant from the site. This made the initial estimate appear too high. Without a better option, the company had to go ahead with its allowable/benchmark price. Feasibility studies, therefore, commenced immediately.

7.6.2.4 Project Planning Stage

7.6.2.4.1 Feasibility Study

A. Prequalification of Tenderers, Invitation to Tender and Inclusion of TVD benchmarks and practices in Tender criteria

Three contractors were prequalified (using the process of selective tendering) and invited to submit tenders for the procurement of equipments for the external electrification of about 640 units (121 blocks) of 3500 units of homes constructed in case study one (CS-01). As noted earlier, selective tendering makes the tendering process more manageable and less of a burden on the parties involved. The framework was presented to the team members and made part of the project policy/contract. The application of TVD benchmarks and a requirement to follow the steps of the framework were some of the conditions of working on the project. Another major criterion was that all the pre-selected tenderers must participate in the collaborative design process. They were informed that their innovative contribution during the design would be used as one of the technical evaluations for the bids. The entire project team were oriented on the framework before engagement.

B. Submission of Tender and Selection of Integrated team

The TVD facilitator (this researcher) and the Company’s President selected an integrated team based on certain selection criteria to perform the external electrical installations during the design and execution stages. The integrated team involved two groups of team members, these being: the in-house team and the teams from the tenderers. The prequalified contractors submitted their tenders and submitted a list of representative consultants that would participate in the planning/design and execution stages. Each team from one prequalified tenderer, together with the in-house project team, formed the cluster teams which were independent of the other prequalified tenderer team during the planning/design stage. Their roles and responsibilities were signed and transparency was a requirement for all.

A part of the team (the in-house team) was expected to maintain the work after completion. Because of this, an external electrical sub-company was formed comprised of selected electrical team members who were independent of the project team but who were part of the company. The team, headed by the chairman of the company, consisted of a representative of the president of the company; the MD of the sub-company, who was also the facility manager of the company; project engineers; the budget officer; and manufacturer (tenderers), suppliers (tenderers), sub-contractors, and representatives of the statutory authorities. Roles and responsibilities were assigned, and the team worked in a transparent manner.

C. TVD training workshop

Training on TVD was conducted during the presentation of the FFITVD. This was facilitated by the researcher and two other staff members of the company. The workshop was carried out using slides and copies of the FFITVD, and it lasted for about 40 minutes.

D. Stakeholder and Project Value

Stakeholder values were discussed with all stakeholders during the interactive meetings. The head of the facility management team, who was also the MD of the external electrical company, gave the team feedback on end-user value. The whole-life target value of the equipment was scrutinised and agreed upon in a bid to reduce the running cost of the external electricals.

E. Target setting

This involved the setting of all the projects targets. These included: costs, schedules, quality and value, as discussed in the following sections.

i. Cost target

A benchmark price of ₦ 500 million (USD 1.39 Million) (allowable cost) was set by the client and the team. Although the internal project team came up with an initial design estimate cost of ₦585,656,040.32 (USD 1.62 Million) (expected cost), the team set the target cost at ₦480,295,488.22 (USD 1.33 Million), which was below the allowable cost. A further reduction during design was established. This prompted the team to decide to fund the project as recommended by the FFITVD

ii. Project timeline

Project timeline meetings were scheduled for team members. During the timeline meetings, the manufacturers/tenderers notified the team that to achieve a cost below the target, they had to import the equipment, which would take some weeks. That information was factored into the time for design and supply to produce a realistic programme of work: the entire project was scheduled for four months. The timeline is shown in Figure 7.4.

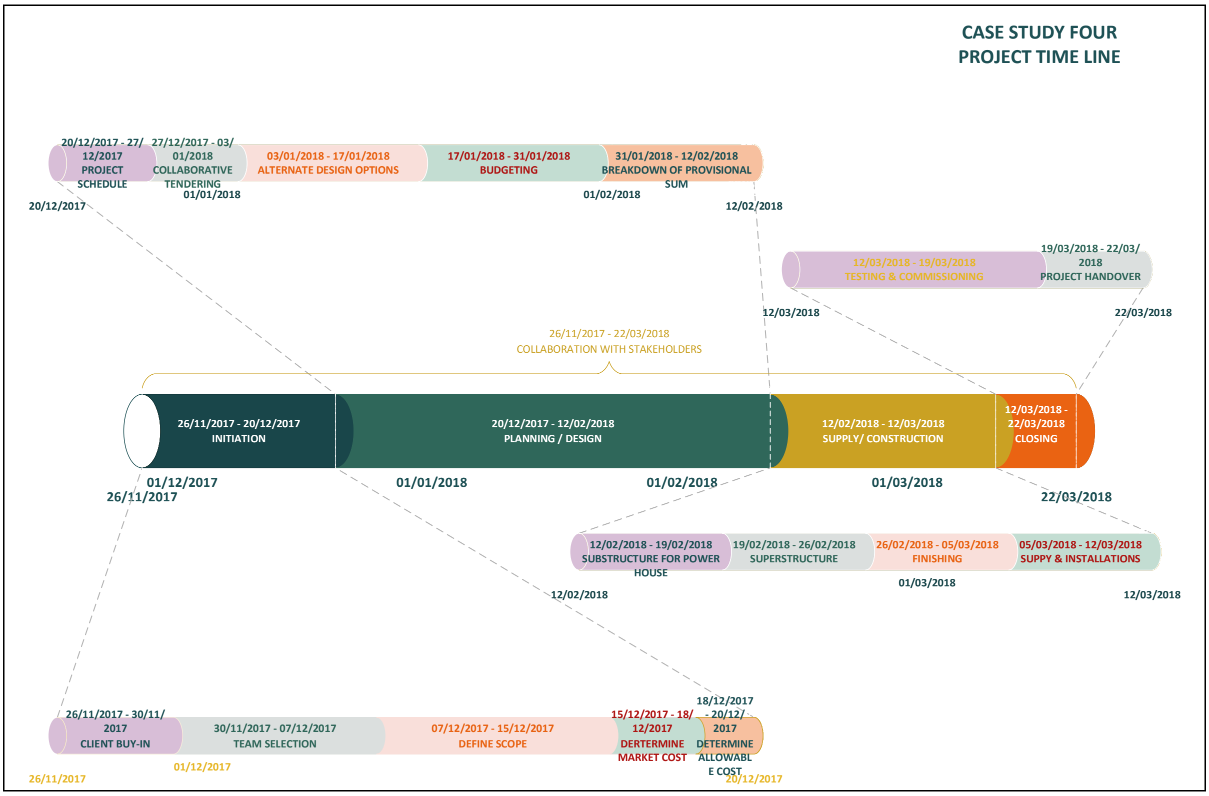


Figure 7.4 Project schedule milestones and timeline

iii. Quality standards

The specifications of high-quality equipment and cables were stated in consideration of whole-life costing. Standards set by the current regulations for electrical installations issued by the Nigerian Institution of Electrical and Electronics Engineers (NIEEE), the Standard Organisation of Nigeria (SON), the British Standards and Codes of Practice and the Abuja Electricity Distribution Company were the basis of the designs and were strictly adhered to.

iv. Value propositions

The feedback on end-user value from the MD and the preferred values of key stakeholders, based on their experience, were examined and discussed. The team observed that the most preferred value for end-users was safety, while the key stakeholders were interested in the operational cost. To this end, the whole life target cost of the project was examined.

7.6.2.5 Design Stage

Pre-Design Planning

A pre-design meeting was carried out involving the tenderers and the in-house team members. The team made it mandatory for all designs to align with existing site conditions to avoid clashes, rework and variations. Part of the design requirement was to design to existing topography, check soil test results, and flow of water. The set targets were allocated to the formed clusters. The teams from the prequalified tenderers actively participated in the design stage of the project.

i. Steering to targets during the design

The targets set at the product level were broken down to component level targets covering cost, quality, duration and project value. Decomposed targets were assigned to clusters groups formed to design product and process according to the targets. When item costs were estimated, cluster members made sure they were steered below the targets. Savings achieved in one cluster were reallocated to another cluster.

Clusters teams were formed to design for various components of the project. These clusters included the power equipment cluster, generator cluster, distribution cluster, cables cluster, general cluster, and the powerhouse cluster. The powerhouse cluster had two sub-cluster: the design cluster charged with the responsibility of breaking down the provisional sums; and the construction cluster, in charge of constructing the powerhouse. The general roles and responsibility of members were specified on the organisational policy and were monitored by cluster leaders who ensured that there were collaboration and transparency in order to avoid contract padding and corruption. The cluster team schematics are shown in Figure 7.5.

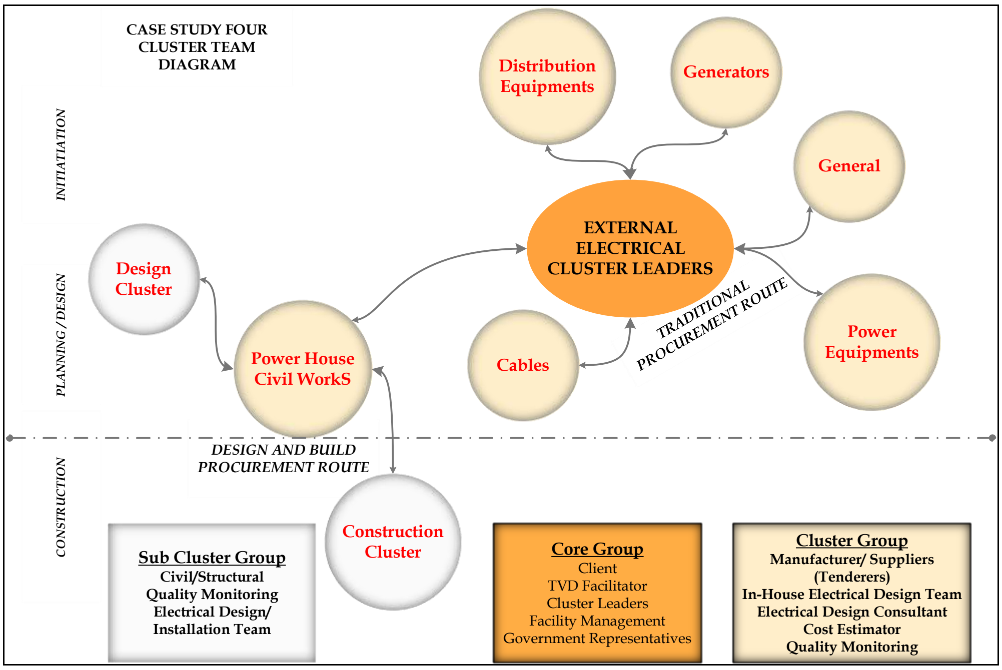


Figure 7.5 CS-04 TVD Cluster Teams

ii. Co-location (big room meetings) and Virtual real-time technology

During the initial meetings, the teams were co-located in the same office. But when the team expanded to include the external electrical company, they only met as a single group to update and plan strategy. Virtual communication was used through emails, conference calls, phone calls, etc. Real-time software was also used to collaborate.

iii. Integrated and collaborative conversations

During collaborative and interactive sessions, the team reviewed all possible options for attaining the set targets. They visited the manufacturers and suppliers located in different major cities in Nigeria to brainstorm on best design options.

iv. Value engineering exercise

Different techniques were used during the process of designing to cost, such as brainstorming and choosing by advantage. The main elements of the project, chosen from different brands, were identified and analysed to determine their functions, quality and cost. The design team proposed products from ABB alone, Schneider alone, and a mixture of ABB and Schneider for the transformers and feeder pillars, while Nocacco was chosen for the cables and Cummings for the generators.

v. Cost modelling and cost tracking

Costs were tracked real-time by the budget officer to update the designers and suppliers of the cost implications of the different design options proposed. The rates used were realistic current market rates, which were achieved by involving sub-contractors during the tender process. The cost estimating process and the cost model (shows actual cost breakdown of the different components of the project before execution) are presented in Figures 7.6 and 7.7 respectively.

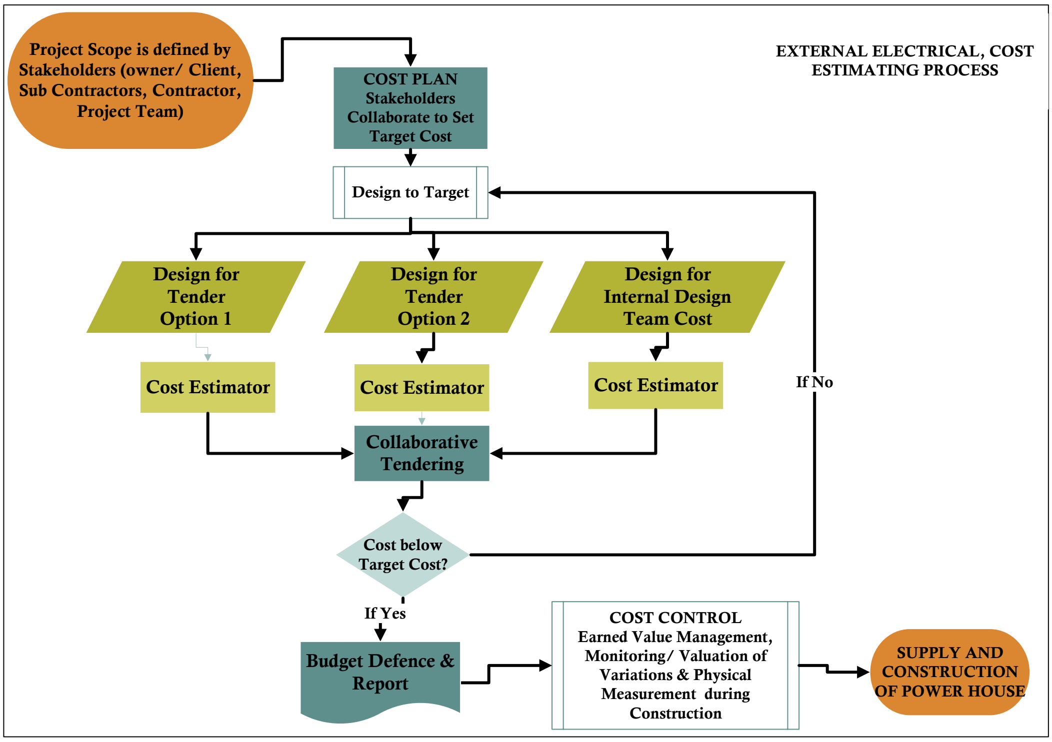


Figure 7.6 Cost estimating process

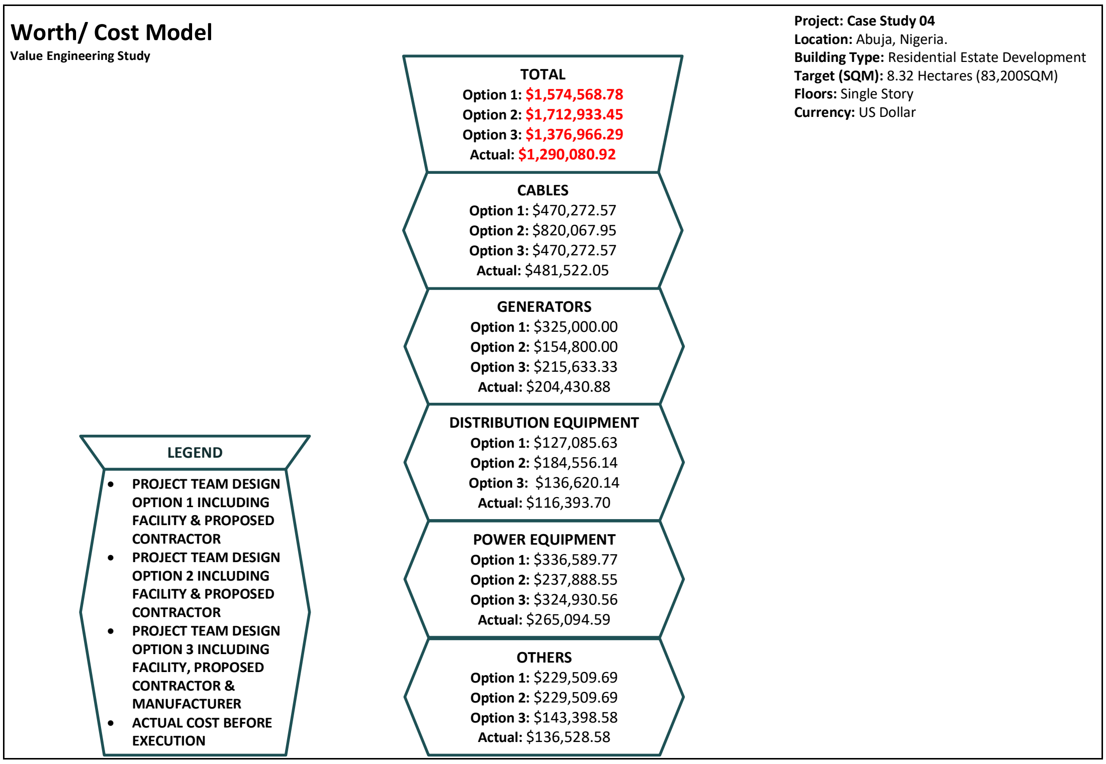


Figure 7.7 The CS-04 cost model and estimates

Table 7.1 and Figure 7.8 and 7.9 present the tabular and graphical comparison of all the costs associated with the project, respectively.

Table 7.1 A Comparison between the allowable cost, tender cost and actual cost

Electrical Bill Summary	Tender Option 1	Tender Option 2	Tender Option 3	Allowable Cost	Target Cost	Actual Cost Before Execution	Actual Cost After Execution
Power Equipment	$336,589.77	$237,888.55	$324,930.56	$285,398.45	$314,634.24	$265,094.59	$265,094.59
Distribution Equipment	$127,085.63	$184,556.14	$136,620.14	$125,308.42	$133,111.75	$116,393.70	$116,393.70
Generators	$325,000.00	$154,800.00	$215,633.33	$220,088.44	$208,800.40	$204,430.88	$204,430.88
Cables	$470,272.57	$820,067.95	$470,272.57	$518,402.31	$455,370.69	$481,522.05	$481,522.05
Others	$229,509.69	$229,509.69	$143,398.58	$173,899.60	$136,125.94	$136,528.58	$161,528.58
Civil Works	$86,111.11	$86,111.11	$86,111.11	$65,791.67	$83,382.44	$86,111.11	$46,346.20
Total	$1,574,568.78	$1,712,933.45	$1,376,966.29	$1,388,888.89	$1,331,425.47	$1,290,080.92	$1,275,316.01

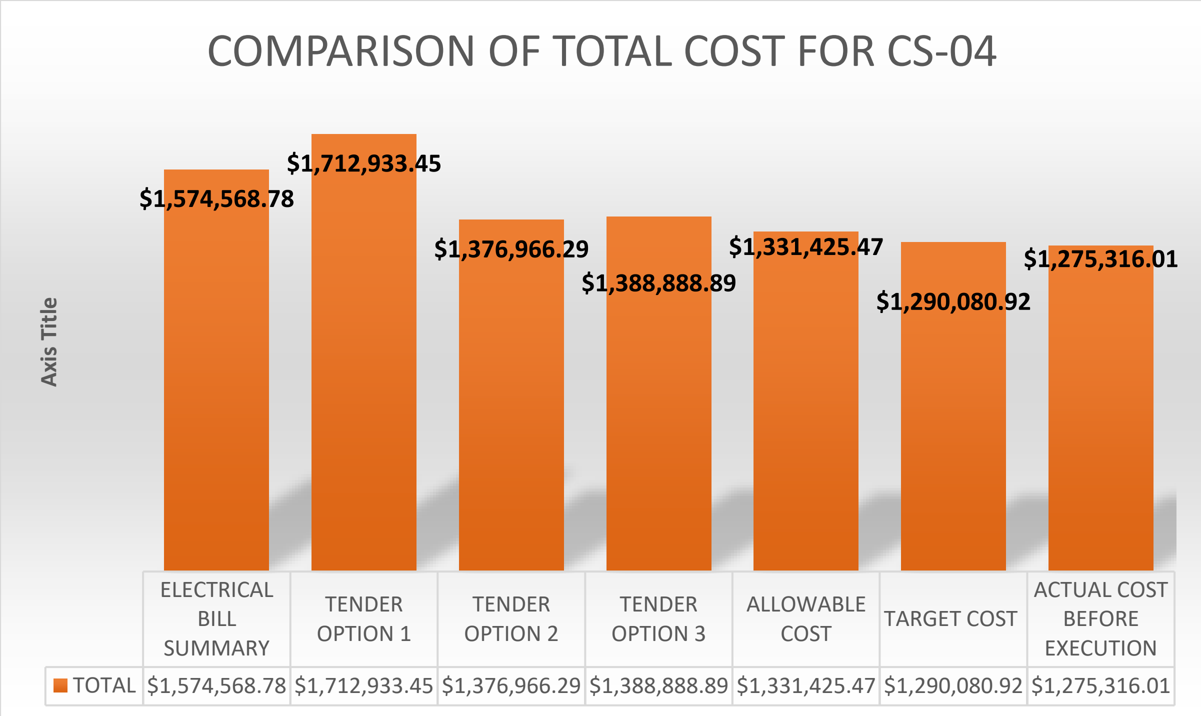


Figure 7.8 Comparison of the total cost for FFITVD

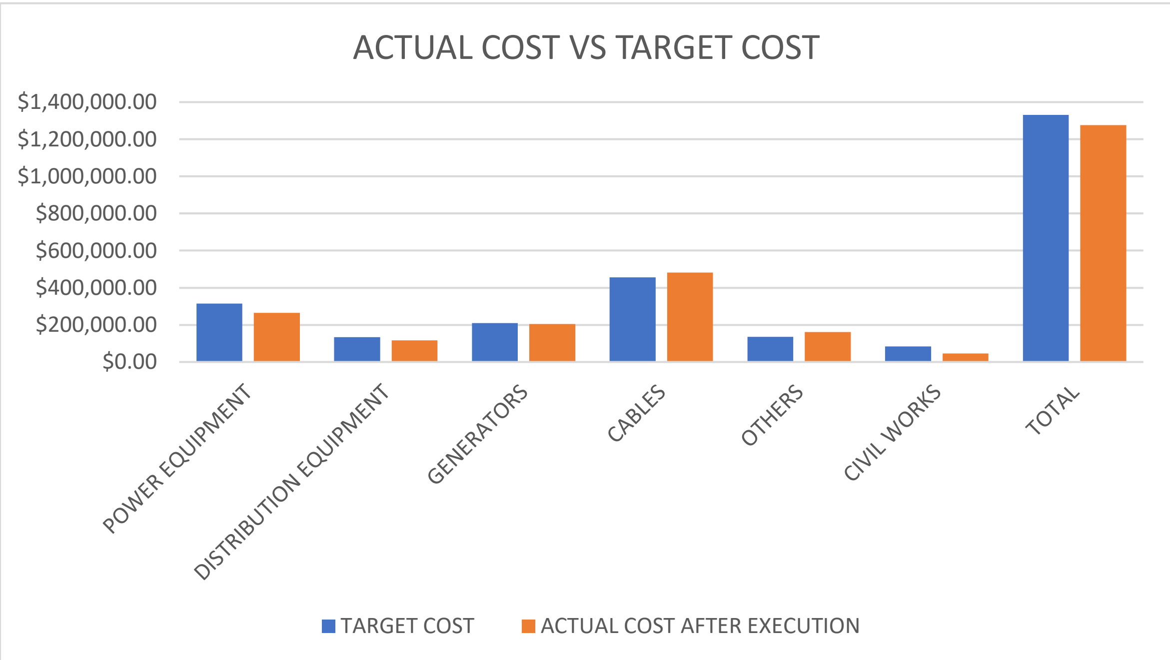


Figure 7.9 Comparison of target cost and actual cost after execution

7.6.2.6 Execution Stage:

The final cost estimate was below the target cost set by the team. The team, therefore, proceeded to the execution stage. The FFITVD steps for the execution stage are discussed in the following section

i. Selection of the most responsive bid and development of an execution team

The determination of the responsive bid was based on the tenderer that complied with the TVD practices that resulted in the most responsive financial quotations, the contribution of the team during design, and the practicability of the design options. The most responsive tenderer was selected to supply and install the external electrical equipment and cables after robust collaborative design and competitive bidding. The powerhouse construction team comprised of some members of the design team, and a few who were not part of the design team. Another round of workshops was conducted for the team to align their mindset to TVD practices: the need to build to target was emphasised. An incentive scheme was agreed upon by the team.

ii. Contracture structure

As noted earlier, the execution stage was divided into two parts. The first part involved the supply and installation of the equipment by the successful tender. The procurement head and budget officer who oversaw drafting the final contract for the successful tender ensured that the contract was a fixed firm price contract. The second part involved the design and build procurement route.

iii. Setting of targets

For the first part of the execution, the successful tenderer already had a fixed firm price contract as such. Thus, there was no need to set targets at this stage.

For the second part of execution, the team identified the provisional sum for the construction of the civil/structural work for the powerhouse (31 million, approximately 86,111 USD) and set it as the allowable cost. The team then set a target cost lower than this allowable cost and designed to this new target cost, as stipulated by the FFITVD.

iv. Cluster teams

The team was then divided into clusters in which they reviewed their resources, admin costs/overheads, as well as their processes and technology. Each cluster team member was assigned a specific role and responsibilities.

v. Construct to target

The first part of the execution that involved the supply and installation was done under the supervision of the quality monitoring and control unit (QMU). The QMU visited the manufacturers' site to assess the quality of the products and on delivery, ensured the equipment met the required specifications as indicated in the contract, using a quality checklist. The execution team ensured the designs were adhered to. This was also done under the supervision of the QMU, who monitored the progress of work using MS Project and recorded it using A3 method. A spreadsheet was used to keep track of the project spending, and to compare it to the budget. All these were noted and discussed during weekly site meetings to help improve workflow and sustain team performance. Cost savings were redirected to where needed. Figure 7.10 and Table 7.2 shows the cost variance between the actual cost before and after execution of the civil works for the powerhouse.

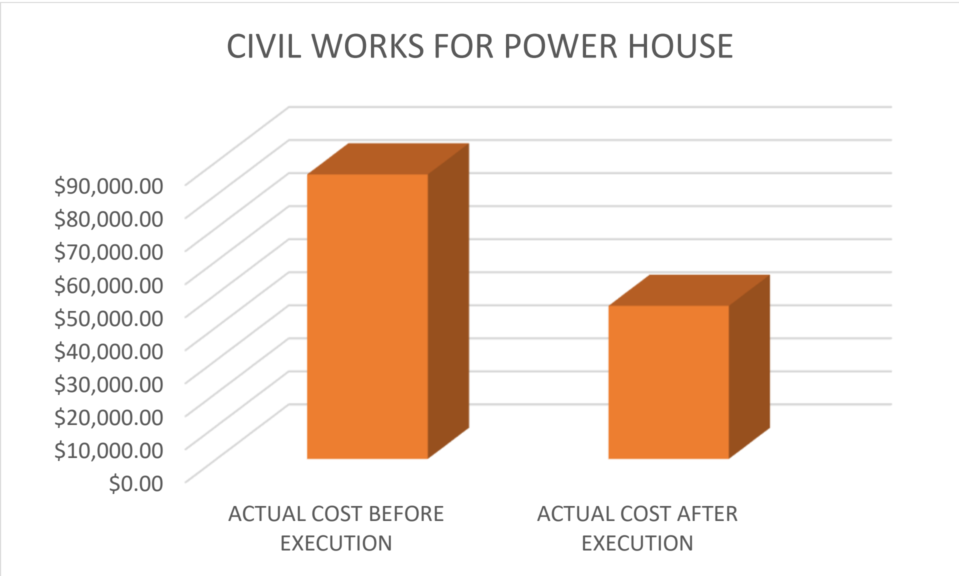


Figure 7.10 A comparison of the actual cost before and after execution

Table 7. 2 A Comparison between the allowable cost, actual cost before and after execution cost

Electrical Bill Summary	Tender Option 1	Tender Option 2	Tender Option 3	Allowable Cost	Target Cost	Actual Cost Before Execution	Actual Cost After Execution
Power Equipment	$336,589.77	$237,888.55	$324,930.56	$285,398.45	$314,634.24	$265,094.59	$265,094.59
Distribution Equipment	$127,085.63	$184,556.14	$136,620.14	$125,308.42	$133,111.75	$116,393.70	$116,393.70
Generators	$325,000.00	$154,800.00	$215,633.33	$220,088.44	$208,800.40	$204,430.88	$204,430.88
Cables	$470,272.57	$820,067.95	$470,272.57	$518,402.31	$455,370.69	$481,522.05	$481,522.05
Others	$229,509.69	$229,509.69	$143,398.58	$173,899.60	$136,125.94	$136,528.58	$161,528.58
Civil Works	$86,111.11	$86,111.11	$86,111.11	$65,791.67	$83,382.44	$86,111.11	$46,346.20
Total	$1,574,568.8	$1,712,933.5	$1,376,966.3	$1,388,888.9	$1,331,425.5	$1,290,080.9	$1,275,316.0
						Savings from Allowable Cost	**$8.20**

7.6.2.7 Closing Stage

At the closing stage of the project, the team performed reviews of target and audit. The testing and commissioning of all installations were carried out, and a record of performance was kept. The performances, which comprised of impacts on the delivery, time, cost/budget, stakeholder value, variations/change orders, and collaboration, were measured and reported.

Lessons learnt, based on feedback from project team members, were documented, as stipulated by the FFITVD.

7.6.3 Re-evaluation of the Framework

The second and third level evaluations were conducted after the implementation of the framework in the case study. The second level evaluation of the second version of the framework was conducted by the participants in the project (internal validity) to produce the third version of the framework (see appendix 16 for the third version of the framework), while the third level evaluation of the third version of the framework was conducted with non-participant academics, lean construction experts and construction stakeholders (external validity) to produce the fourth version of the framework (see appendix 17 for the fourth version of the framework)).

7.6.3.1 Rationale for Internal Evaluation of the Framework

Ellis and Levy (2010) argue that it is essential to establish that the framework developed can solve the problem it was established during the design and development phase. The results of the research, which in this case is the framework, should be able to meet the aims and objectives of the research.

The Indiana Dictionary (2018) states that internal evaluation refers to how well an experiment is done, based on its success in avoiding confusion, the less chance of confusion in a study, the higher its internal validity. This internal evaluation was carried out to achieve the following goals:

i. to assess benefits, barriers, impact, success factors, and support needed for TVD implementation.
ii. to assess the appropriateness of the five stages of the framework.
iii. to ascertain the level of completeness and comprehensiveness of the framework.
iv. to ascertain if and how the framework will aid the implementation of TVD. This is to establish that the framework is appropriate to address the problem it was created to solve; and
v. to determine how comprehensible the framework is, and the level of ease of application.

To this end, the interval evaluation was conducted for the participants of the implementation project CS-04. The evaluation was in the form of semi-structured interviews and a survey.

7.6.3.2 Semi-structured Interviews

The interviews were divided into sections for benefits, barriers, impact, success factors, and support needed for TVD implementation in the construction industry. (see Appendix 10 for a sample of interview guide)

7.6.3.2.1 Demographic Information of Respondents on CS-04

Eight out of the 20 participants of the framework implementation case study were interviewed after implementation of the framework. The participants were denoted with a code (FE), which stands for ‘framework evaluation’. The respondents were drawn from the client, contractors, manufacturers and consulting firms. The respondents included the managing director of the external electrical company of the project, the design and execution team members, manufacturers' representatives, and the contractors and consultants. This shows that the evaluation results would satisfactorily represent the opinions of the key stakeholders that the TVD framework was meant to serve. All the respondents had adequate experience in the construction industry, suggesting that their assessments could be trusted. Table 7.3 presents the background information of the respondents, such as years of experience in construction, their discipline, and their code and role categorisation on the project.

Table 7.3 Background information of the respondents for the evaluation

S/NO	ROLE CATEGORISATION ON THE PROJECT	RESPONDENT CODE	DISCIPLINE	YEARS OF EXP. IN CONST.
1	Site manager	FE-004	Quantity Surveyor	7
2	Contractor 1	FE-006	Electrical Engineer	15
3	Electrical designer	FE-010	Electrical Engineer	5
4	Electrical designer	FE-011	Electrical Engineer	24
5	Research & development officer	FE-013	Land Surveyor	10
6	Budget Officer	FE-014	Quantity Surveyor	8
7	Manufacturer	FE-015	Electrical Engineer	16
8	MD External Electrical	FE-016	Electrical Engineer	11

7.6.3.2.2 Benefits of TVD Implementation

From the interviews conducted with the participants of the implementation case study, the following benefits of TVD implementation were identified:

i. Collaborative and harmonious working relationships: The participants all agreed that the implementation of the TVD framework on the case study brought about a very interesting collaborative and harmonious working relationship. This collaboration was interesting because it involved all the stakeholders of the project: from the client to the design and execution team members, manufacturers, contractors and consultants. The stakeholders engaged in collaborative planning/design, collaborative tendering at the planning/design stage, and further collaborative working during the execution, monitoring and control stages. This was aptly captured by the MD of the client's firm when he volunteered that:

> *"What TVD does is that it encourages teamwork, especially with costing, with design, and then with actual relationships between engineers, contractors and everybody, because when people are involved from early stage, it builds better relationships, you will understand each other more and everybody is carried along through the specific goals of the project."* (FE-15 **MD External Electrical**)

ii. Better identification and satisfaction of stakeholder values: The interviewees noted that because of the harmonious working relationship, it was very easy to better identify and satisfy the stakeholder values. As the manufacturers and contractors participated in the planning and designing of the project, there was a sense of obligation for the success of the project on their part. The involvement of the client from the beginning to the closing of the project facilitated the work of the design and execution team. In the end, everybody was happy. The budget officer succinctly captured the view thus:

> *"All the key stakeholders participated in the planning, design and execution of the project; it was a better planning process. Based on that, it gave better identification and satisfaction of stakeholder's value as well. In fact, everybody was happy with the whole process."* (FE-14, **Budget officer**)

iii. Innovations and multiple design options: There was innovation and multiple design options as a result of the implementation of TVD in the case study, as noted by one of the respondents:

> *"I think what TVD does in a project is that when you know your target, then it gives rooms for people to be more innovative in terms of how solutions are conceived or how solutions are produced for a particular need. With this particular project, initially the client wanted just one transformer to cover a whole lot of units, but we realize that instead of buying one transformer, we could actually buy two smaller transformers and achieve better cable "raft", and by so doing, you reduce massively the amount of cable, which means cost is reduced; and also the cable size has to be reduced from 500mm to about 120mm max, so that helped because of the cable router and for disintegrating a larger transformer to a smaller unit."* (FE-16, **MD External Electrical**)

iv. Minimum waste: The respondents reported that because of TVD, it helped to minimise waste in the project because the target cost was used at every point in aligning the design and constructions and ensuring that quality was not compromised. One of the design team members noted:

> *"Target value design enhanced our design process and minimised the waste of materials in the delivery process. It encourages a form of planning where everything is taken care of even before the project is commenced." (*FE-010, **Electrical designer**)

v. Prevents corruption: The respondents observed that there was a high level of trust among the team members because of the collaborative tender and joint negotiation arising from the TVD framework implementation. This belief was captured by one of the respondents thus:

> *"The coming together of all the stakeholders helped in eliminated corruption and contract padding, because of the collaborative tender and joint negotiation as practised in the case study, there was reduction of all elements of corruption because you have different manufacturers giving all the stakeholder prices and solutions on the same project." (*FE-004, **Site Manager**)

vi. Reduction of change and variation: The respondents noted that another benefit of TVD in the case study was that it reduced variation and change order in the project because a lot of details went into planning and design when people came together.

vii. Cost savings and prevention of cost overrun: A lot of cost savings were realised in the case study as a result of the implementation of the TVD framework. The words of one of the respondents better explain this:

> *"The initial rough estimate of the first design was about 880 million naira (about 2.45 million USD), so when we got back to the design, the contractors, we the team followed up and changed the cable router and placement of transformers and generators, it was shocking how much could be saved, about 40% of the initial cost was saved at the design stage as the initial design was about 585 million naira (about 1.63 million USD). When we came to the construction, we still have to renegotiate with the manufacturer, in fact before the construction, we got option one to 535 million naira (1.49 million USD), another option, we saw another one of 495 million naira (about 1.38 million USD), but when we travelled all the way to Lagos, with our team and then collaborated with the manufacturers, they gave us ideas on designs which further reduced our design estimate. Then I remember we still went on negotiating on discount through the process and we communicated with*

the foreign transformer manufacturing company to see how it would be, and then we now got over twenty million Naira (approximately 5,555 USD) saving from just the transformers alone." (FE-16, **MD External Electrical**)

7.6.3.2.3 Barriers to TVD Implementation

Since the goal of this case study was the evaluation of the developed framework, it was interesting to note that all the barriers and challenges to the implementation of TVD experienced in the other three case studies were not mentioned in this one, except for inflation and recession in the market. This was because the participants of the case study had had the experience of TVD principles and practices in previous case studies, and the extensive training and workshops were carried out.

7.6.3.2.4 Drivers of TVD Implementation

The main driver of the implementation of TVD in this case study was the need to evaluate and refine the TVD framework that had been developed from this research work. The other drivers included: a desire to deepen the knowledge and practice of TVD; the need to improve the way construction projects are carried out in Nigeria, thereby achieving client goals and reducing project costs without compromising on quality; and delivering the project on target.

7.6.3.2.5 Success Factors of TVD Implementation

The participants offered the selection of an integrated competent team, the early involvement of stakeholders, the addition of TVD in the project contracts, the appointment of a TVD facilitator, and the use of TVD benchmarks as the major success factors. The other success factors included organisational support, management policies, adoption of TVD benchmarks, senior management buy-in, training, collaborative practices, incentives and motivation.

7.6.3.2.6 Impacts of TVD on the CS-04

The participants reported that the framework implementation had a momentous impact on the following:

i. budget and cost, the implementation of TVD on CS-04 enable the team to gain 8.2% savings from the allowable cost. (see table 7.2)

ii. The implementation of TVD in this case study enabled the project team to deliver the project three weeks before the scheduled time.

iii. waste, variations and rework;
iv. their knowledge and practice of TVD; and
v. stakeholder satisfaction

7.6.3.2.7 Support Needed for the Implementation of TVD

The support needed for the successful implementation of a TVD framework was the same as that earlier listed in CS-01. It includes:

a. training;
b. awareness of TVD benchmarks, principles and practices;
c. academic support and partnerships;
d. professional support;
e. management support; and
f. monitoring and control.

7.6.3.3 Survey for the Post-Implementation Evaluation of FFITVD

After the project was completed, a semi-structured evaluation survey was developed and administered to 16 of the 20 members of the project team (See appendix 9 for a sample of the survey questionnaire).

7.6.3.3.1 Demography of the Respondents

The survey was distributed to the key stakeholders of the project. Table 7.4 shows the demography of the respondents, and Figure 7.11 shows the years of experience of the respondents.

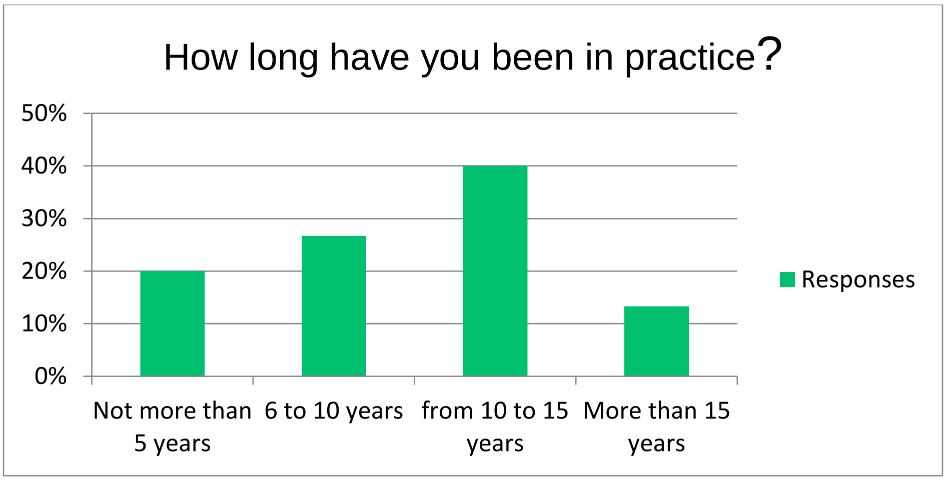


Figure 7.11 Years of experience of the respondents

Table 7.4 The demography of respondents

S/NO	ROLE CATEGORISATION ON THE PROJECT	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.
1	Procurement head city	FE-001	Business Admin	10
2	Design Team	FE-002	Architect	4
3	Quality control officer	FE-003	Civil Engineer	10
4	Site manager	FE-004	Quantity Surveyor	7
5	Consultant	FE-005	Electrical Engineer	15
6	Contractor 1	FE-006	Electrical Engineer	15
7	Contractor 2	FE-007	Civil Engineer	9
8	Quantity Surveyor	FE-008	Quantity Surveyor	5
9	Quantity Surveyor	FE-009	Quantity Surveyor	11
10	Electrical Designer	FE-010	Electrical Engineer	5
11	Electrical Designer	FE-011	Electrical Engineer	24
12	Civil Engr team member	FE-012	Civil Engineer	3
13	Research & Development Officer	FE-013	Land surveyor	10
14	Budget Officer	FE-014	Quantity Surveyor	8
15	Manufacturer	FE-015	Electrical Engineer	16

The figure shows that 53.3% of the respondents had more than 10 years of experience. This implies that the respondents have enough experience in construction to make valid suggestions or criticisms of the framework.

The questionnaire was divided into eight sections, namely; stages of a project, behaviours, drivers, tools and techniques, barriers, benefits, steps, and comprehensiveness

7.6.3.3.2 Assessing the Stages of a Project

The question asked in this section was to determine the appropriateness of the five stages of the project for TVD implementation in the framework (initiation, planning, execution, monitoring and control, and closing). Based on their experience from the TVD framework implementation, all the respondents believed that the stages of the project chosen were appropriate for the implementation of TVD (see Figure 7.12).

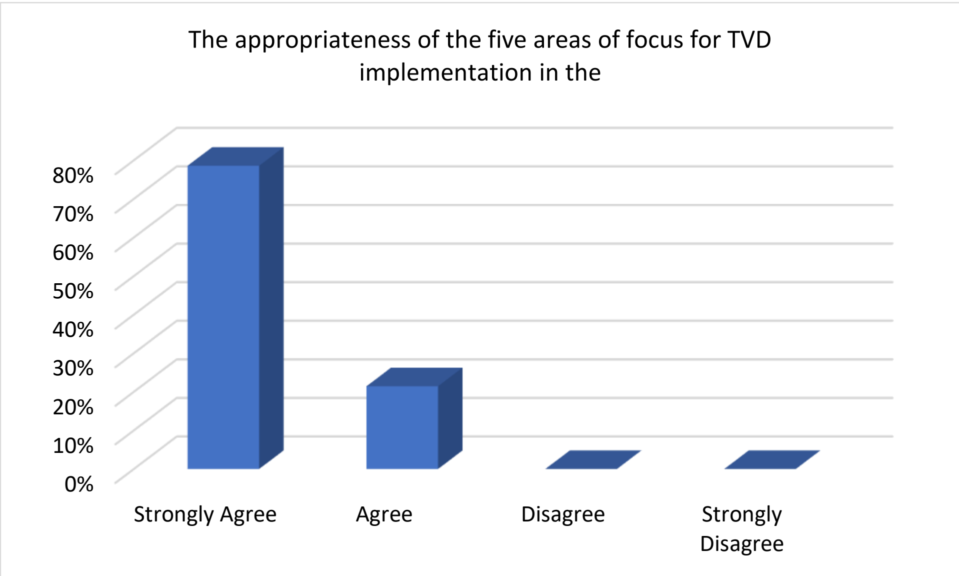


Figure 7.12 The appropriateness of the five areas of focus for TVD implementation

7.6.3.3.3 Assessing the Sequential Steps of the FFITVD

This section focused on the level of completeness of the steps and sequence of the FFITVD as required at all the stages of the implemented project.

All the respondents believed that the steps and sequence required at the initiation and planning/design stages of the project were complete. One of the respondents said:

"*All angles involving/including end customer, project managers and executors are covered.*" **[FE-15]**

Of the respondents, 92% believed that the steps and sequence required at the execution and closing stages were complete, while only 8% disagree with the completeness of the steps in the execution and closing stages of the project. A summary of the results is presented in Figure 7.13. One respondent suggested:

"*There is always room to add more improvement.*" **[FE-06].**

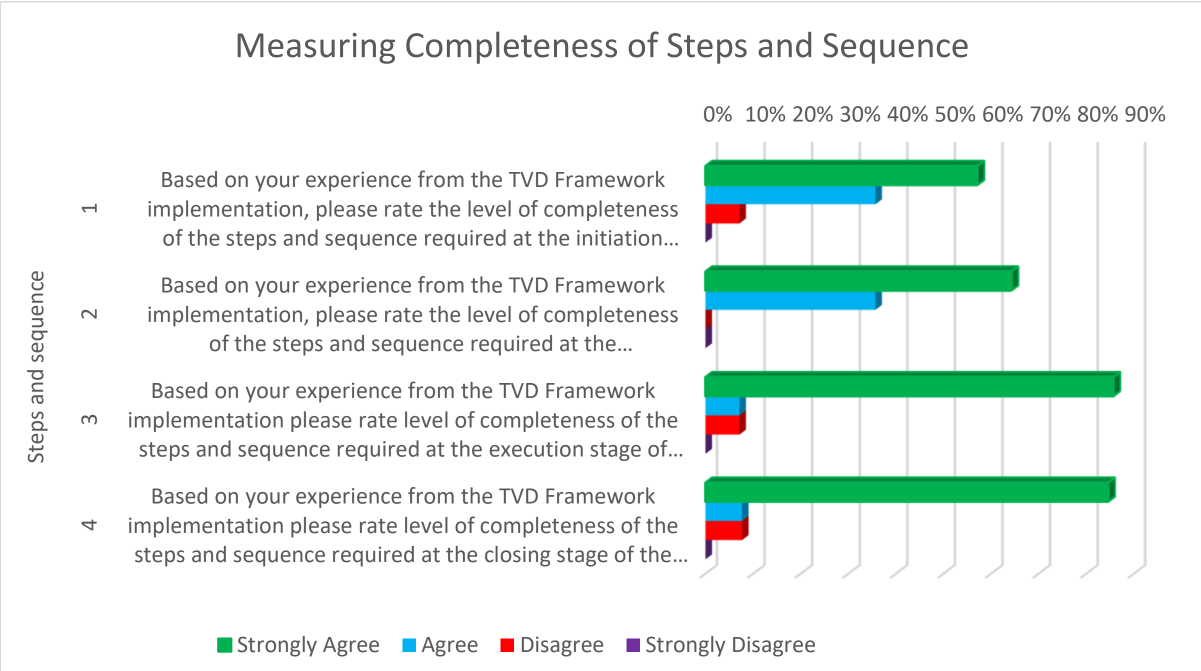


Figure 7.13 Measuring the completeness of the steps and sequence

7.6.3.3.4 Assessing the Tools & Techniques

The respondents were asked to rate the level of completeness of the tools and techniques required during all the stages of the implementation of the TVD.

The respondents all agreed that, based on their experience from the framework implementation on this project, the tools and techniques required during the initiation, planning/design and execution stages were complete. Of the respondents, 93% believed that the tools and techniques required during the closing stage of the project were complete, while 7 % disagreed. The summary of the results is presented in Figure 7.14.

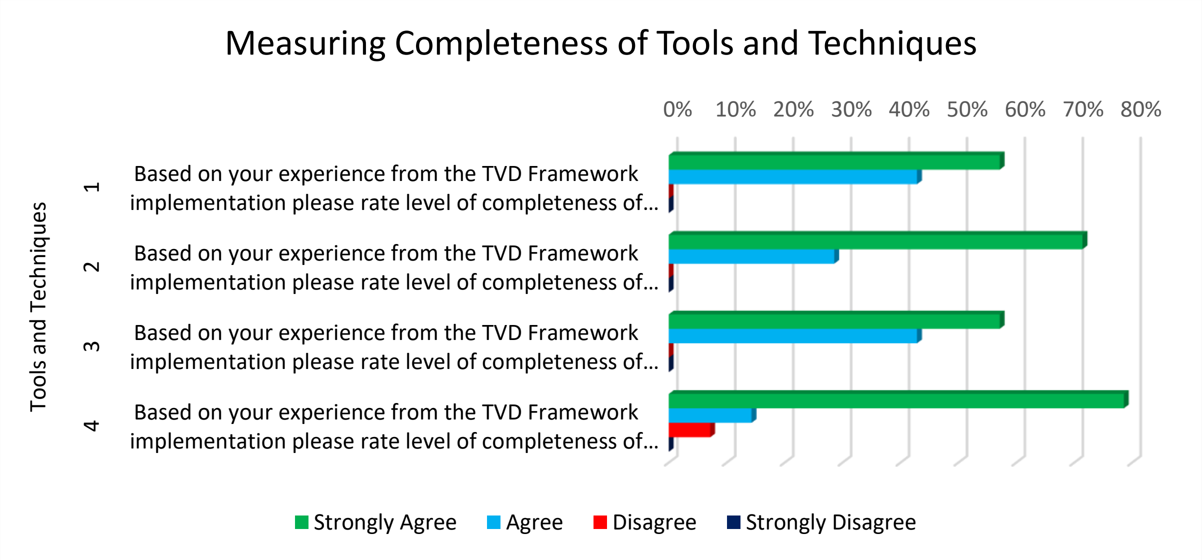


Figure 7.14 Measuring completeness of tools and techniques

7.6.3.3.5 Assessing the Barriers

This section focused on the level of completeness of the barriers encountered at all the stages of the implementation of TVD on the project.

The results presented in Figure 7.15 show that 79% of the respondents believed that the listed likely barriers that can be encountered during the implementation of the TVD framework in the initiation, planning/design and execution stages are complete, while 21% disagreed. Some of the respondents believed:

> *"Intentional sabotage could be a barrier in the Planning stage."* **[FE-06]**

> *"In the execution stage, the fluctuation due to political instability and government policies could be a barrier to the implementation of TVD."* **[FE-08]**

Of the respondents, 86% are of the opinion that the likely barriers that could be encountered in the closing stage of the project are complete, with only 14% offering contrary opinions. One stated:

> *"Incomplete records or documentation of work progress could serve as a barrier at the closing stage of a project."* **[FE-12].**

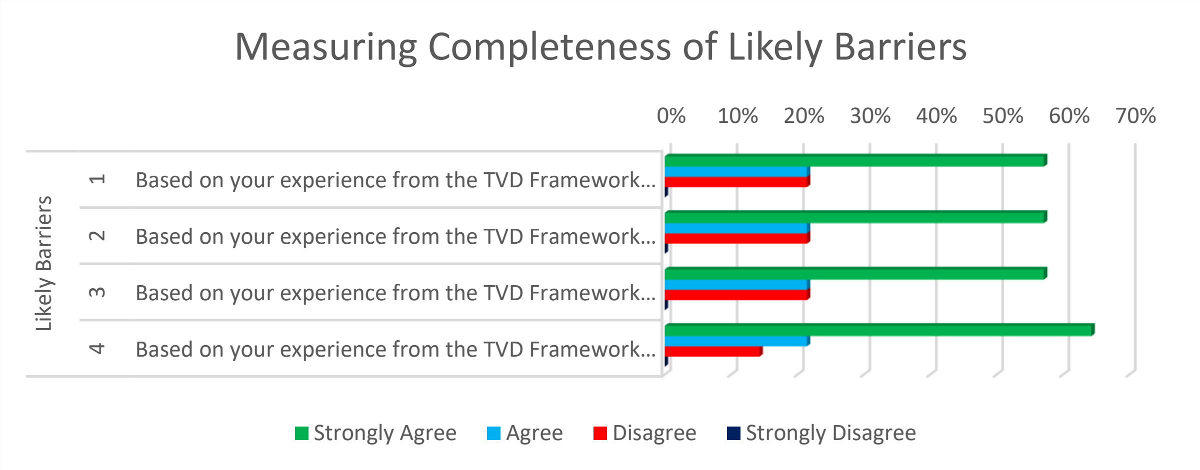


Figure 7.15 Measuring completeness of likely barriers to TVD implementation

7.6.3.3.6 Assessing the Benefits

In this section, the respondents were asked to rate the level of completeness of the benefits observed during all the stages of the implementation of TVD on a project.

The results presented in Figure 7.16 indicate that all the respondents agreed that the listed benefits of the implementation of TVD in all stages of the project are complete.

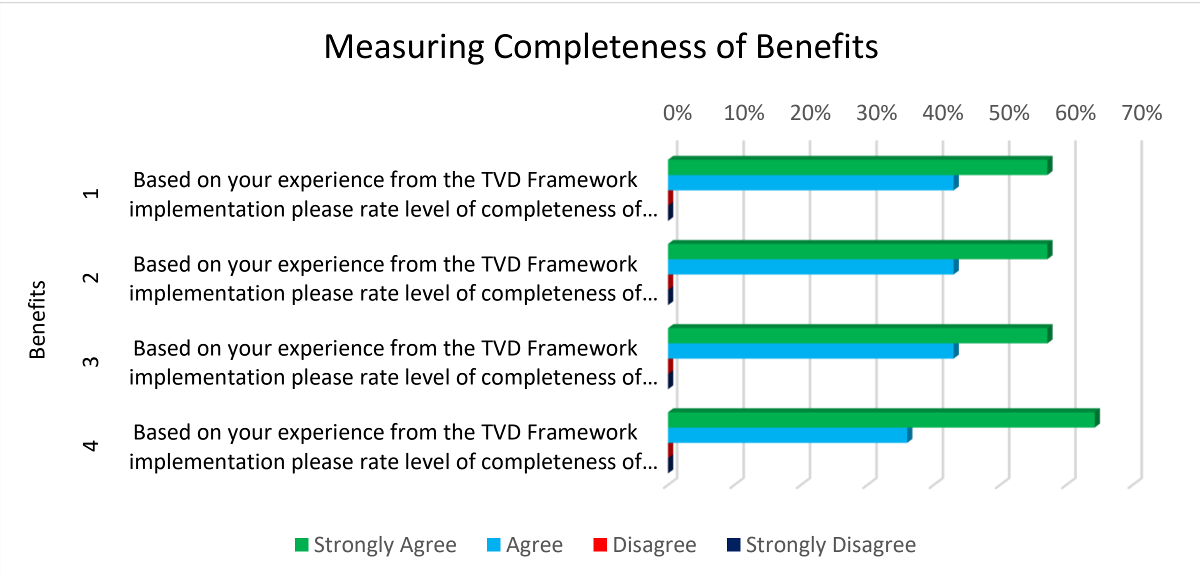


Figure 7.16 Measuring completeness of benefits

7.6.3.3.7 Assessment of the Project Mindset

In this section, the respondents were asked to rate based on their experience of the TVD framework implementation regarding the level of completeness of the project mindset required.

The result presented in Figure 7.17 indicates that 93% of the respondents agreed that the project mindsets listed in the framework were complete, while only 7 % disagreed.

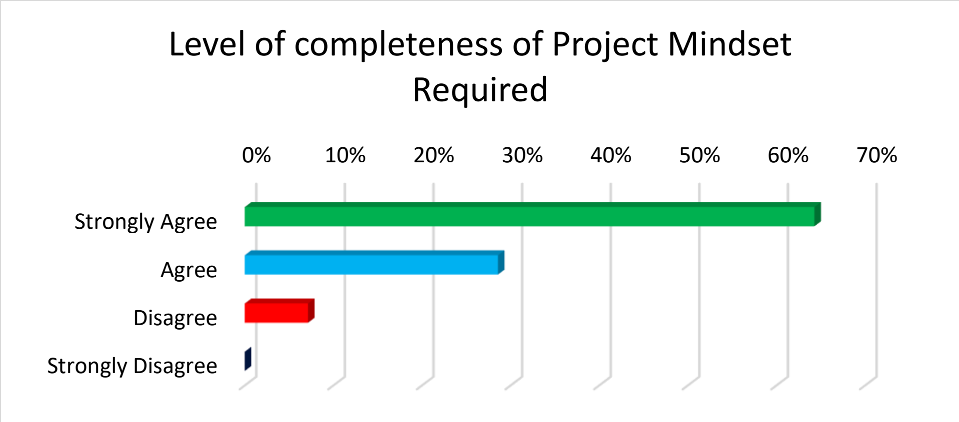


Figure 7.17 Level of completeness of project mindset required

7.6.3.3.8 Assessing the Drivers

Here the respondents were asked to rate the level of completeness of the drivers that prompt the use of TVD in projects.

The results presented in Figure 7.18 indicate that 93% of the respondents agreed that the listed drivers in the framework were complete, while only 7% of them rated the drivers incomplete.

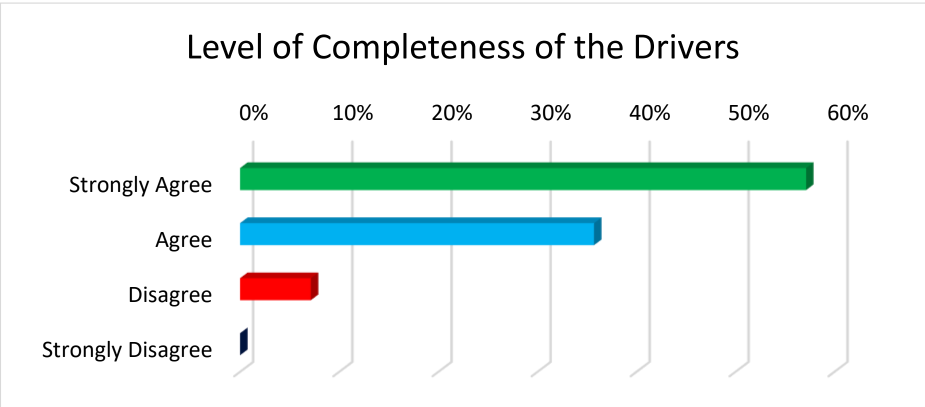


Figure 7.18 Level of completeness of the drivers

7.6.3.3.9 Assessing the Level of Comprehensiveness

The question in this section focused on how comprehensive the respondents found the TVD implementation framework.

The results presented in Figure 7.19 indicate that 93% of respondents found the framework comprehensive enough, while 7% disagreed. One respondent believed that:

> *"It is self-explanatory; it should be followed the way it has been explained or proper way of which it should be done."* **[FE-04].**

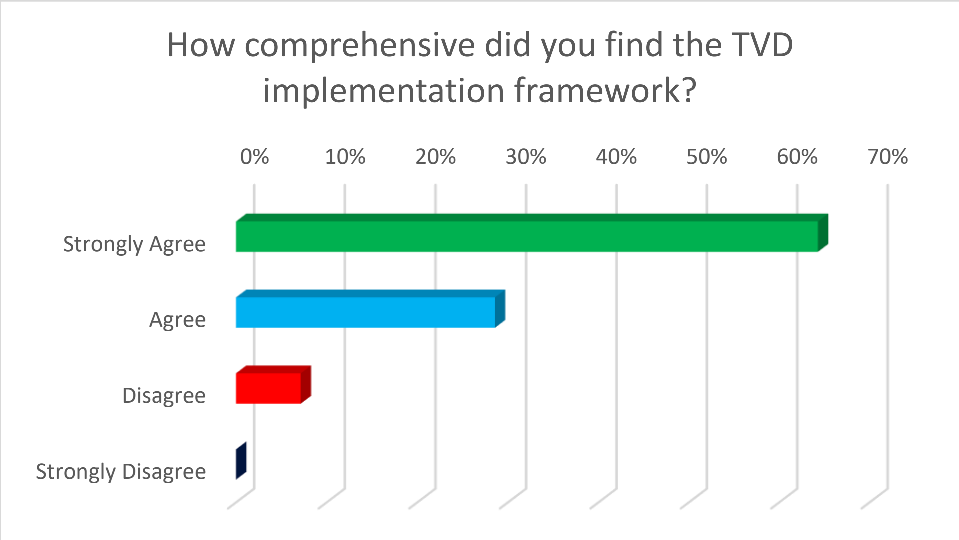


Figure 7.19 Level of comprehensiveness

7.6.3.3.10 Use of the Framework in Nigeria

The respondents were asked to ascertain if the framework would, in any way, support the implementation of TVD in the construction industry and if it could be adapted to suit Nigeria.

All the respondents held the view that the TVD framework would give all the stakeholders involved in the construction industry an idea and knowledge of what TVD is about, and how to implement the TVD. This is because the framework employs a step-by-step approach, which is the approach needed in order to achieve its implementation to set up a cost-efficient project.

More so, they equally believed that the implementation of the framework in Nigeria would be invaluable in reducing the challenges encountered in the construction industry.

7.6.3.3.11 Recommendation on the use of the Framework by the Respondents

The respondents were asked to recommend how the framework should be used. Most of them advised that the steps in the framework should be carefully followed. According to some respondents:

"A person seeking to use the framework should follow the recommended steps in the order they have been stated and should refer to the framework regularly during implementation." ***[FE-12]***

*"The TVD framework should be published in an academic journal, seminars and presentations to professional bodies so that the stakeholders of the construction industry will be aware of its existence." [**FE 13]***

7.6.3.4 Suggestions for Further Improvement by Respondents and Changes to the Framework

Most of the respondents believed that the framework was efficient, while a few suggested that further research should be carried out to develop more TVD benchmarks for the execution and closing stages of a project.

7.6.3.4.1 Second Refinements to the Framework

All the comments and suggestions by the respondents were taken into consideration, and some refinements were carried out on the second version of the framework. The changes included:

i. Adding a barrier each to the planning/design, execution, and closing stages of the framework:
   a. intentional sabotage in the planning/design stage [FE-06];
   b. fluctuation due to political instability/government policy in the execution stage [FE-08]; and
   c. incomplete records/documentation to work progress in the closing stage.

ii. Moving the choice of procurement route to the initiation stage of the project [FE-01].

iii. Changing the 'stop' at the initiation stage to 'Validate Business plan'; in other words, continuing to bear the risk in mind. According to (Ballard 2008), the Validate Business Plan comes into play after you have chosen to continue bearing the risk in mind.

7.6.3.5 External Evaluation of FFITVD

The third level evaluation (external evaluation) was carried out to ensure that the applicability of the framework was not restricted to the empirical context under study, but that the FFITVD could be applied in a wider context. To this end, the external evaluation was conducted with academics, lean construction experts and construction stakeholders who were not part of the testing of the FFITVD. The data collection method used for the evaluation was survey and interviews.

7.6.3.5.1 Rationale for External Evaluation of the Framework

This external evaluation was carried out to achieve the following goals:

a. To determine that the framework can be applied in another context.
b. To determine that the framework can be applied in other countries.
c. To further ascertain the level of completeness and comprehensiveness of the framework.
d. To establish that the framework is appropriate to address the problem it was created to solve.

7.6.3.5.2 Survey for External Evaluation of FFITVD

The questionnaire was divided into eight sections, namely: stages, behaviours, drivers, tools and techniques, barriers, benefits, steps, and comprehensiveness (See appendix 9).

7.6.3.5.3 Demography Information of the Survey Participants

Seven respondents, comprising academics, lean construction experts and construction stakeholders, who did not participate in the implementation of the FFITVD were administered questionnaires for further evaluation of the framework. The participants were denoted with a code: (EFE), which stands for ‘external framework evaluation’. The respondents included two lecturers, a researcher, a contractor, two clients, and a supplier. They were chosen so that the evaluation results would satisfactorily represent the opinions of the key stakeholders that the FFITVD is meant to serve. Table 7.5 and Figure 7.20 present the background information of the respondents.

Table 7.5 Background information of the respondents for the evaluation

S/NO	ROLE CATEGORISATION	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.	LOCATION
1	Lecturer	EFE-001	Builder	5-10	UK
2	Lecturer	EFE-002	Quantity Surveyor	5-10	UK
3	Client	EFE-003	Architect	10-15	Nigeria (NG)
4	Contractor	EFE-004	Architect	10-15	Nigeria (NG)
5	Research & Development Officer	EFE-005	Land surveyor	10-15	Nigeria (NG)
6	Supplier	EFE-006	Civil Engineer	5-10	Nigeria (NG)
7	Managing Director	EFE-007	Architect	5-10	Nigeria (NG)

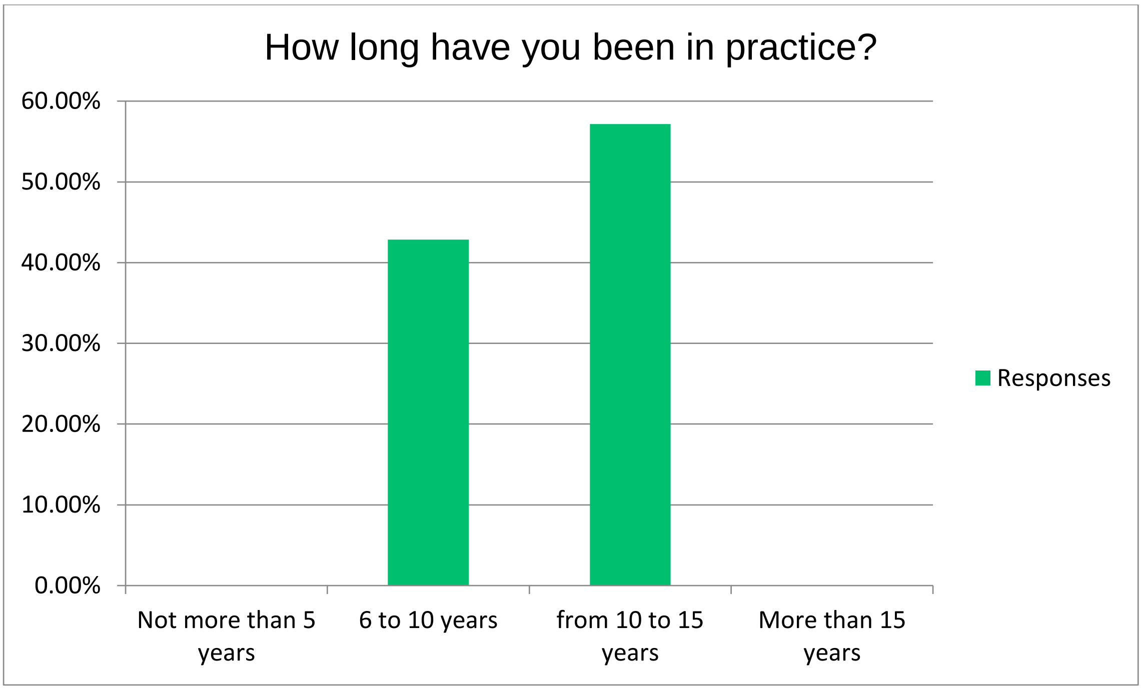


Figure 7.20 Years of experience of the respondents

Figure 7.20 shows that 57.1% of the respondents have more than 10 years' experience in the construction industry. This suggests that the respondents have enough experience to make valid suggestions or criticisms of the FFITVD, and their assessments could be reliable.

7.6.3.5.4 Assessing the Stages of a Project

The question asked in this section was to determine the appropriateness of the five stages for TVD implementation in the framework (initiation, planning, execution, monitoring and control, and closing) chosen by the researcher, based on the respondents' assessment of FFITVD. All the respondents believed that the five stages were appropriate for the implementation of TVD. Figure 7.21 shows the results of the assessment.

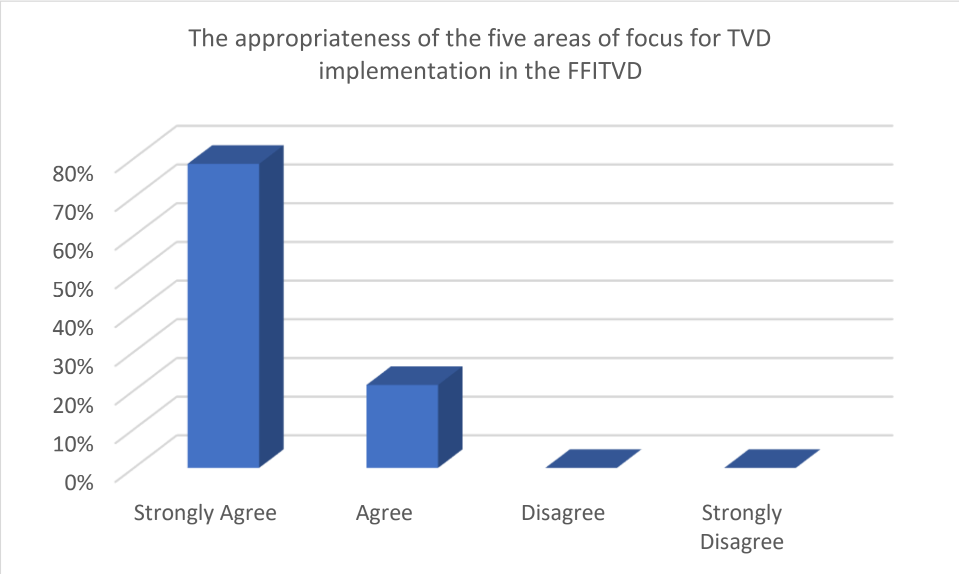


Figure 7.21 The appropriateness of the five stages for TVD implementation in the FFITVD

7.6.3.5.5 Assessing the Sequential Steps of the FFITVD

This section focused on the level of completeness of the steps and sequence required at all stages of the FFITVD. All the respondents believed that the steps and sequence required at the initiation, planning/design, execution and closing stages of the project were complete. The result is shown in Figure 7.22.

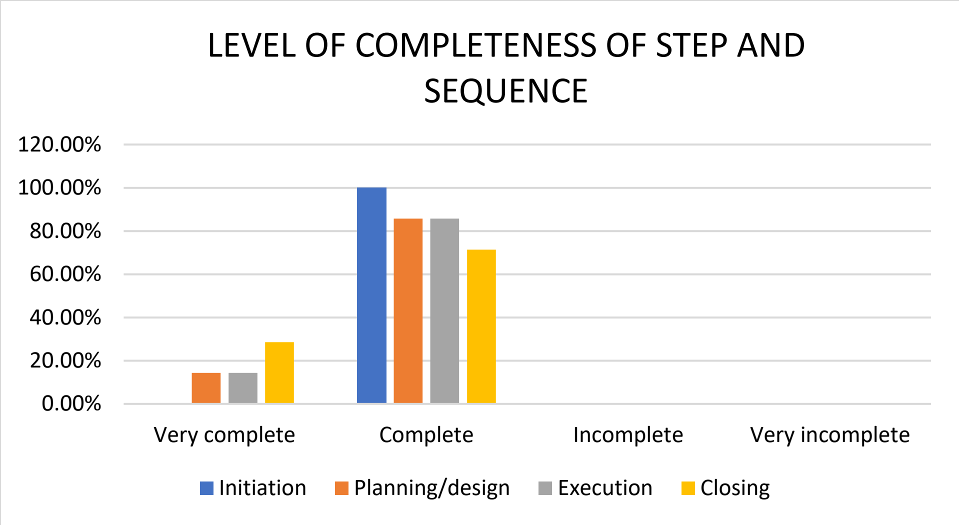


Figure 7.22 The level of completeness of steps and sequences of FFITVD

7.6.3.5.6 Assessing the Tools & Techniques

The respondents were asked to rate the level of completeness of the tools and techniques required during all the stages of the implementation of FFITVD on a project.

The respondents all agreed that, based on their assessment of the FFITVD, the tools and techniques required during the initiation, planning/design and closing stages were complete. Of the respondents, 85.7% believed that the tools and techniques required during the execution stage of the project were complete, while 14.3 % disagreed. Figure 7.23 shows the results.

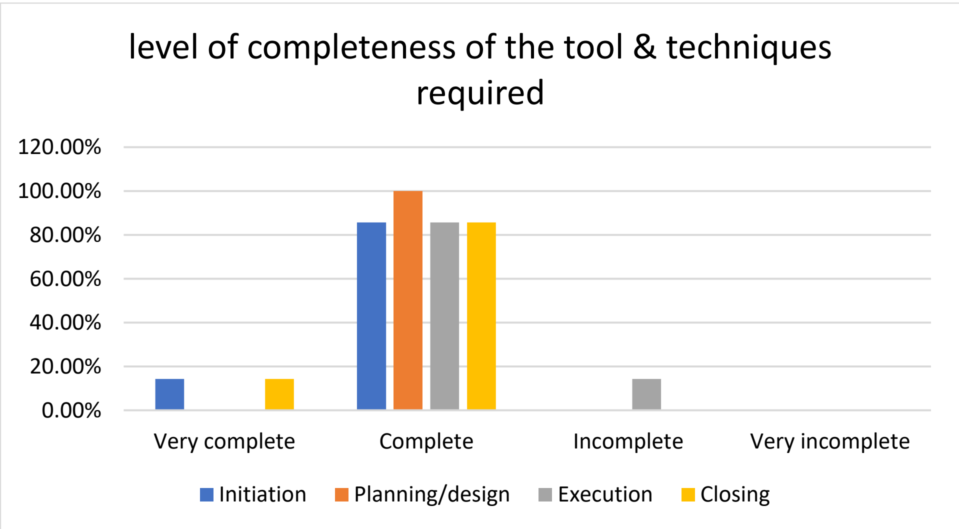


Figure 7.23 The level of completeness of tools and techniques of FFITVD

7.6.3.5.7 Assessing the Barriers

This section focused on the level of completeness of the barriers listed for all the stages of the implementation of FFITVD on the project.

Of the respondents, 71.4% believed that the listed likely barriers that could be encountered during the implementation of the TVD framework in the initiation stage were complete, while 28.6% disagreed. Furthermore, 85.7% of the respondents believed that the listed likely barriers that could be encountered during the implementation of the TVD framework in the planning/design stage were complete, while 14.3% were of the opposite opinion.

Of the respondents, 85.7% believed that the listed likely barriers that could be encountered during the implementation of the TVD framework in the execution stage were complete, while 14.3 % disagreed. Finally, 71.4% of the respondents believed the likely barriers that could be encountered in the closing stage of the project were complete, with only 28.6% offering contrary opinions. (see Figure 7.24).

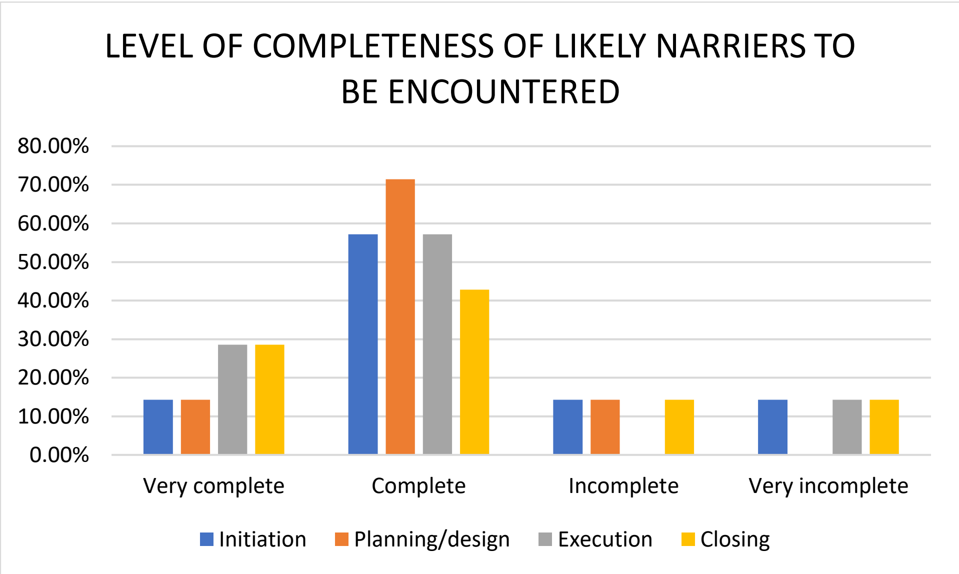


Figure 7.24 The level of completeness of the likely barriers of FFITVD

7.6.3.5.8 Assessing the Benefits

In this section, the respondents were asked to rate the level of completeness of the benefits listed for all the stages of the implementation of TVD on a project. Of the respondents, 57.1% agreed that the listed benefits of the implementation of TVD in the initiation stage of the project were complete, while 42.9% stated that the benefits at the initiation stage were not complete. A respondent noted that:

> *"' Likely Benefits' should replace the title 'Benefits' as a comprehensive list of benefits cannot be added to the small sheet of framework paper."* **[EFE-06 NG]**

Of the respondents, 71.4% agreed that the listed benefits of the implementation of TVD in the planning/design stage of the project were complete, while 28.6% stated that the benefits were not complete.

Finally, 85.7% of the respondents agreed that the listed benefits of the implementation of TVD in the execution and closing stages of the project were complete, while 14.3% stated that they were not complete. (see Figure 7.25).

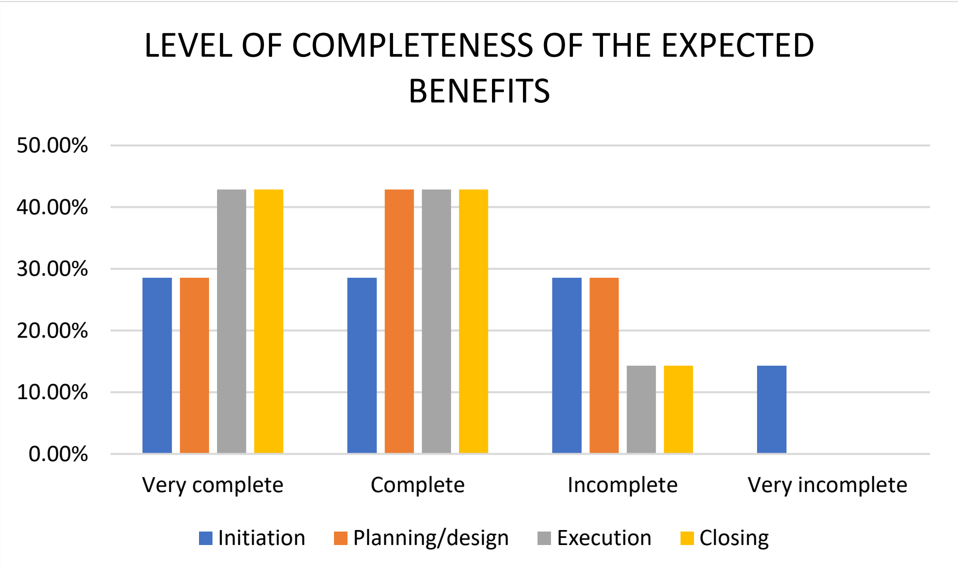


Figure 7.25 The level of completeness of likely benefits expected in the FFITVD

7.6.3.5.9 Assessment of the Project mindset

In this section, the respondents were asked to rate the level of completeness of the project mindset required for the implementation of TVD on a project. All the respondents agreed that the human behaviours listed in the framework were complete.

7.6.3.5.10 Assessing the Drivers

Here the respondents were asked to rate the level of completeness of the drivers that necessitate the use of TVD in projects, and 100% of the respondents agreed that the listed drivers in the framework were complete.

7.6.3.5.11 Assessing the Level of Comprehensiveness

The question in this section focused on how comprehensive the respondents found the FFITVD. All the respondents agreed that they found the framework comprehensive enough. One respondent said that;

> *"Yes, the framework will actually give you the estimated core values of what a project should entail, based on documentation, initiation, planning, execution etc. This will also allow you to either go on with the project or look for a more realistic approach to such a project."* **[EFE-07 NG]**

7.6.3.6 Semi-structured Interviews

The interviews were conducted to get a further understanding of the participants' opinions and contributions to the framework. The interviews were focussed on the eight sections covered in the questionnaire, namely: Stages, Behaviours, Drivers, Tools and Techniques, Barriers, Benefits, Steps and Comprehensiveness. The interviews went further to solicit the views of the respondents on the applicability of the framework in their countries, as well as their recommendations for implementation and improvement of the framework.

7.6.3.6.1 Demographic Information of Interview Participants

Three out of the seven people that took the survey were interviewed as part of the external evaluation of the framework. The code (EFE) used for denoting the participants in the survey was maintained for the interview. The respondents included two lecturers and a researcher. Table 7.6 presents the background information of the respondents

Table 7.6 Background information of the respondents for the evaluation

SN	ROLE CATEGORISATION	RESPONDENT CODE	DISCIPLINE	YEAR OF EXP. IN CONST.	LOCATION
1	Lecturer	EFE-001	Builder	5-10	UK
2	Lecturer	EFE-002	Quantity Surveyor	5-10	UK
3	Research & Development Officer	EFE-005	Land surveyor	10-15	Nigeria (NG)

7.6.3.6.2 Assessing the Stages of a Project

The participants of the external evaluation of the framework were interviewed to assess the appropriateness of the stages of a project in the framework. Analysis of the results revealed that all the respondents in the interviews believed that the project management process groups used as the stages of the project in the framework were appropriate.

7.6.3.6.3 Assessing the Sequential Steps of the FFITVD

The participants of the external evaluation of the framework were interviewed to assess the completeness of the sequential steps at all stages of the FFITVD. They believed that the steps were complete; however, they argued for a readjustment of the sequence. Some of the respondents recommended some modifications to the sequence, stating that:

> *"The procurement route should be indicated; either design and build or traditional."* **[EFE-05 NG]**

> *"The business plan should be "Review and Validate Business plan."* **[EFE-05 NG]**

One respondent suggested that a sequence in the initiation should be corrected. They argued that:

> *"I said the client should buy in before the appointment of a facilitator. I still believe that the client will be the one that will have a need; he now will appoint the facilitator. There may be somebody who will tell you about something but if you do not believe in it, you will not appoint anybody to do it for you? So, I said yes, the steps are complete, but I feel the client must buy in first before appointing a facilitator."* **[EFE-01 UK]**

7.6.3.6.4 Assessing the Tools & Techniques

The participants of the external evaluation of the framework were interviewed to assess the completeness of the tools and techniques listed in all the stages of the FFITVD. Two of the respondents agreed that the tools and techniques that could be used during the implementation of TVD were adequate. However, one respondent disagreed, saying that they were incomplete, especially during the execution stage of the framework. They recommended other tools and techniques, saying:

> *"More lean tools, such as BIM, 5S, etc., should be included in the execution stage."* **[EFE-05 NG]**

7.6.3.6.5 Assessing the Barriers

The participants of the external evaluation of the framework were asked to assess the appropriateness and completeness of the barriers listed in all the stages of the FFITVD. Two of the respondents believed that the barriers recorded in the framework were incomplete. They noted that the framework could not possibly capture all the barriers a practitioner could face while implementing TVD on a project. One respondent noted:

> *"Of course, you can't list the whole (all the) barriers. That's why they are likely barriers, just to give an insight into what can happen when you are doing TVD."* **[EFE-02 UK]**

Another respondent raised another challenge that could be faced during the implementation of TVD in the execution stage of the framework. He said:

> "*Corrupt practices can be a barrier during the execution."* **[EFE-05 NG]**

7.6.3.6.6 Assessing the Benefits

The focus here was to assess the completeness of the benefits of TVD listed in the FFITVD. Although the widely held opinion of the respondents was that the benefits listed in the framework were adequate, one respondent argued that the framework could not possibly capture all the benefits of the implementation of TVD on a project, recommending that they are labelled as 'Likely Benefits'**.**

7.6.3.6.7 Assessment of the Project Mindset

All the respondents interviewed reported that the behaviours listed in the framework were adequate. One of them suggested that they should be referred to as the "project mindset", stating that:

> *"The behaviours should be called the "project mindset" as it involves influencing the philosophies of the participants."* **[EFE-05 NG]**

7.6.3.6.8 Use of the Framework in Nigeria

The respondents were examined to determine if the framework would in any way support the implementation of TVD in the construction industry and if it could be adapted to work in Nigeria.

All the respondents held the view that the TVD framework would give all the stakeholders involved in the construction industry an idea and knowledge of what TVD is all about, and that it would aid TVD implementation. They stated that the framework was detailed enough, and nothing had been left out. Some of the respondents stated that:

> *"Because these will give you a better identification of stakeholder's values, which enables you to manage any such project accurately."* **[EFE-02 UK]**

> *"Yes, likely problems/challenges are identified and tackled at the early stage of the project."* **[EFE-05 NG]**

Furthermore, they equally believed that the framework could be used in Nigeria as the country needed innovative ideas for value creation and improvement of the construction industry. Some of them said:

> *"Yes, the framework will be adopted in the sense that clients require assurance that the business they are venturing into is safe and with a better level of profit, also considering less risk."* **[EFE-02 UK]**

> *"Yes, absolutely! Because this is the very thing the NCI needs at this time to reduce waste, curb corruption and satisfy the clients."* **[EFE-05 NG]**

The respondents based outside Nigeria concurred that the framework could be used in their countries of residence, while some reported that it could be adapted in countries with similar characteristics. One respondent stated that:

> *"It could be adapted in other developing countries that have similar characteristics."* **[EFE-01 UK]**

This offers a level of generalisability.

7.6.3.6.9 Recommendation on the use of the Framework by Respondents

All the respondents recommended the use of the framework in the construction industry as all innovation to the industry would be welcomed. They said;

> *"Absolutely, I would recommend any innovation that helps to curb the menace of building collapse and increases value in the Nigeria construction industry."* **[EFE-05 NG]**

> *"Yes, because it captures what is required in each stage of the construction project. It also considers how it would work under D&B and traditional procurement methods."* **[EFE-01 UK]**

One of the respondents suggested a guiding document for the use of the FFITVD, stating that:

> *"It would definitely support TVD implementation. However, in addition to the framework, a support guiding document that explains the procedures identified in the framework is stilled required."* **[EFE-01 UK]**

7.6.3.6.10 Suggestions for Further Improvement by the Respondents

One respondent made the following suggestions for the improvement of the framework, saying:

> *"You have put much thought and effort into creating the TVD framework. But here is my suggestion to further improve the proposed approach: I feel a guiding document should be developed to explain the procedures identified in the developed framework. Also, I feel some of the detailed information (e.g. benefits and barriers) could be in the guide if you go ahead to create one as suggested. And finally, make the legend more legible."* **[EFE-01 UK]**

7.6.3.7 Third Refinements to the FFITVD

All the input from the participants of the external evaluation were taken into consideration and some changes were made to the third version of the FFITVD to produce the fourth version. Some of the changes in the framework included:

a) The label “benefits” was changed to “likely benefits”.
b) The label “behaviours” was changed to “project mindset”.
c) The step “client buy-in, TVD presentation” was made to be the first step at the initiation stage and “appoint a facilitator” became the second.
d) The step “client buy-in TVD presentation” was modified to become “client buy-in TVD presentation/training”.
e) The step “validated business plan”, also at the initiation stage, was modified to “review and validate business plan”.
f) The step “last planner system” in the planning/design stage was changed to “use last planner system or alternative planning tool”.
g) The legend was made bolder and more legible.
h) The barrier “corrupt practices” was added to the barriers in the execution stage.

Figure 7.26 presents the final version of the FFITVD.

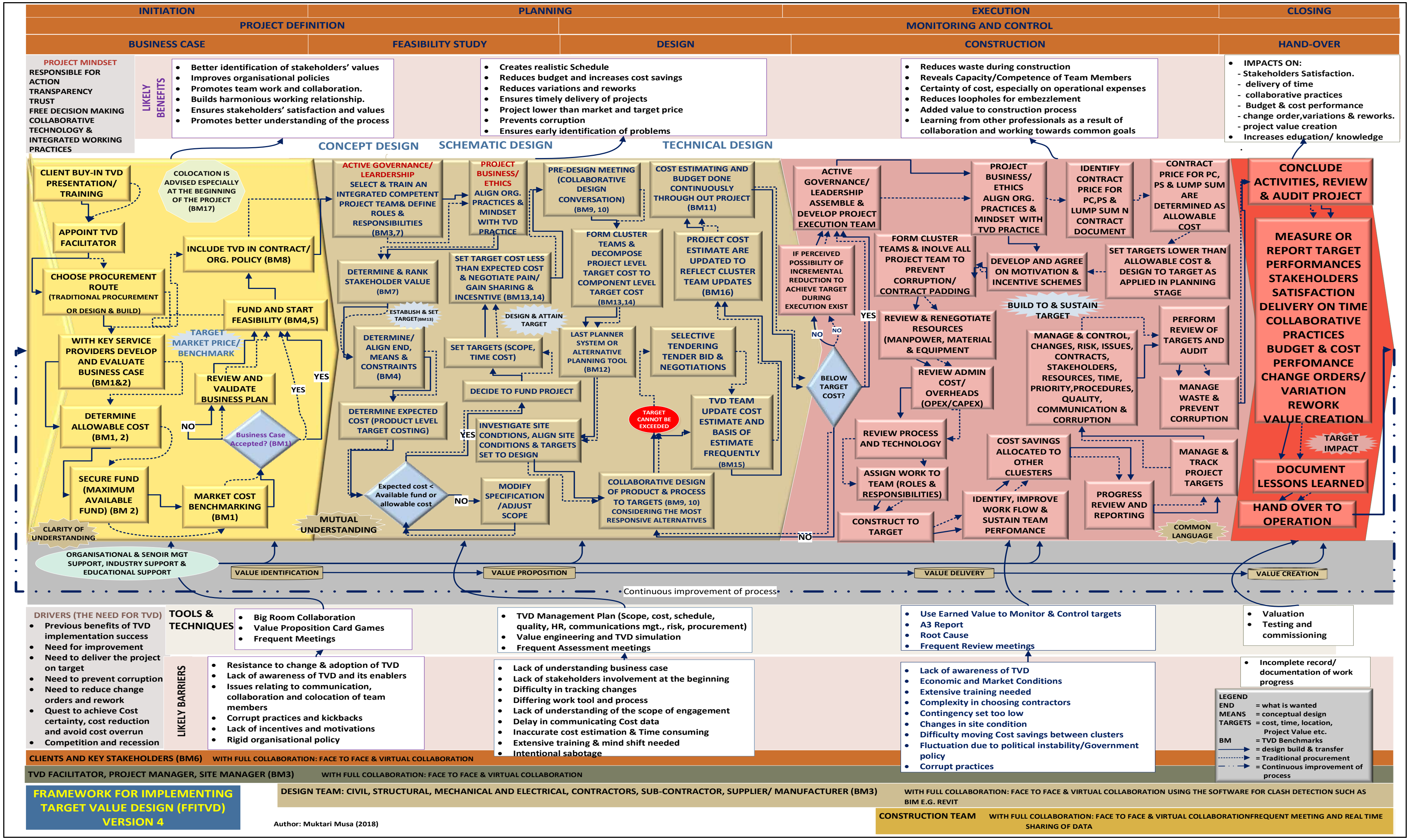


Figure 7.26 The framework for implementing target value delivery (FFITVD)

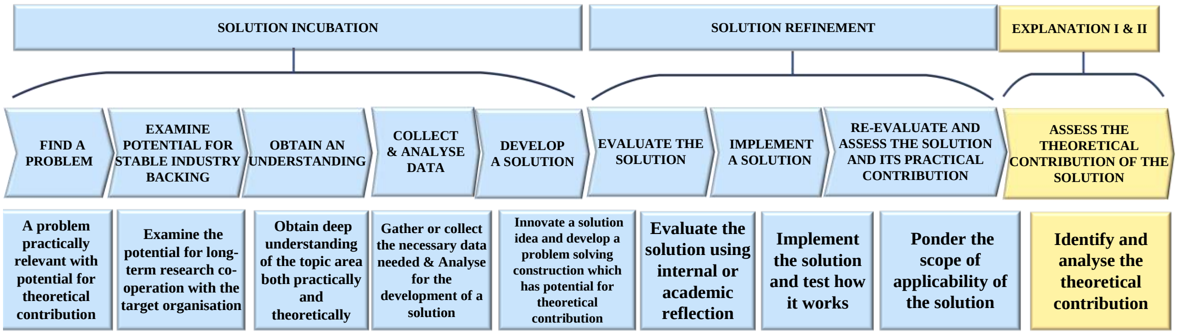
7.7 Chapter Summary

This chapter has discussed the design and development of the framework, as well as its iterative refinement. The chapter explains how the research incorporated the 17 TVD benchmarks proposed by Ballard (2011) and the practices outlined by Macomber et al., (2012) in order to implement TVD on three projects (CS-01, CS-02 and CS-03). The participants in these projects were interviewed and administered surveys. The responses from the participants of the three projects, together with the literature, were used to design and develop a framework that was implemented on a fourth project (CS-04).

The framework was then subjected to three levels of evaluation: an internal reflection by the researcher, internal evaluation with the participants of CS-04, and external evaluation with a group of non-participants of CS-04. The responses, comments, critiques and recommendations from the evaluation participants were used to refine and update the framework. The following chapter draws conclusions from the research and then makes contributions to theory and practice and then makes recommendations for construction industry practitioners and recommendations for further research.

CHAPTER EIGHT

RESEARCH CONCLUSION, CONTRIBUTION AND RECOMMENDATIONS



8.1 Introduction

The previous chapter discussed the development, evaluation, testing and re-evaluation of the Framework for Implementing Target Value Delivery (FFITVD). This chapter corresponds to part of stage 3 (Explanation I) and stage 4 (Explanation II) of the DSR process. This stage of the study involves assessing the practical and theoretical contribution of the solution, communicating the solution developed, its usefulness and originality, and its effectiveness to researchers and other relevant audiences, such as practising professionals.

The goal of this chapter is to conclude the research, state its contribution to knowledge and make recommendations from the research. The chapter begins by revisiting the aim, objectives and research questions of the study in order to establish whether the research questions have been answered and the research objectives met; it further discusses the conclusions on individual research objective and the research questions. The research's contribution to theory and practice are identified. It concludes with the study limitations and recommendations for further research.

8.2 Overview of Research Aim and Objectives

The aim of this study is to develop and test the framework for implementing TVD for enhancing value creation in the construction industry. Five objectives were identified and pursued in order to achieve the aim of the study; these are presented in chapter one and subsequent sections of this chapter.

Qualitative and quantitative data were collected from major sectors (building, ancillary and infrastructure) of the NCI through an extensive literature review, observation, interviews and case studies. The data generated were analysed and used to develop a framework for implementing TVD (FFITVD) in the NCI. The framework was evaluated before it was implemented and tested in a fourth case study. It was then re-evaluated internally and externally after its application. All of this served as sources for the iterative refinement that produced various versions of the framework. Overall, A total of 17 projects were observed, 4 in-depth case studies conducted, 101 interviews conducted, and 189 questionnaire survey responses analysed. The summary of these findings is presented in the following sections.

8.3 Summary of Research Results

This section presents a summary of the empirical findings from the literature review, interviews, survey, observation and case studies. The summary of the research results from phases 1 to 6 is presented in Table 8.1.

Table 8.1 The summary of research results

SN	SUMMARY OF RESEARCH RESULTS
1	A limited empirical study has been conducted in the NCI regarding the application of TVD. No study to date has explored and tested the application of TVD practice across major sectors of the NCI.
2	Literature suggests more research on TVD is needed for the wider application to various project types to support evidence-based decisions regarding its adoption/adaptation in the construction industry, especially in developing countries.
3	Results from the review of the literature identified that previous studies had concentrated on assessing the possibility of application and awareness of TVD in the construction industry, rather than its implementation.
4	The literature review indicated that previous researchers worldwide have presented TVD approaches and processes which focused more on the pre-design and design stage of projects, which are not all-inclusive.
5	The awareness of TVD is limited, some fundamental TVD practices recognised in the literature partially align with current Nigerian design management practices.
6	The term “TVD” is not used in the NCI and there is no record of the implementation or use of TVD in any project in the NCI. However, practitioners are aware of Target cost and target cost contracts.
7	Initial findings reveal that there exists a negligible application of TVD benchmarks; out of the 17 benchmarks observed, only two are applied systematically, with over 60% implementation.

8	The common practice in the NCI is for the architect/civil/structural engineers to design first then develop an estimate. This leads to a design-estimate-rework cycle due to missing information from the design stage. Consequently, projects normally exceed time and cost targets.
9	The most common procurement route adopted in the NCI is the traditional route, which does not provide an avenue for all project members to participate and collaborate at the beginning of the project. While design and build is occasionally carried out, this is normally done on what is called turnkey projects, and it encourages team members to work together in the same room.
10	Generally, the design team members do not stay in the same room during design, but rather meet during coordination meeting/technical meetings. However, developers/design and build contractors occasionally have their design team in the same room.
11	Not all key members of the project team help in developing the business case and feasibility study. Mostly QS participate in the business case preparation. Also, the budget and cost estimates are not done through collaboration with all the team members.
12	There is a willingness to adopt any management practice that aims to achieve the maximum value without altering the scope. In the same vein, there is a strong agreement that designing to a target cost (TVD) will increase cost certainty and make products more competitive.
13	The study revealed that a general lack of awareness of TVD was a major challenge to its implementation. The traditional mindset of industry practitioners does not support collaboration and poses a challenge to the successful implementation of TVD.
14	There is often late involvement of some key stakeholders, including subcontractors and suppliers.
15	Recommendation of TVD was agreed as it is seen as a good innovation that can be gained from.
16	TVD implementation ensures the early identification of problems. It helps prevent corruption and fosters cost savings, as well as reduction of waste.
17	The inclusion of TVD into contracts and organisation policies aid its successful implementation, as do incentives and motivation (pain, gain and share), as well as training.
18	Academic partnerships and support from professional bodies are needed for the successful implementation of TVD in the NCI.
19	The need to reduce cost, waste and rework is the major motivation for the implementation of TVD.

20	The most important value attributes for the study population were security, financing and rent instalment plans, the size of rooms, safety and finishing quality. Meanwhile, the least desired value attributes included parking areas, community centres, more rooms, and business opportunities.
21	It is evident that it will be difficult to implement TVD without a guide to help construction stakeholders and practitioners; this prompted the development of the FFITVD.
22	The study recognised that the implementation of FFITVD promotes long-term healthy working relationships between team members, even after the project is completed.
23	The implementation of FFITVD improved the construction process of organisations where it was implemented.
24	The study shows that trust, transparency, responsibility and the ability to use real-time technology are essential requirements for team members to ensure the success of TVD.
25	The study revealed that FFITVD can be applied in the Nigerian construction industry and other countries with similar contexts.
26	The FFITVD stages, steps and components are appropriate and complete enough to support the implementation of TVD globally.

8.4 Conclusion on Research Objectives

This section discusses how the six research objectives of the study were achieved as well as the conclusions reached on each research objective in the following sections.

8.4.1 Research Objective 1

To understand the need for value creation in construction within the literature

The aim of objective one is to explore and understand the need for value creation in the construction industry. To achieve this aim, publications on value, value creation, value management, lean construction and the construction industry were reviewed in chapter 2. This revealed that stakeholder fulfilment and successful outcomes have been realised in the construction industry through value creation. Literature established that the success of many projects is linked to the initial agreement of value propositions, also; value creation for stakeholders is the fundamental purpose of projects. It was established that the construction industry is globally regarded as highly inefficient and lacking when delivering value. The literature on value creation reveals it is still an unclear and confusing concept with insufficient research which has raised inconsistencies that impede a general understanding of the concept, one which could find synergy in current thinking throughout several disciplines. However, the literature established that LC and VM are considered as practices that improve value creation for clients and stakeholders in construction. The study showed that although LC and VM are used interchangeably having the same objective of delivering value, they differ in philosophy and scope in various areas. Finally, also revealed that TVD is identified as the practise whose principles not only have roots in both disciplines, but also that which encompasses the strengths of LC and VM. TVD serves as a platform for value identification (what is needed), value proposition (planning what is needed) and value delivery (achieving what is needed) by generally addressing construction challenges to eventually create value.

8.4.2 Research Objective 2

To review the literature on the current theoretical understanding and application of Target Value Design in construction.

The aim of this objective is to critically review the current theoretical understanding and application of TVD in the construction industry globally. Publications on TVD were reviewed, together with IGLC publications, published between 1998 and 2018. The literature review in chapter 3 shows that TVD is a lean practise which serves as a strategic pathway for using collaboration to drive design, eliminate waste, and satisfy the client's expectations. It is the term given to the 2007 adaptation of target costing from the manufacturing to the construction industry by Macomber, Howell and Barberio. The literature review establishes that the advancement of TVD is evident in the current report of TVD implementation across the globe. TVD research is largely focussed on the level of industry awareness, its adoption, and the contributions to theory and practice from studies on TVD from around the world.

It is now being used as a medium for supporting greater collaboration, cost reduction, cost certainty, and the delivery of products with higher added value during design and construction at a Target Cost set below the Market Price. Over 150 cases of TVD implementation with various degrees of success have been reported. This shows that TVD has continued to evolve significantly in construction. This is confirmed by the integrated nature of Target Value Design, and its involvement with other concepts such as BIM, Last Planner®, Set-Based Design alternatives, A3 reports, Choosing by Advantage, Value Engineering, Cost Modelling, and Value Stream Mapping, among others. Regardless of its advancement, the literature reveals limited attempts to measure the levels of collaboration and achievement in value-generation on TVD projects, Previous researchers worldwide have presented TVD approaches and processes which focus more on the pre-design and design stage of projects, which is not all-inclusive. Literature suggests more research on TVD is needed on wider applications in various project types for evidence-based decisions regarding its adoption/adaptation in the construction industry, especially in developing countries.

8.4.3 Research Objective 3

To explore; the current design management practices in relation to TVD, the awareness of TVD, the feasibility of TVD and value creation in the NCI

The aim of objective 3 is to identify the current design management practices in the NCI in relation to TVD, the awareness of TVD, the feasibility of TVD and value creation. To achieve this, the researcher conducted 26 interviews with construction professionals from the four geographic zones; distributed 208 survey questionnaires, of which 112 returned by professionals from the NCI; and observed 13 projects, from which data on current design management practices, the awareness of TVD and the feasibility of TVD were gathered from major sectors (building, ancillary and infrastructure works).

In chapter 5, research results revealed that the term TVD is not used in the NCI; however, some fundamental TVD practices recognized in the literature partially align with current Nigerian design management practices. A few of the benchmarks appear to be applied to an extent, while some are not applied at all. The study reveals that the current practice in the NCI, as observed in major sectors, show most TVD principles have not been fully explored. The application of the core features of TVD benchmark and practices that could illustrate how many benefits are lacking. This has hindered the achievement of the significant benefits of TVD implementation as reported in the literature.

8.4.4 Research Objective 4

To identify the benefits, drivers, barriers, impacts, support and success factors of implementing TVD at all stages in the NCI.

To achieve objective 4, three comprehensive case studies comprising a building, ancillary and infrastructure projects were carried out. Results were achieved from data collected through interviews, surveys, and observations. In chapter 6, research findings established the benefits, drivers, barriers, impact, support and success factors of implementing TVD at all the stages of the project. The barriers/challenges were grouped into cost issues, collaboration problems, adoption problems, lack of common understanding, legal issues, organisational problems, and time-related problems. The study concluded that various factors considered under this categorisation were linked to challenges peculiar both to the NCI and to the industry globally, as mentioned in the literature. The study revealed that these challenges had a negative impact on the project and, if they were not mitigated, they could have impeded the successful implementation of TVD.

The benefits were grouped into economic benefits, social benefits, process benefits and educational benefits. Some of the aspects identified that aid the successful implementation of TVD are: early participation in the project by key stakeholders; organisational support and senior management buy-in; inclusion of TVD in management or organisational policies/contracts; selection of a competent integrated team; co-location and virtual collaborative practices; the presence of facilitators; training, incentives/motivation and review of work done; and monitoring and control.

All of these reflect the positive outcome of TVD implementation. The study confirmed that TVD implementation has a positive impact on projects with regard to improvement in the timely delivery of projects; the delivery of projects below target cost; a significant reduction in change orders/variations; efficient working relationships; better collaboration and understanding of processes; and the achievement of stakeholder satisfaction/values.

8.4.5 Research Objective 5

To develop and test a framework for the successful implementation of TVD in the NCI for enhancing value creation

The aim of this objective is to develop and test a framework that will serve as a guide to aid construction stakeholders and provide awareness to prospective users on the scope of information required to effectively implement TVD. Figure 8.1 shows the process used in achieving objective 5. Three detailed case studies were carried out over a period of eleven months to achieve this objective. In chapter 7 the Framework for Implementing Target Value Delivery (FFITVD) was developed and evaluated by the researcher using academic reflection and then tested on another case study. The framework was re-evaluated using internal and external evaluation with a total of 23 construction industry professionals. Previous researchers worldwide have presented TVD approaches and processes which focused more on the pre-design and design stage of projects, with few details on the other stages, which is not all-inclusive. This framework identifies the life cycle of a project, categorized into the following stages: project initiation, planning, execution, monitoring & control and closing. It also offers a detailed step-by-step process of implementing TVD at all the stages of a project and highlights the likely benefits, support, drivers, as well as the project mindset required for the success of TVD. It also notes the likely challenges that can obstruct TVD success.

The FFITVD was refined four times - from version 1 to 4 - based on the feedback received from the participants of the evaluation and the case study implementation experience. The evaluation report indicated that the framework is comprehensive enough to be understood by stakeholders and has the capability of sustaining the implementation of TVD in the NCI. It also shows that the framework can be used in other countries. A guiding document to support the use of the FFITVD was developed as part of the feedback from the evaluation (see Appendix 19).

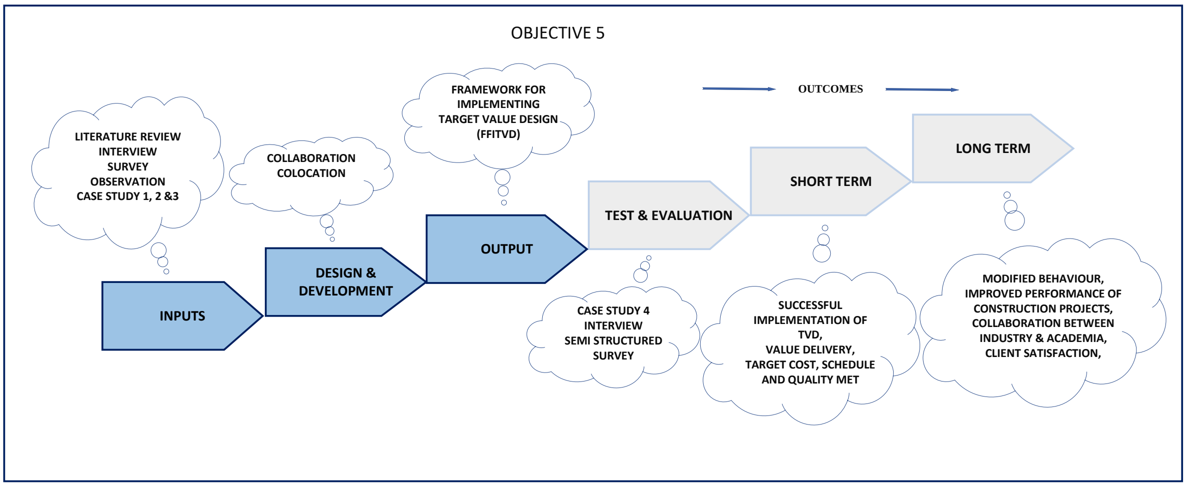


Figure 8.1 Fulfilling objective five

8.5. Conclusion on the Research Questions

This section presents the two research questions and how they were answered. The conclusions of both research questions are presented below.

Research Question I:

How does the current application and understanding of target value design in the Nigerian Construction industry align with the theories of TVD?

Research Question II:

How can construction stakeholders be supported using a framework for the successful implementation of TVD for enhancing value creation?

The first research question was answered through the achievement of objectives 1 to 6. To be precise, results show that the current understanding and application of the target value design in the NCI barely align with the underlying theories of TVD. The second research question was answered through the achievement of the development and testing of a framework named FFITVD. The outcome of the evaluation process proved that FFITVD was a good innovation that had the potential to support construction stakeholders to successfully implement TVD

8.6 Contribution of Research to Knowledge

This research has made several contributions to the existing body of knowledge in construction project management, value creation in construction, lean construction, the NCI, and specifically to the upcoming implementation of TVD in construction. The contribution to this thesis is categorised into theoretical and practical contributions.

8.6.1 Contribution to Theory

The contribution to theory is demonstrated in Table 8.2.

Table 8.2 The contribution of this study to theory

SN	CONTRIBUTION	DISCUSSION
1	**The development of a framework**:	Extant literature shows no record of a comprehensive framework for the implementation of TVD which details all the project life cycles from initiation to closing. This study developed a framework to fill the knowledge gap in the NCI. The framework has the potential to support construction stakeholders by making construction industries more efficient by adding value, reducing waste, and reducing cost and time overrun. The framework merges TVD steps with the PMI process for better understanding and management. It also establishes that targets do not just mean cost but include time, quality and stakeholder value.
2	**Highlighting perceived benefits, barriers,**	This study has succeeded in highlighting a comprehensive list of benefits, tools and techniques, barriers, drivers, supports, success factors and the

	drivers, supports, success factors:	project mindset required for the successful implementation of TVD in one document.
3	**Testing the different levels of collaboration:**	The study was able to test the five levels of collaboration in three different case studies to explore and expose the current shortfalls of collaboration when applying TVD in the NCI.
4	**Identification of the misalignment between the current design management practices in the NCI and the underlying TVD theories**:	This shows the level of understanding and practice of TVD in the NCI and gives a perception of the kind of support needed for successful implementation.

8.6.2 Contribution to Practice

The contribution to practice in construction project management and lean construction practice globally is demonstrated in Table 8.3 below

Table 8.3 The contributions of this study to practice

SN	CONTRIBUTION	DISCUSSION
1	**Implementation of the TVD benchmarks and practices in the NCI:**	The significance of this contribution is that it is the first recorded case of TVD implementation in the NCI. TVD benchmarks and practices were implemented in four case study projects. These projects cut across the design and build and traditional procurement routes.
2	**Application of TVD in the traditional procurement route:**	The application of TVD in case study 2 and 3 provided empirical evidence of the implementation of TVD in the traditional procurement route. This proves that TVD practices can be applied in both contract types.
3	**Application of TVD in selective and competitive tenders:**	The originality of this contribution is the ability of the TVD facilitator to bring competing contractors to participants in the design stage of a project even before the award of contracts. This study demonstrated that it is possible for key project stakeholders, such as the contractors and suppliers, to participate early in a project during TVD

		implementation through tender criteria that included TVD principles to selective and competitive tenderers.
4	**Implementation of TVD in the construction and closing stages of the project (to provisional and prime cost sums):**	This contribution relates to the implementation of TVD in the construction and closing stages of a project. In case study 3, which was a public construction contract, the main contractor and other key project stakeholders did not participate in the business case and design processes but were handed a contract document with some design items quoting lump sums instead of detailed cost data. The team broke down and designed the provisional and prime cost sum to target. This project was able to apply TVD not at the project initiation or planning stages, but at the construction and closing stages of the project. This another innovation of this research.
5	**Implementation of the developed framework in a case study:**	The TVD framework that was developed was successfully tested and evaluated in case study four. This is another contribution to the existing body of knowledge and practice.

8.6.3 Research Publications

This research has developed and published the following papers as an input of this research to the construction project management, value creation and lean construction body of knowledge.

Conference paper

Musa, M.M., Pasquire, C., and Hurst, A. (2016). "Where Lean Construction and Value Management Meet." In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction, Boston, MA, USA, sect.1 pp. 103–112. Available at: <www.iglc.net>.

Musa, M., Pasquire, C. & Hurst, A. 2019, 'Using TVD Simulation to Improve Collaboration' In: *Proc. 27th Annual Conference of the International Group for Lean Construction (IGLC)*. Dublin, Ireland, 3-5 Jul 2019. pp 503-514. Available at: <www.iglc.net>.

Plan for Publication

i. Determination of the most preferred Value of Construction industry stakeholders.

ii. A case for Design Science Research in the Construction industry
iii. TVD in bid process
iv. An exploratory study into the current design management practices and awareness of TVD in the NCI
v. Implementation of TVD in the NCI
vi. Development of a Framework for implementing TVD (FFITVD)
vii. Evaluation, testing and re-evaluation of the framework for implementing TVD
viii. The influence of procurement on the implementation of target value design in construction.
ix.

8.7 Limitations of the Research

Some limitations have been observed in the course of the research. The research limitations include:

a. The main limitation of this research is the limited literature on TVD implementation outside the U.S.A. This limitation posed a big research challenge in this study, making it difficult to conduct a comprehensive review of TVD implementation in Nigeria and Africa.
b. It was difficult to convince the construction industry practitioners in Nigeria to implement TVD, possibly because they are not familiar with the concept.
c. The study was conducted in Nigeria, with case studies selected only from Nigeria, and so this research and its results are limited to the Nigerian context. Although, it is believed that countries with similar characteristics will likely yield similar findings.
d. The evaluators of the developed artefacts were drawn only from the United Kingdom and Nigeria. This implies that the evaluation may not have a wide enough perspective.

8.8 Research Recommendations

This study explored and tested the application of target value design in the NCI with the view to enhancing value creation and has developed a framework to enhance the implementation of TVD in construction and revealed opportunities for further research. The study also makes some recommendations for construction industry stakeholders.

8.8.1 Recommendations for Construction Industry Practitioners

The following recommendations are made for construction industry practitioners and stakeholders based on the result of this study:

a. The organisation should endeavour to include TVD benchmarks and practices in its policies and contract agreements before engaging staff and contractors.
b. Practitioners should engage in frequent training, workshops and seminars to create awareness of TVD and align stakeholders' mindsets with those of TVD.
c. Collaboration should be fully embraced.
d. Practitioners should ensure that stakeholders' values are identified to form the basis of design; this will guarantee their values.
e. Practitioners should ensure that the site is visited to align designs with site conditions.
f. TVD simulation, developed at Texas A&M University, should include discussion of levels of collaboration, especially after the first round to show the differences between environments with collaboration and those without.
g. Different incentives and motivation schemes should be adopted (researched) to induce stakeholder participation differently from the pain and gain share already practised by TVD practitioners in the USA
h. Alternative construction coordination activities should be explored in cases where the team is not conversant with Benchmark 12 (Last Planner) of the TVD developed by Ballard.
i. Client buy-in and presentation should be prioritised at the initiation of the project.
j. Practitioners can proceed to construction even if expected cost is more than target cost if there is a perceived possibility of reducing the cost further during construction.

8.8.2 Recommendations for Further Research

There are several prospects for further research to build on the conclusions of this study, some of which are itemised below:

i. Further research should be directed at stipulating more TVD benchmarks that focus on the construction and closing stages of projects. This is because the established benchmarks focus mainly on the project initiation, planning and design stages.

ii. The developed framework should be implemented in other countries for its further generalisability.
iii. The developed framework should be implemented in procurement routes other than the traditional and design & build used in this study.
iv. Findings from this study reveal that a lack of collaboration at all levels of product development is one of the major barriers in the implementation of TVD, largely due to the adversarial nature of the construction industry. Future studies should focus on enhancing collaboration, especially virtual collaboration, in construction.

8.9 Chapter Summary

This chapter has discussed the research conclusion on each study objective and the research questions; it has further discussed the research's contribution to theory and practice. It concludes with the study limitations and recommendations for further research. The main contribution of this study is the framework that has been developed and expanded over and beyond what has been done before, with the additional embedded processes and strategy enhancing its contribution. It supports embedding the process in organisations through its steps and its continuous improvement of the process cycle. It has identified related organisational, cultural and background issues, which have not been addressed by other frameworks. The framework developed herein is a contribution in terms of how it was designed and how it serves as a solution to unsolved problems.

The major conclusion is that value creation can be improved using a more structured process. Most of the waste in the construction process can be moderated because value creation can be improved; a different approach is required, and that is what this research has developed. This study concludes that problems associated with value creation can be overcome by the developed framework, which is an expansion of previous models. Value can be created by the correctly structured techniques, approaches, the appropriate training and the creation of the right mindset.

Upon completing the research, it is important to note that the framework has been well received by industry stakeholders. There have been changes in the industry because of this research. It has improved projects outside the research, and it is continuing to develop and influence practice in Nigeria, research in the US and academics in the UK. The framework is regularly being used by practitioners in the NCI and professional bodies in Nigeria, researchers in other countries, such as the Texas A&M University in the USA, who are interested in this research and have requested possible collaborative work in the future on how TVD is used in the bidding process. A senior lecturer in NTU has requested a copy of the card game used in this thesis, which he intends to make use of for his lectures.

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APPENDICES

Appendix 1: Sample of Semi-Structured Interview guide

Research Title: The Application of Target Value Design in Nigeria.. Construction Industry

The interview consists of 18 open and closed-ended questions, which are divided into 5 themes covering the Respondents Background information; Current Design Management Practices in the Nigerian Construction Industry (NCI); Awareness and practice of Target Value Design (TVD) in NCI.; Cost related practices and Feasibility of TVD in NCI. The aim is to identify how the current cost and design practice in NCI relate to TVD benchmark, principles and essential practice**.**

❖ **<u>Respondents Background:</u>**

This section aims to obtain general information of the interviewee:

1. What is your professional background?
2. What organization do you belong to?
3. How long have you been in practice?
4. What is your geographical location in Nigeria?

❖ **<u>Current Design Management Practices and how close is it to TVD in NCI:</u>**

This section aims to identify the current design management practices carried out by professionals in the NCI. Information on the current problems/practices will help the researcher to develop and validate a framework to support the application of TVD in NCI to enhance value creation.

5. What design practice do you use to deliver exactly what the clients in your projects demand?
    - ✓ Architects/civil/structural designs then an estimate is built up –
    - ✓ compile cost to a design
    - ✓ Architect designs then the other designers base their designs on the architect's design
    - ✓ First, a detailed estimate is built up then a design is made in line with the estimate.
6. What challenges/problems do you encounter with the traditional cost estimating practice during projects (i.e. design estimate rework) in terms of cost, quality and time targets?
7. How do you determine the target cost for your project?
    - ✓ When estimated cost is more than the budgeted cost at the design stage, how do you achieve cost reduction?
    - by sacrificing scope, functionality or quality intended?
8. What type of procurement do you do?

- ✓ Design bid build
- ✓ Design and Build,
- ✓ Partnering
- ✓ Management Contracting
- ✓ Target Costing Contract

9. Who is involved during design?
   - ✓ Do they stay in the same room during design?

10. Are targeted Scope and cost further allocated to each individual design team member during design so they can design to cost?

❖ **<u>Awareness and Practice of TVD in the NCI</u>**

This section aims to ascertain your experience and current design practices in relation to Target Value Design. These questions seek to establish what practices are adopted and to what extent.

11. Are you familiar with any of the following
    - ✓ Target Value Design
    - ✓ Value Engineering
    - ✓ Target Costing

12. Do you take part in the business case preparation of proposed projects?
    - ✓ What does it normally entail?
    - Do you consider life cycle cost?
    - Does it include Limitations on the customer's ability to fund the investment required to obtain life cycle benefits?

13. How often do you conduct feasibility studies before projects are set off?
    - Do all key members participate in the feasibility studies?
    - Is a detailed budget/schedule aligned with scope and quality requirements?
    - Is it assessed by aligning what's wanted, conceptual design and constraints (time, cost …etc)?

❖ **<u>Cost Related Practices</u>**

This section aims to identify the respondents' views on certain cost-related practices and their implications. Information obtained will help the researcher in establishing the current application of TVD.

14. Do you estimate budgets through collaboration with team members?
15. When project targets are set does it encourage innovation?
16. Do you use value engineering to support target costs?
17. Which stage do you involve the quantity surveyor?

❖ **<u>Feasibility of TVD in NCI</u>**

This section looks at the respondent's perception of the feasibility of TVD in the NCI. It would help the researcher in developing a framework for the application of TVD in the industry.

18. Would you be willing to try out TVD, which aims to increase affordability while improving the effective quality of project performance?

- ✓ Do you think it would add value to your projects?
- ✓ Would you recommend it to your clients?

19. What challenges do you think you would face when implementing TVD in your projects:

Appendix 2: A copy of the ethical approval letter from College Ethical Committee

JICEC Approval: An Exploratory Study on the integration of Lean principles and Value Management to enhance client value creation.

Dossor, Sarah <sarah.dossor@ntu.ac.uk> Fri, Jul 24, 2015, 2:27 PM

to Muktari, Claire

Dear Muktari

I am pleased to inform you that the JICEC was happy to confirm that in its judgement there were no outstanding ethical concerns that required further discussion or exploration prior to data collection related to your application: An Exploratory Study on the integration of Lean principles and Value Management to enhance client value creation.. The committee would like to wish you well in the completion of your project.

Please note that your risk assessment document has been referred on to Dr Andrew Knight for approval.

Best Regards,

Sarah Dossor
Research Office Team Leader
Maudslay 312
College of Art, Design and Built Environment

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Burton Street
Nottingham NG1 4BU

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Appendix 3: Sample of Consent Form and Invitation to participate in Interview

Information Sheet

CONSENT FORM

Title of research: Exploring the application of Target Value Design in the NCI with the view to enhance value creation.

Name: ______________________ Please initial box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason.

3. I agree to take part in the study.

Please tick

Yes/No

4. I agree with the interview being audio recorded.

5. I agree to the use of anonymised quotes in publication

Name of participant: Date: Signature:

Muktari Musa (Researcher) Date: Signature:

Muktari Musa

Doctorate researcher

School of Architecture, Design and the Built Environment

Nottingham Trent University

muktari.musa2012@my.ntu.ac.uk

Dear Sir/Madam,

Re: Dissertation- Doctor of Philosophy in Project Management (Construction)

I am presently undertaking a Doctor of Philosophy at the Department of Architecture and Built Environment, Nottingham Trent University UK. As partial fulfilment of my degree I am undertaking research focused on design and cost practices by exploring the application of some of the latest techniques (Target Value Design) in the Nigerian construction industry using case study with the view to enhance Value Creation and I am seeking for your support for this study.

The most important source of information will come from professionals, such as you within the construction industry. I would be extremely grateful if you or any member of your organisation could discuss with me in confidence how your company approaches projects and programmes. The discussion would take about an hour. Also, I assure you that the information provided will be used in the thesis for statistical analysis and tabulations, individuals or their firms will not be identified. To ensure any concerns, confidentiality is taken account of as part of the interview fieldwork process, the Nottingham Trent University has a confidentiality agreement available if required.

A copy of the report will be available for co-operating firms. However, we would also be pleased to discuss the generic outcomes of the research with you once the study is completed, and, intend to write a publication on the outcome of the research when the fieldwork is complete. We would be very pleased if you could attend. Information will be forwarded in due course.

Please do not hesitate to contact me on my mobile {UK: +447436554017; Nigeria +2348037875017} or email provided below if you would like to discuss the research in more detail. I will contact you directly to arrange an interview at your convenience.

Thank you for valuable time. Yours faithfully

Research Student:
Muktari Musa
Graduate Student
School of Architecture, Design and the Built Environment
Nottingham Trent University
muktari.musa2012@my.ntu.ac.uk

Supervisor:
Prof. Christine Pasquire,
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Supervisor:
DR. Alan Hurst,
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Appendix 4: A sample of the survey (Phase 3)

NOTTINGHAM TRENT UNIVERSITY

The Application of Target Value Design (TVD) in the Nigerian Construction industry (NCI).

Welcome to the survey on exploring the application of Target Value Design (TVD) in the NCI

Dear Participant,
You are invited to take part in a research project focused on design and cost practices by exploring the application of some of the latest techniques (Target Value Design) in the Nigerian construction industry.

BACKGROUND
I am presently undertaking a Doctor of Philosophy at the department of Architecture and Built Environment, Nottingham Trent University UK. As partial fulfilment of my degree I am undertaking research into exploring the application of Target Value Design (TVD) in the Nigerian construction industry using case study with the view to enhance Value Creation and I am seeking for your support for this study. The most important source of information will come from professionals, such as yourself within the construction industry. I would be extremely grateful if you or any member of your organisation could complete the attached questionnaire and return it in the addressed, prepaid envelope or email address provided at your earliest convenience. If you decide to take part, the time for completing the questionnaire should take about fifteen minutes.

Instructions for the Participants
Participating in this survey is entirely voluntary and you are free to withdraw at any time. All information provided will be treated with strict confidence and full anonymity of participants will be ensured during the collection, storage and publication of research material in accordance with Nottingham Trent University's policies and procedures.

Consent
-I have read the Participant information Sheet
-I understand the purpose and nature of the research
-I understand that i can withdraw from the research at any time without any repercussions.
-I understand that although information gathered for the research could be published, my participation will not be identified and my personal input will remain anonymous.
-I am over 18 years of age
-By completing and returning this questionnaire, I am consenting to participate in this research project carried out by Muktari Musa of Nottingham Trent University, UK.
Contact for Further Information: If you have any concerns about the way in which the study has been conducted, do not hesitate to contact us.
Thank you for your valuable time.

Muktari Musa,	Prof. Christine Pasquire,	Dr. Alan Hurst,
Post-Graduate Student,	Senior Lecturer,	Senior Lecturer,
Mail:muktari.musa2012@my.ntu.ac.uk.	Mail:christine.pasquire@ntu.ac.uk.	Mail:alan.hurst@ntu.ac.uk
UK: +447436554017,		
Nigeria: +2348037875017		

Nottingham Trent University,
School of Architecture and Built Environment,
Burton St, Nottingham,
United Kingdom, NG14BU,

Date: November, 2016

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The Application of Target Value Design (TVD) in the Nigerian Construction industry (NCI).

Section 1: Respondents Background

1. What is your professional Background?

- [ ] Quantity Surveyor
- [ ] Project Manager
- [ ] Civil Engineer
- [ ] Architect
- [ ] Contractor
- [ ] Lecturer
- [ ] Electrical Engineer
- [ ] Mechanical Engineer
- [ ] Client
- [ ] Consultant
- [ ] Subcontractor
- [ ] Supplier
- [ ] Construction Manager
- [ ] Other (please specify)

2. What Organization do you belong to ?

- [ ] Government
- [ ] Private Architectural Firm
- [ ] Client
- [ ] Private Quantity Surveying Firm
- [ ] Private Engineering Firm
- [ ] Contractor
- [ ] Private Developers
- [ ] Professional body
- [ ] Academia
- [ ] Project Management
- [ ] Other (please specify)

3. What is your geographical location in Nigeria ?

- North
- West
- East
- South

4. How long have you been in practice?

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The Application of Target Value Design (TVD) in the Nigerian Construction industry (NCI).

Section B: Current Design Management Practices in the NCI

This section aims to identify the current design management practices carried out by professionals in the NCI. Information on the current problems/practices will help the researcher to develop and validate a framework to support the application of TVD in NCI to enhance value creation.

5. Based on your work experience, can you please select to what extent you practice the following cost estimating techniques during design.

	Never	Rarely	Sometimes	very often	Always
Cash flow forecasting	○	○	○	○	○
Cost scheduling	○	○	○	○	○
Cost budgeting	○	○	○	○	○
Traditional cost planning	○	○	○	○	○
Cost reporting	○	○	○	○	○
TVD	○	○	○	○	○
Target costing	○	○	○	○	○
Value engineering	○	○	○	○	○

Other (please specify)

6. Please indicate your level of agreement regarding these issues relating to design practices in your organisation.

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Disagree	Strongly Disagree
Projects normally exceed cost targets	○	○	○	○	○	○
Projects normally exceed time targets	○	○	○	○	○	○
Cost estimates are usually more than the client can bear which leads to altering the project scope to meet project budget	○	○	○	○	○	○
Design is done within individual discipline	○	○	○	○	○	○
Client and stakeholders are permanently involved in assessing what is value and how that value is produced during the design process	○	○	○	○	○	○
There is little interaction among designers which results in design errors and construction rework	○	○	○	○	○	○
It is very difficult to obtain accuracy of the target cost	○	○	○	○	○	○
When estimated cost is more than budgeted cost at design stage, cost reduction is achieved by sacrificing scope, functionality and quality.	○	○	○	○	○	○

7. Based on your current management practice in construction projects. please indicate how often you encounter the practices below.

	Never	Rarely	Sometimes	Very Often	Always
The architect, electrical, mechanical, structural engineers and cost estimators all stay in the same room during design.	○	○	○	○	○
Work is carried out during detailed design concurrently in small teams face to face	○	○	○	○	○
The project design and details are carried out with the customer who will use it	○	○	○	○	○
All designers are involved from the initial design, architect, engineers, landscape...etc.	○	○	○	○	○
suppliers are involved during the design stage	○	○	○	○	○
subcontractors are part of the design stage	○	○	○	○	○
In the early design stage process, the allowable project cost is identified by subtracting the desired profit margin from the expected selling price.	○	○	○	○	○
Architects/civil/mechanical and electrical designs are prepared then an estimate is built up.	○	○	○	○	○
Architects design then other designers' base their designs on the architects' design.	○	○	○	○	○
First a detailed estimate is built up then a design is made in line with the estimate	○	○	○	○	○

8. Please indicate how often the following are done as part of the current design practice in your organisation.

	Never	Rarely	Sometimes	Very Often	Always
All team members understand the business case and stakeholders values.	○	○	○	○	○
he architects, service engineers, structural engineers, quantity surveyors and clients all come together at the same time to discuss cost, quality and schedule	○	○	○	○	○
A form of relationship and trust is maintained between all parties involved to align their interests with project objectives.	○	○	○	○	○
Cost estimates and basis of estimates (scope) are updated frequently.	○	○	○	○	○
Targeted Scope and cost are further allocated to each individual design team member during design so they can design to cost.	○	○	○	○	○

9. During project design, how many design team members do you work with in your organisation.

Other (please specify)

10. In your opinion, to what extent do these pre-construction practices meet the expectation of clients in terms of value for money? Please tick the appropriate one.

	Excellent	Average	Below Average	Poor	Not at all
Design	○	○	○	○	○
Predictability of cost	○	○	○	○	○
Quality standards	○	○	○	○	○

11. Can you please indicate your level of agreement based on the statements below.

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Disagree	Strongly Disagree
Last planner system is used to coordinate team members	○	○	○	○	○	○
All project team members share mutual ○ information formally	○	○	○	○	○	
Project planning is done based on shared understanding with all team members	○	○	○	○	○	○
Formal roles and communication procedures that must be adhered to clearly are set in place.	○	○	○	○	○	○
Common information is shared informally with all team members	○	○	○	○	○	○

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The Application of Target Value Design (TVD) in the Nigerian Construction industry (NCI).

Section C: Awareness and Practice of TVD in the NCI.

This section aims to ascertain your experience and current design practices in relation to Target Value Design. These questions seek to establish what practices are adopted and to what extent.

12. Do you take part in the business case preparation of proposed projects?

- ◯ Never
- ◯ Rarely
- ◯ Sometimes
- ◯ Very Often
- ◯ Always

13. Based on your practice in your organisation, please can you specify what the project business case normally entails from the options below.

	Never	Rarely	Sometimes	Very Often	Always
The customer or client develops and evaluates the project business case with the help of all key project team members and decides whether to fund a feasibility study partly based on expected profit.	◯	◯	◯	◯	◯
The business case is based on a forecast of facility life cycle cost and benefits derived from an operations model.	◯	◯	◯	◯	◯
Limitations on the customer's ability to fund the investment required to obtain life cycle benefits are included in the business case.	◯	◯	◯	◯	◯

14. In your projects, how often do you conduct feasibility studies before projects are started.

◯ Never

◯ Rarely

◯ Sometimes

◯ Very Often

◯ Always

15. Please, based on your work practice, can you select from the following options below.

	Never	Rarely	Sometimes	Very Often	Always
All key members participate in the feasibility studies	◯	◯	◯	◯	◯
A detailed budget aligned with scope and quality requirements is produced from the feasibility study	◯	◯	◯	◯	◯
A detailed schedule aligned with scope and quality requirements is produced from the feasibility study	◯	◯	◯	◯	◯
Feasibility studies are assessed by aligning what's wanted	◯	◯	◯	◯	◯
Feasibility studies are assessed by designing for construction	◯	◯	◯	◯	◯
Feasibility studies are assessed by aligning constraints (cost, time, location etc.)	◯	◯	◯	◯	◯

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The Application of Target Value Design (TVD) in the Nigerian Construction industry (NCI).

Section D: Cost Related Practices during design.

This section aims to identify the respondents' views on certain cost related practices and their implications.Information obtained will help the researcher in establishing the current application of TVD.

16. Please, based on your work experience, Can you select from each of the following.

	Never	Rarely	Sometimes	Very Often	Always
Do you estimate and budget costs through collaboration with team members	○	○	○	○	○
When project targets are set, does it encourage innovative ideas/thinking that result to finding alternatives to achieve the target	○	○	○	○	○
Do you evaluate the design against the budget and the clients target values	○	○	○	○	○
When finalising designs, do you establish a routine for reflection and learning	○	○	○	○	○
Do you use value engineering to support achieving cost targets	○	○	○	○	○

17. During projects, at what point do you usually involve the cost estimator/quantity surveyor?

- ☐ Strategic Definition
- ☐ Preparation Brief
- ☐ Business Case
- ☐ Feasibility Studies
- ☐ Concept Design
- ☐ Developed Design
- ☐ Technical Design
- ☐ Construction

Other (please specify)

18. During projects, at what point do you establish the target costs of your projects?

- ○ Strategic Definition
- ○ Preparation Brief
- ○ Business Case
- ○ Feasibility Study
- ○ Concept Design
- ○ Developed Design
- ○ Technical Design
- ○ Construction

Other (please specify)

19. How do you establish the target cost of your projects?

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The Application of Target Value Design (TVD) in the Nigerian Construction industry (NCI).

SECTION E: FEASIBILITY OF TVD IN NCI

This section looks at the respondents perception on the feasibility of TVD in the NCI. It would help the researcher in developing a framework for the application of TVD in the industry

20. Please indicate your level of agreement with the following statements based on your experience.

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Disagree	Strongly Disagree
Designing to cost, increases cost certainty						
You would recommend a process aimed at increasing affordability while improving project delivery.						
You would adopt a management practice that aims to achieve the maximum value in a set target cost lower than the market benchmark price						
When cost is an input to design and the design process is a collaborative process constantly updating the cost to align client's requirement with their constraints (cost, features, time, etc,), it will reduce cost overrun.						

Appendix 5: Sample of the consent form for case study

Case Study Consent Letter Issued

Case Study Consent Form

Research Project: Exploratory Study into use of Target Value Design in the Nigerian Construction Industry with the view to enhance Value Creation.

Case Study Project:

Note: This consent form is to be retained by you and the researcher. Once the research has been completed, it should be disposed of in a secure manner.

Relevant data will be collected via:

- Documentary Evidence
- Observation
- Interviews

I agree to take part in the study

I understand that my participation is voluntary, that I can decide not to participate in part or all of the project, and that I am free to withdraw at any time during the project without being penalised or disadvantaged in any way.

I understand that details of the material discussed are confidential and agree not to disclose any of the information given to any other party.

I agree to the interview being audio recorded for the interviewer's

reference only.

I agree with the use of anonymised quotes in this thesis and other academic publications.

Participant's Name: ____________________

Signature: _____________________________

Date: __________________________________

Researcher	**Supervisory Team**
Muktari Musa Doctoral	Professor, Christine Pasquire Dr Alan Hurst

Nottingham Trent University

Appendix 6: A sample of the case study interview

Case Study Semi-Structured Interview

Semi-structured Interview

Project:

Exploratory Study into the use of Target Value Design in the Nigerian Construction Industry with the view to enhance Value Creation

Target populations and sample

- Senior-level managers
- Middle-level managers
- Bottom level managers

The underlying philosophy of the study:

The aim of this case study is to gather knowledge for the purpose of understanding

Section 1:

This section attempts to obtain background information on the organisation and respondents participating in the study.

Nature of organisation …………………………………………………………………

Nature of project ………………………….................…………………………………

Position in organisation ………………………………………………………………

Professional membership attained………………………….…………………….………………

Years of experience in construction ……………………….………………….………………

Section 2: Benefits

This section examines the benefits of the Target value design (TVD) on the design and construction process.

1. From your experience, what would you say are the major benefits of using TVD at the project initiation stage?
2. From your experience, what would you say are the major benefits of using TVD at the planning and design stage of your project?
3. What were some of the benefits of TVD during the construction stage of your project??
4. What were some of the benefits of TVD during the monitoring and evaluation stages of your project?
5. Did you experience any benefit of using TVD during the closing stage of the project? If yes, please state.

Section 3: Barriers

This section seeks to identify and categorise the barriers of TVD implementation in Nigeria construction industry.

6. What do you think were some of the barriers to TVD at the project initiation stage of your project?
7. Were there any barriers when implementing TVD at the planning and design stage of this project?

Section 4: Drivers

This section attempts to identify the drivers of TVD implementation:

8. What do you see as the core driver for implementing TVD during the project initiation stage in this project?
9. What are the drivers of TVD at the project planning stage of the project?
10. What do you think was the driver of TVD during the construction stage of this project?

Section 5: Success factors and Enablers

This section seeks to identify the success factors for TVD implementations in Nigeria construction industry.

11. Please mention the success factors of TVD implementation at the project initiation stage in your project.
12. Please mention the success factors of TVD implementation at the project planning stage in this project.
13. What were some of the crucial factors that enabled the implementation of TVD during the construction stage of this project?

Section 6: Impact

14. What are the impacts of implementing TVD during the project initiation stage in this project?
15. What are the impacts of TVD implementation during the project planning stage in this project?
16. What are the impacts of TVD implementation during the project execution stage in this project?
17. What are the impacts of TVD implementation at the monitoring and control stage of this project?
18. What are the impacts of TVD implementation at the project closure of this project?

Section 7: Support for effective implementation

This section seeks to identify the support needed for rapid adoption and implementation of TVD in the Nigerian construction industry.

19. What form of support do you think is required for the effective implementation of TVD at the project initiation stage in the Nigerian construction industry?
20. Can you suggest any support that was useful during the project planning and stage of your project?

Appendix 7: A sample of the interview transcript

Interviewer: Good afternoon Mr I, the MD of XXX Limited, as you already know, I am a researcher from Nottingham Trent University, I am here to conduct my interview on post TVD implementation at one of your sites, which is proposed construction of fire station, for the XXXX CLIENT, so do you consent to this interview?

Respondent: Yes, I do

Interviewer: It will be recorded. So how many years of experience do you have?

Respondent: 22 years in the field

Interviewer: What is the name of your organisation?

Respondent: XXX Limited.

Interviewer: So, what are you in this project?

Respondent: I am the Managing Director, Chief Executive Officer of the company

Interviewer: Are you the contractor of this project?

Respondent: Yes, I am. The main contractor

Interviewer: For this government /public sector construction.

Respondent: Yes

Interviewer: So now that we have implemented TVD, what are some of the benefits of TVD that you noticed, you know we didn't participate in the initiation and design stage or in the bidding process, we were called after you got the contract of the Ushafa project. We came during construction, during construction what are the benefits of TVD that you noticed?

Respondent: Well, the main thing is, we engage you when we were given the contract to look at areas where there might be faults, or anything to do with the bill and anything that can make the contract successful at the most minimal cost, so we invited you to come in and help us to identify the problems, if there are any problems with the bills and if there are any changes or variations and anything that has to be done. So that is where we invited you for your expertise. Also, we wanted to encourage teamwork, an approach which will create … We invited you to look at the provisional sum and identify areas we can reduce cost and areas that there are any corrections to be made because of your expertise. And then we were looking at saving cost and then also adding value to the design of the project. Also, we also look at harmonious working relationship, which encourages efficiency. More opportunity for participants to express opinions and concerns openly and freely was an area as well. And then minimum waste in the construction process was an area we wanted you to look at and help us solve if there is any issue there.

Interviewer: So, what you are saying is that we helped you, so did TVD benefit you, did we end up in getting cost savings?

Respondent: TVD really helped us, that was the best thing that actually happened to us in this project, because we were able to save a lot of money and we were able to get better corrections in all the areas, in the bill and the designs. Areas that were not well done and given to us by the client, TVD has made us save a lot of money and improve the construction and the project.

Interviewer: so, as you said, TVD helped in identifying problems, like how when you called us, we noticed that there are provisional sums which had no drawings and you immediately commissioned us to carry out a design but we should be careful because the government has given a particular amount for these provisional sums and prime cost sums, the government has already said there will be no variation, so you told us to find a way to design to that cost whereby you will be able to make profit from what the government had allowed. Which we did and we were able to design to that cost I may remind you.

So, Mr MD, also did TVD help in more collaborative and harmonious relationship with all the team members during construction?

Respondent: Yes, it helped a lot to complete stakeholders and all the people involved both the NDCA, my company and yourself the consultant. It brought a very good relationship and brought everybody together which we were able to identify mistakes and put our heads together and able to fix things.

Interviewer: If I may recall So Mr MD, the savings that were made from areas that we saved during the construction were used to pay for areas that were missing in the drawing, for example, you remember we did a generator house, we did interlock externally which the Government didn't pay us, they said we should look for a way of doing it, we expanded their spiral staircase from 600 to 900

Respondent: Yes we had a lot of things like full air-conditioning of the project was not involved in the bill, and due to TVD and your intervention, the fully air-conditioning of the project, intercom systems and other things we were able to be achieved because of the reductions which we got through you expertise and advise that was able to make us save money, and at the time make us be able to achieve what we want and make profit on this job.

Interviewer: Who do you think benefit more from this TVD?

Respondent: We obviously as a company benefit more because as a contractor at the end of the day you try to change money to be able to make maximum profit and at the same time do a very good standard job; which the authorities of the NDCA are very pleased with, and this wouldn't have been done without your expertise.

Interviewer: So, what do you think are some of the challenges of using TVD during the construction stage?

Respondent: We have traditional design practice of different stakeholder used to working in isolation lacking in interaction. Differences in organisation and ideas; and then procurement route, also the bidding process and outsourcing of the design was also an obstacle.

Interviewer: So if I may put in more light, the mechanical and electrical consultant that did the design was in Kaduna, so he was outsourced, so because he was not located in the same place with us we had to be going back and front, we had the challenge of trying to communicate with him, meanwhile the other contractors and your staff all were in the same place, this made things better. And also, I would ask again, would you say it was time-consuming?

Respondent: Time consuming as the product design cycle increases and the target costing system typically become more complex, so that is it. But at the end of the day with what we have been able to do and achieve by getting involve in TVD, we were able to meet up the target and time, put our head together and then we achieve the results we were meant to do.

Interviewer: as you mentioned before, some of the team members are not collocated in the same office, that was a challenge, difficulty in adoption by team members even you staff we had to conduct training and workshop for them because they were not aware of this or used to this new technique, but because of your buy-in, you made it as a policy, so they had to follow it. It was a challenge for us, I think that is it.

Interviewer: What do you think made us do TVD, what drove us to do TVD at the planning stage?

Respondent: Well the previous benefits of TVD implementation and success of the project, quest toward a common understanding and goal between all parties involved, demand for achieving our values as clients and making sure as contractors the clients see the value of what we have done. So, design criteria, cost schedule and constructability, all these things were what gave us a very good drive to do TVD in this project.

Interviewer: What do you think made us do TVD, what drove us to do TVD at the construction stage?

Respondent: we needed to maintain a predictable project cost and control the overruns of the project which TVD was made it possible for us to achieve that.

Interviewer: And then we achieve the cost below what market price was

Respondent: Yes, we were able to achieve a very good cost below the market price.

Interviewer: What of the need to reduce any changes, variation and rework, so because of coming together and interrogating the design and making sure that are missing are being put in

Respondent: yes, those are the things that made the project successful. You just mentioned it

Interviewer: So now that you are talking about success let's move over critical success factors. What are the things that need to be in place for TVD to succeed? Or what are the enablers that made TVD to succeed?

Respondent: Collaboration and early involvement and inputs of stakeholders. And then client and senior management that buy-in and got involved. Capable sponsors and leadership support, managerial support, formalised support structures, improvement on management strategies and contractual approaches to applying TVD. Then the adoption of benchmarks and tools are very important.

Interviewer: so, during the construction stage, what are other success factors that you think should be in place TVD to succeed?

Respondent: Value-driven designs adopted by the organisation, degree of integrated component team, supportive organisation. And then training, learning and simulations, workshop and training was very important and added a lot of importance to my company staff and myself and the management team. And then we had customer focus, stakeholder value proposition, accurate definition of the client value, and then cost modelling and real-time costing was very important as well, incentives and motivation, savings and risk-sharing. Commitment to TVD project success is very important as well. Then use value engineering proactively which was done.

Interviewer: so, do you say adherence to quality standard and constant review of work done will help TVD to succeed?

Respondent: Yes, it will, they are very important

Interviewer: what of the use of a facilitator? Somebody that will be in charge to help explain what TVD means

Respondent: Very, very important.

Interviewer: and the need for project target not to be exceeded.

Respondent: All-inclusive, very important.

Interviewer: So, what are the impacts of TVD that you noticed on this project?

Respondent: well TVD has giving us a very wonderful result because out of the three contractors that were awarded the same projects in three different locations, my company was able to be successful to become the best and fastest company to complete the project, so we did it and delivered ahead of the remaining two companies which was a very big plus to us. And it was because of the collaborative practices and putting our heads together work as a team. And then the budget and cost, we were able to save money because of TVD in different areas, which I don't think the other contractors were able to do the same thing because they did not apply TVD in what they were doing and our company was able to achieve very great success. And there was impact with change orders, variation and rework, value creation and stakeholders' satisfaction. So, this has given our company a very good experience.

Interviewer: As I believe even the design that we did on the provisional sums is the prototype that is what other contractors used

Respondent: Yes, we were, the clients were very happy with our job and decided to use our own fire station as the prototype for rest of the contractors to come and do exactly what we have done that makes us the best among the three.

Interviewer: Lastly, the last section is section 8, what is the support needed for implementation of TVD?

Respondent: We create awareness of TVD benchmarks, strategies and benefits at all levels, training and learning, workshop and simulations are all very important. Adding TVD to contract and organisational policy is something that is a very key thing that has helped us. Early involvement and engagement of all essential stakeholders, educational institutional support, industry and academic partnership support and select competent teams to work together. Awareness of previous challenges and enablers to succeed.

Interviewer: Thank you very much, Mr MD, you said it all, thank you for your time and for the opportunity you gave us to participate in your project after we approached you to let you know that this is what we wanted to use it for. Thank you for supporting the Researcher in your organisation.

Respondent: You are very welcome, and we look forward to working with you in the near future. We are very impressed.

Appendix 8: A sample of the case study survey

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TVD POST IMPLEMENTATION IMPACT SURVEY

Welcome to the survey on Evaluating the impact of the application of TVD in the NCI

Dear Participant,
You are invited to take part in a research project focused on assessing the impact of Target Value Design implementation in the Nigerian construction industry.

BACKGROUND
I am presently undertaking a Doctor of Philosophy at the department of Architecture and Built Environment, Nottingham Trent University UK. As partial fulfilment of my degree I am undertaking research into The Exploration and Testing of the Potential of Applying Target Value Design in Nigerian Construction Industry with the view to enhance Value Creation and I am seeking for your support for this study. This survey aims to assess the delivery and impact of Target Value Design on Time, Budget and cost, value creation, collaborative practices, quality and rework and finally on stakeholder satisfaction. The most important source of information will come from professionals, such as yourself within the construction industry. I would be extremely grateful if you or any member of your organisation could complete the attached questionnaire and return it in the addressed, prepaid envelope or email address provided at your earliest convenience. If you decide to take part, the time for completing the questionnaire should take about fifteen minutes.

Instructions for the Participants
Participating in this survey is entirely voluntary and you are free to withdraw at any time. All information provided will be treated with strict confidence and full anonymity of participants will be ensured during the collection, storage and publication of research material in accordance with Nottingham Trent University's policies and procedures.

Consent
-I have read the Participant information Sheet
-I understand the purpose and nature of the research
-I understand that i can withdraw from the research at any time without any repercussions.
-I understand that although information gathered for the research could be published, my participation will not be identified and my personal input will remain anonymous.
-I am over 18 years of age
-By completing and returning this questionnaire, I am consenting to participate in this research project carried out by Muktari Musa of Nottingham Trent University, UK.

Contact for Further Information: If you have any concerns about the way in which the study has been conducted, do not hesitate to contact us.
Thank you for your valuable time.

Muktari Musa, Post-Graduate Student, Mail: muktari.musa2012@my.ntu.ac.uk. UK: +447436554017, Nigeria:+2348037875017

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Nottingham Trent University,
School of Architecture and Built Environment,
Burton St, Nottingham,
United Kingdom, NG14BU,

Date : November, 2016

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TVD POST IMPLEMENTATION IMPACT SURVEY

Section A: Respondents Background

1. What is your professional Background?

- [ ] Quantity Surveyor
- [ ] Project Manager
- [ ] Civil Engineer
- [ ] Architect
- [ ] Contractor
- [ ] Lecturer
- [ ] Electrical Engineer
- [ ] Other (please specify)
- [ ] Mechanical Engineer
- [ ] Client
- [ ] Consultant
- [ ] Subcontractor
- [ ] Supplier
- [ ] Construction Manager

2. What Organization do you belong to ?

- [ ] Government
- [ ] Private Architectural Firm
- [ ] Client
- [ ] Private Quantity Surveying Firm
- [ ] Private Engineering Firm
- [ ] Contractor
- [ ] Private Developers
- [ ] Professional body
- [ ] Academia
- [ ] Project Management

3. What is your geographical location in Nigeria ?

- North
- West
- East
- South

4. How long have you been in practice?

3

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TVD POST IMPLEMENTATION IMPACT SURVEY

Section B: IMPACT AND DELIVERY ON TIME

This section aims to ascertain the impact of the TVD implementation on Time

5. We were able to deliver the project on or before scheduled time with TVD

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

6. TVD process consumed our time in the planning stage but helped us gain more speed in the execution stage.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

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TVD POST IMPLEMENTATION IMPACT SURVEY

Section C: IMPACT AND DELIVERY ON COLLARATIVE PRACTICES

This section aims to evaluate the impact of TVD on collaborative practices

7. Co-location improves communication and facilitates consensus decision- making among stakeholders

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

8. Harmonious working relationship is maintained which encourages a teamwork approach to innovative ideas in problem solving

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

9. Collective planning was important in implementing TVD in your project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

5

10. Use of cross-functional teams/cluster teams increased the efficiency of the TVD project.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

11. Stakeholder collaboration helped in setting targets.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

6

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TVD POST IMPLEMENTATION IMPACT SURVEY

SECTION D: IMPACT AND DELIVERY ON BUDGET AND COST

This section looks at the impact and delivery on budget and cost

12. Significant cost savings have been realized with the use of TVD practices in your project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

13. More cost certainty with TVD in your project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

14. Projects Delivered on budget cost

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

15. Target Cost Benchmarking helped control cost overruns.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

7

16. Outcome cost is substantially below market price—both achieved without sacrificing scope or quality

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

8

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TVD POST IMPLEMENTATION IMPACT SURVEY

SECTION E: IMPACT AND DELIVERY ON CHANGE ORDERS AND VARIATIONS

This section aims to evaluate the impact and delivery of TVD implementation on change orders and variations

17. Engaging the client and other stakeholders as key performers reduced change orders and variations.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

18. 14. TVD Reduces uncertainty on projects which in turn reduces the contingency required to absorb variability.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

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TVD POST IMPLEMENTATION IMPACT SURVEY

SECTION F: DELIVERY AND IMPACT ON SPECIFICATION, QUALITY AND REWORK

This section seeks to assess the delivery and impact of TVD implememtation on specification , quality and rework

19. The TVD process has enabled us to reduce the level and number of re-work on this project significantly.

- ◯ Very satisfied
- ◯ Satisfied
- ◯ Neither satisfied nor dissatisfied
- ◯ Dissatisfied
- ◯ Very dissatisfied

20. Results from TVD did not compromise quality and best quality was achieved despite designing to target.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neither agree nor disagree
- ◯ Disagree
- ◯ Strongly disagree

21. TVD Process brings more quality for the product delivered taking into account all stakeholder interests.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neither agree nor disagree
- ◯ Disagree
- ◯ Strongly disagree

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TVD POST IMPLEMENTATION IMPACT SURVEY

SECTION G: DELIVERY AND IMPACT ON VALUE CREATION

This sections aims to assess the delivery and impact of TVD on Value Creation

22. TVD has lowered the project cost by reducing waste and adding value

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

23. Better stakeholder value has been achieved with application of TVD

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

24. Better target -value was achieved by engaging with the client, designers and end users

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

25. 21. The TVD process and tools created the conditions for identifying and delivering the target -value from the design process during planning stage

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Dissatisfied
- Very dissatisfied

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TVD POST IMPLEMENTATION IMPACT SURVEY

DELIVERY AND IMPACT ON STAKEHOLDER SATISFACTION

This section seeks to assess the delivery and impact of TVD implementation on stakeholder satisfaction.

26. 22. I like working in this manner

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

27. 23. Co-location as practiced in TVD has improved my trust and confidence in other members of the project team

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

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Measuring Collaboration

Section B: measuring the five (5) levels of collaboration

This section aims to measure the five (5) levels of collaboration in the case study after this implementation of Target Value Design (TVD).

5. Based on your experience of TVD implementation on this project, kindly indicate your view on the following based on a 5-point Likert scale: Strongly Agree, Agree, Disagree, Strongly Disagree and Don't Know.

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Disagree	Strongly Disagree
During the design stage of the project all team members were located at the same place.	○	○	○	○	○	○
Team members belong to a single system	○	○	○	○	○	○
Team members have clearly defined roles	○	○	○	○	○	○
Team members have Loosely defined roles	○	○	○	○	○	○
All team members have somewhat defined roles	○	○	○	○	○	○
Information frequently shared by team members was characterized by mutual trust.	○	○	○	○	○	○
Team members had frequent prioritized communication	○	○	○	○	○	○
There was frequent communication without trust	○	○	○	○	○	○
There was just formal communication.	○	○	○	○	○	○
There was Little communication	○	○	○	○	○	○

4

	Strongly Agree	Moderately Agree	Slightly Agree	Slightly Disagree	Moderately Disagree	Strongly Disagree
All decisions are taken with mutual agreement of all team members before implementation	◯	◯	◯	◯	◯	◯
All team members have a vote in decision making	◯	◯	◯	◯	◯	◯
There was shared decision making among team members	◯	◯	◯	◯	◯	◯
All decisions were made independently	◯	◯	◯	◯	◯	◯
Data was shared in real time among team members.	◯	◯	◯	◯	◯	◯
Information was provided by team members to each other.	◯	◯	◯	◯	◯	◯
Team members Shared resources and ideas frequently	◯	◯	◯	◯	◯	◯
A real feeling of team work is in place with my work group.	◯	◯	◯	◯	◯	◯
Team members are distrustful of each other in my workgroup. The opinions and ideas of all team members are considered in my workgroup	◯	◯	◯	◯	◯	◯
The opinions and ideas of all team members are considered in my work group	◯	◯	◯	◯	◯	◯

6. Based on your experience on the implementation of TVD on this project, which of the following best describe your working relationship during the course of the project

- [ ] High Risk: Meaning I will be held highly responsible for the success or failure of the project
- [ ] No risk: Meaning the success or failure of the project is not my responsibility
- [ ] Increased risk. Meaning I will be held partly responsible for the success or failure of the project

7. Based on your experience on the implementation of TVD on this project, which of the following best describe your working relationship during the course of the project

- [ ] High level of commitment
- [ ] Little or no commitment
- [ ] Some level of commitment

8. Based on your experience on the implementation of TVD on this project, which of the following best describe your working relationship during the course of the project

- [ ] Formal
- [ ] Informal

9. Based on your experience on the implementation of TVD on this project, which of the following best describe your working relationship during the course of the project

- [ ] Shared decision-making process with each organisation
- [ ] Decisions made Independently by each organisation

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POST CASE STUDY TVD BENCHMARK IMPLEMENTATION SURVEY

Section B: LEVEL OF TVD BENCHMARK IMPLEMENTATION

This section aims to assess the level of implementation TVD benchmarks in the case studies observed during the course of the research work. Information on the level of implementation will help the researcher to develop and validate a framework to support the application of TVD in NCI to enhance value creation.

5. The customer/client developed and evaluated the business case with the help of the key project team members and decides to fund a feasibility study based on the gap between the project's allowable and market cost.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

6. The business case included forecast of facility lifecycle costs, allowable cost and specifications of the project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

7. Financing constraints were specified in the business case: limitations on the customer's ability to fund the investment required to obtain life cycle benefits.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

4

8. All key project team members participated in the feasibility study

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

9. Feasibility studies are assessed by alignin what's wanted;

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

10. Feasibility studies are assessed by designing for construction

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

11. Feasibility studies are assessed by aligning constraints (cost, time, location etc.)

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

12. A detailed budget aligned with scope and quality requirements was produced from the feasibility study

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

5

13. A detailed schedule aligned with scope and quality requirements was produced from the feasibility study

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

14. The customer/client is an active and permanent member of the project delivery team.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

15. All team members understand the business case

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

16. All team members understand the stakeholder values.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

17. A mutual trust was maintained between all parties involved.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

6

18. The cost target set by the project team in this project was not exceeded. Only the client/ owner changed the target scope and quality during the project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

19. The target project schedule set by the project team in this project was exceeded Only the client/ owner changed the target scope and quality during the project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

20. Prior to investment of design time, implications of cost, schedule and quality of design alternatives were discussed by team members and external stakeholders

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

21. Cost estimating, and budgeting is done continuously through intimate collaboration between members of the project team

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

22. The Last Planner®4 system is used to coordinate the actions of team members.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

23. Targets are set as stretch goals to spur innovation.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

24. Targeted scope and cost were allocated to each individual design team member (structural, mechanical, electrical, exterior, interiors.) during design.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

25. Cost estimates and basis of estimate (scope) were updated frequently

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

26. Project cost estimates are updated and reviewed in weekly team meetings which was open to all project team members.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

27. Team meetings were held frequently.

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

28. The architect, electrical, mechanical, structuralengineers and cost estimators all stayed in the same room during the early stages of the project

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

9

Appendix 9: A sample FFITVD internal and external evaluation survey questionnaire

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Structured and Semi-Structured Survey to Evaluate, Refine, and Validate Target Value Design Framework

Dear Participant,

You are invited to take part in a post TVD Framework implementation survey to Evaluate, Refine, and Validate the Framework for Target Value Delivery (FFTVD) that was implemented as part of a study undertaken on the "The Exploration and Testing of the Potential of Applying Target Value Design in Nigerian Construction Industry with the view to enhance Value Creation.

This evaluation questionnaire aims at assessing the level of completeness and comprehensiveness of this TVD framework (presented overleaf). The TVD framework is to serve as a guide to construction stakeholders (client, engineers, design team, project managers, main contractors, subcontractors, suppliers etc.) in understanding what needs to be in place for the successful implementation of TVD and also sustaining its implementation in the Nigerian construction industry.

Background information of respondents:

1. What is your professional Background?

☐ Quantity Surveyor ☐ Project Manager ☐ Engineer ☐ Architect

☐ Contractor ☐ Lecturer ☐ Civil ☐ M&E

Others, Please Specify: ____

2. Your Organization?

☐ Government ☐ Private Architectural Firm ☐ Client

☐ Private Quantity Surveying Firm ☐ Private Engineering Firm ☐ Contractor

☐ Private Developers ☐ Professional body ☐ Academic

Others, Please Specify:

3. How long have you been in practice?

☐ Not more than 5 years ☐ 5 to 10 years ☐ from 10 to 15 years

☐ More than 15 years

4. Your current position in the organization?

☐ Managing Director ☐ Project Manager ☐ Supervisor

Others, Please Specify

Evaluation Questions:

Attached to this question is the implemented TVD framework which is to be evaluated, kindly study it and respond to the following questions. Please rate the following questions regarding the framework on a scale of 1 to 4. Indicate your response by ticking appropriate number in the boxes provided and add comments as required.

Description of scale:

1= Very Appropriate 2 = Appropriate 3 = In Appropriate 4 = Very Inappropriate
1= Very Complete 2 = Complete 3 = Incomplete 4 = Very Incomplete.
1= Very Comprehensive 2 = Comprehensive 3 = Incomprehensive 4 = Very Incomprehensive.

SN	QUESTIONS	1	2	3	4	COMMENTS
	Based on your experience from the TVD Framework implementation,					
1	how would you rate or describe the appropriateness of the five areas of focus for TVD implementation in the framework (Initiation, Planning, Execution, Monitoring and control, and Closing)					
2	Based your experience, please rate the level of completeness of the steps and sequence required at the initiation stage					
3	Based your experience, please rate level of completeness of the steps and sequence required at the Planning stage					
4	Based your experience, please rate level of completeness of the steps and sequence required at the execution stage					
5	Based your experience, please rate level of completeness of the steps and sequence required at the closing stage					
6	Based your experience, please rate level of completeness of the tool & techniques required at the initiation stage					
7	Based your experience, please rate level of completeness of the tool & techniques required at the Planning stage					
8	Based your experience, please rate level of completeness of the tool & techniques required at the execution stage					

SN	QUESTIONS	1	2	3	4	COMMENTS
9	Based your experience, please rate level of completeness of the tool & techniques required at the closing stage					
10	Based your experience, please rate level of completeness of the likely barriers encountered at the initiation stage					
11	Based your experience, please rate level of completeness of the likely barriers encountered at the Planning stage					
12	Based your experience, please rate level of completeness of the likely barriers encountered at the execution stage					
13	Based your experience, please rate level of completeness of the likely barriers encountered at the closing stage					
14	Based your experience, please rate level of completeness of the human behaviours required during implementation of TVD on a project					
15	Based your experience, please rate level of completeness of the drivers that prompt the use of TVD in projects					
16	How comprehensive did you find the TVD implementation framework?					

17. Do you think the framework would in any way support the TVD implementation in construction? Please give reasons for your comment:

____

____

____

____

18. Do you think the framework could be adopted/ adapted in your country?

Please give reasons for your response:

____

____

____

____

19. Would you recommend the use of this framework for TVD implementation?

Please give reasons for your response:

____

____

____

____

20. How would you recommend the use of the framework?

Please insert comments: ____

____

____

____

21. Please suggest further improvements that can be considered in this framework that aims to guide construction stakeholders (client, main contractors, and subcontractors) in understanding what needs to be in place for the successful implementation of TVD?

____

____

____

____

Appendix 10: A sample of post-FFITVD implementation interview

FFITVD implementation interview guide

The interview consists of 15 open-ended questions, designed to assess the framework, to determine if it can be used to support the application of TVD and solicit recommendations for improvement of the framework

❖ **Respondents Background:**

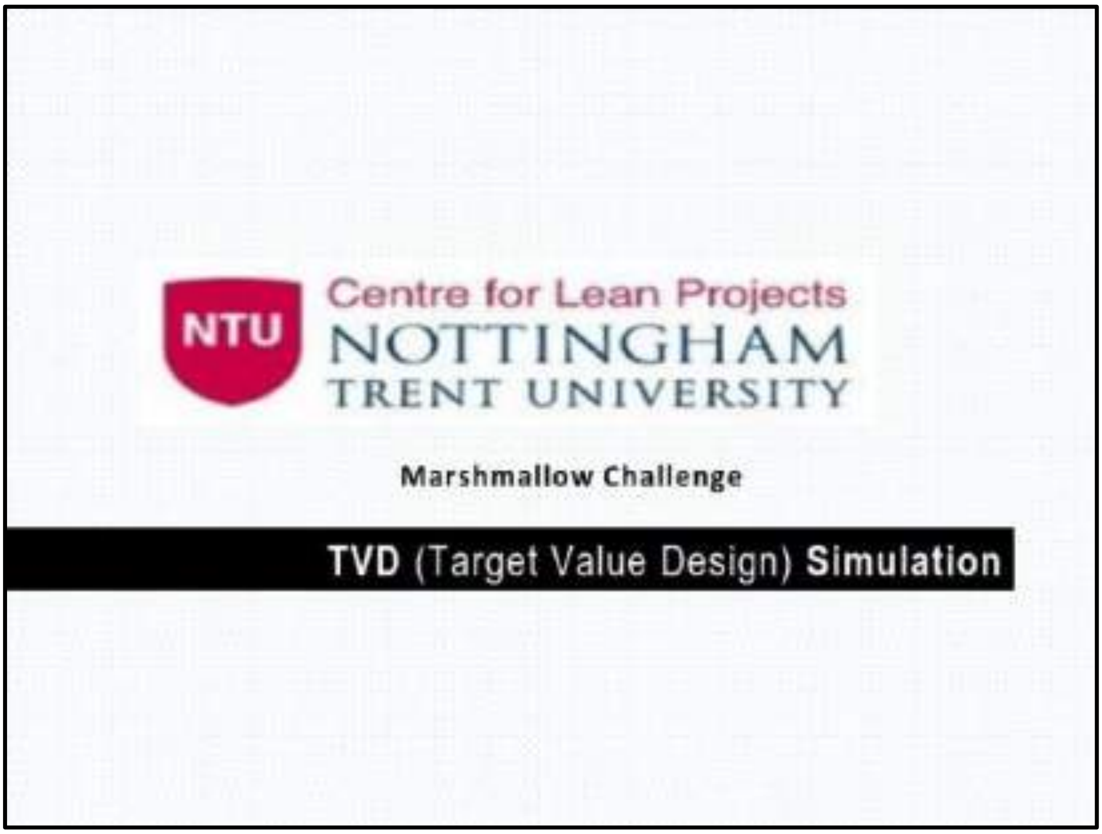
This section aims to obtain general information of the interviewee:

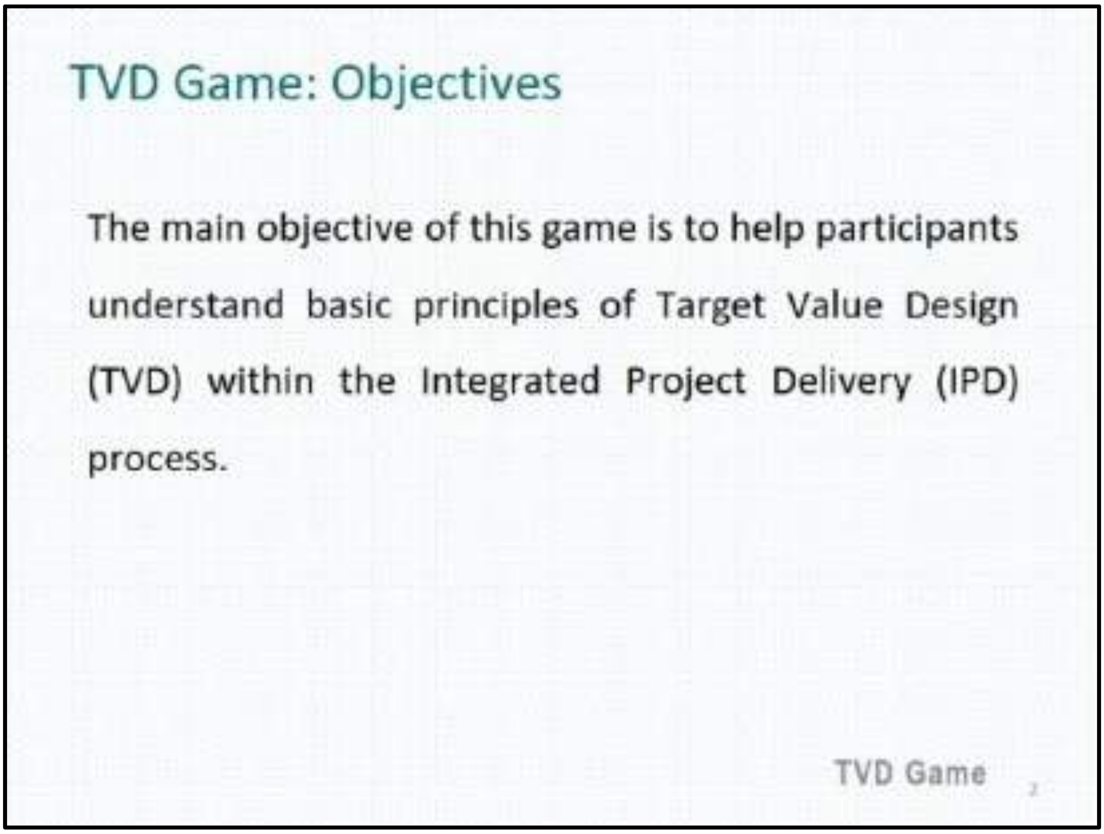
1. What is your professional background?
2. What organization do you belong to?
3. How long have you been in practice?
4. What is your geographical location in Nigeria?

❖ **Interview Question**

5. Please assess the appropriateness of the stages of a project in the framework.
6. Kindly assess the completeness of the steps in all the stages of a project in the framework.
7. Kindly assess the completeness of the Tools and techniques in all the stages of a project in the framework.
8. Please assess the appropriateness and completeness of the barriers in all the stages of a project in the framework.
9. Kindly assess the completeness of the benefits in all the stages of a project in the framework
10. Assess the completeness of behaviours in all the stages of a project in the framework
11. How comprehensive did you find the framework?
12. Can this framework support the implementation of TVD in the construction industry?
13. Can the framework be adapted in the Nigerian construction industry?
14. Recommend the appropriate use of the Framework
15. Kindly make suggestions for Further Improvement of the framework

Appendix 11: A sample of simulation game training slides





Overview

- ❖ The Owner wishes to design and build a tower that is 2 feet tall (approx. 60 cm), that is capable of holding a marshmallow at the top, and that is no more than 2 inches out-of-plumb (i.e. not exactly vertical).
- ❖ The tower must be constructed with supplied materials and must be free-standing (i.e. cannot be taped to a table).

TVD Game 3

Teams

- ❖ Participants are grouped into teams of 5- 6 people each.
- ❖ Within each team, form the following groups:
  - Owners
  - Designers
  - Constructers

	Team Abuja	Team Lagos	Team Port Harcourt	Team Ibadan
Owner	Aminu (Procurement)	Hakeem (SM)	Tanko (QS)	Rayyan
Designer	Faruq Musa (Architect)	Ahmed Rawa (Architect)	Felix (Architect)	Hamza (Architect)
Constructor	1. Abdulazeez Umar 2. Suleiman Ahmed (TH) 3. Abdulsalam Zakari (TH) 4. Benjamin (QMU)	1. Omeiza 2. Engr. Khazim 3. Engr. Iato 4. Alhasan Abubakar (Supervisor)	1. Engr. Abe 2. Engr. Ralph 3. Sadiq (Supervision) 4. Engr Sunday (QMU)	1. Engr. David 2. Kheinde 3. Abdulmalik (QMU) 4. Maurice (QS) 5. Shamsudeen Usman (Supervisor)

TVD Game 4

Materials

The following materials have been provided:

- Design sheet
- Costing sheet
- masking tape
- bamboo skewers
- drinking straws
- uncooked spaghetti
- coffee stirrers
- and marshmallows.

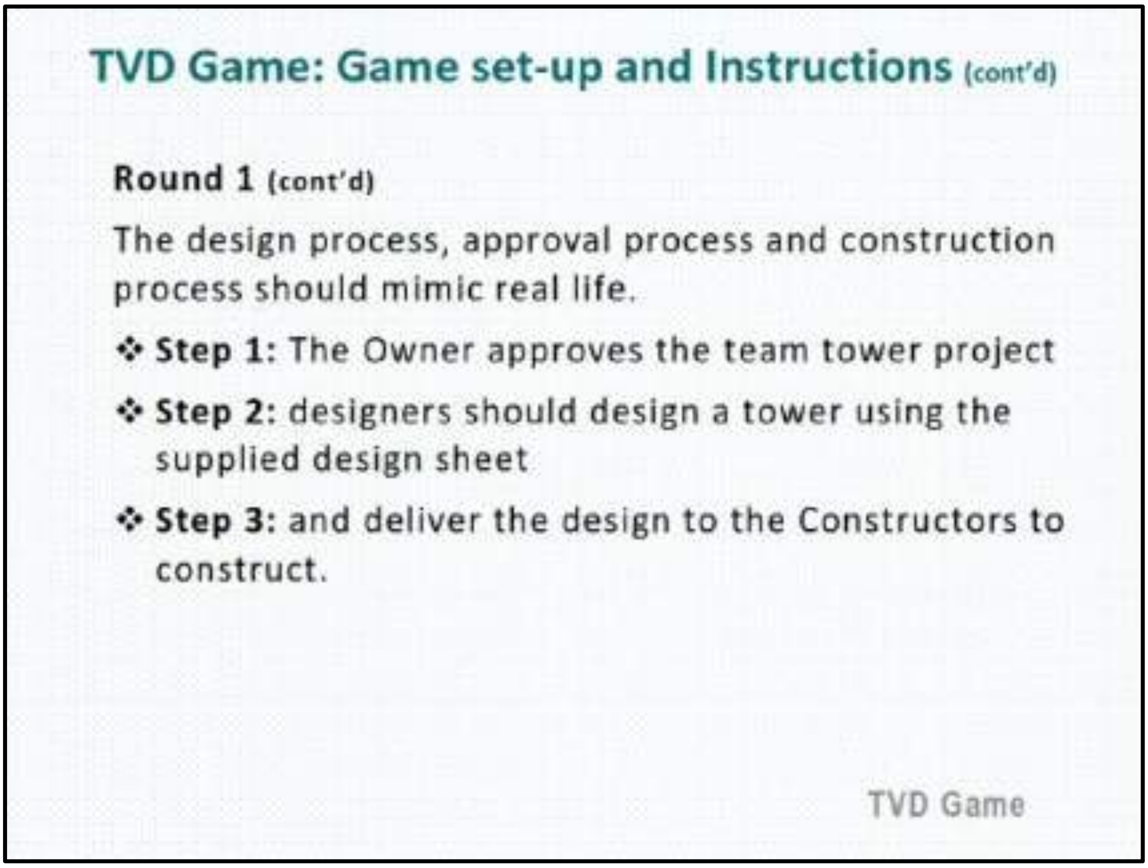
TVD Game

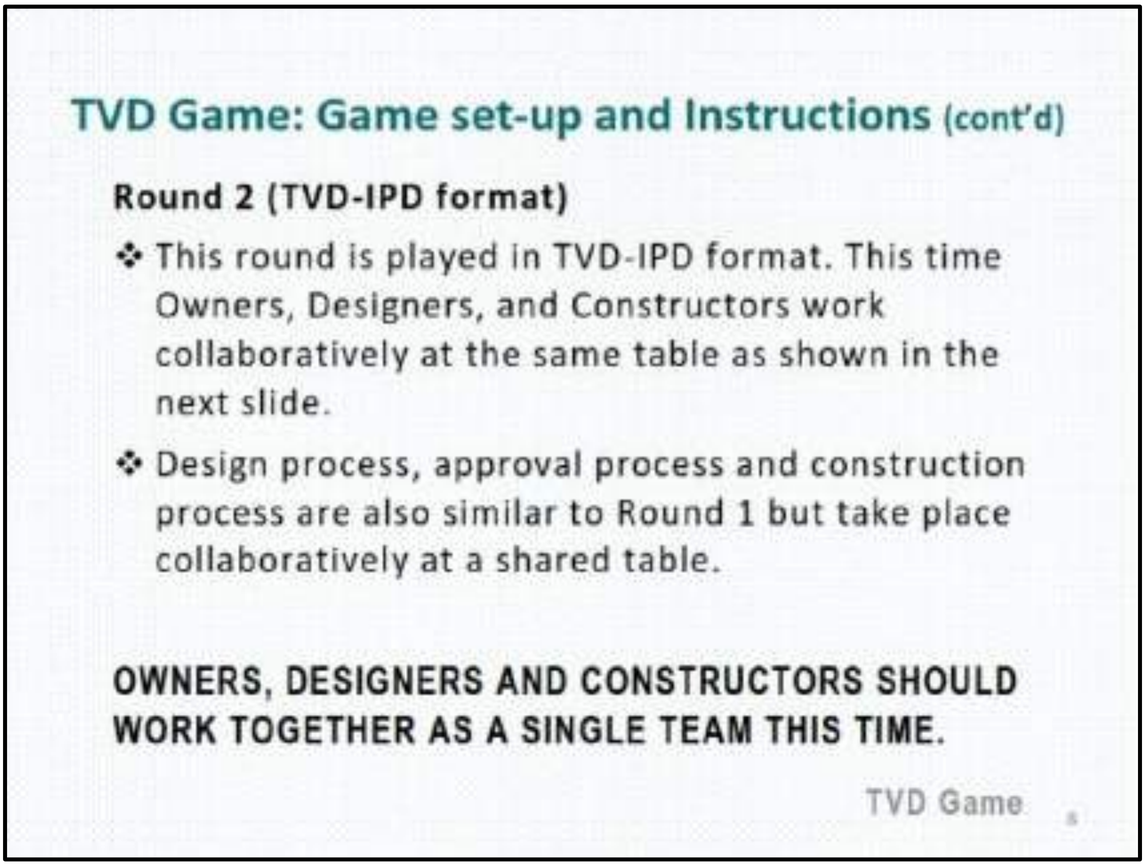
TVD Game: Game set-up and Instructions

Round 1 (traditional Design Bid Build project delivery)

- This round is played in traditional Design Bid Build format. The Owners, Designs and Constructors are located in different areas.

TVD Game


TVD Game: Game set-up and Instructions (cont'd)
Round 1 (cont'd)
The design process, approval process and construction process should mimic real life.
❖ Step 1: The Owner approves the team tower project
❖ Step 2: designers should design a tower using the supplied design sheet
❖ Step 3: and deliver the design to the Constructors to construct.
TVD Game


TVD Game: Game set-up and Instructions (cont'd)
Round 2 (TVD-IPD format)
❖ This round is played in TVD-IPD format. This time Owners, Designers, and Constructors work collaboratively at the same table as shown in the next slide.
❖ Design process, approval process and construction process are also similar to Round 1 but take place collaboratively at a shared table.
OWNERS, DESIGNERS AND CONSTRUCTORS SHOULD WORK TOGETHER AS A SINGLE TEAM THIS TIME.
TVD Game

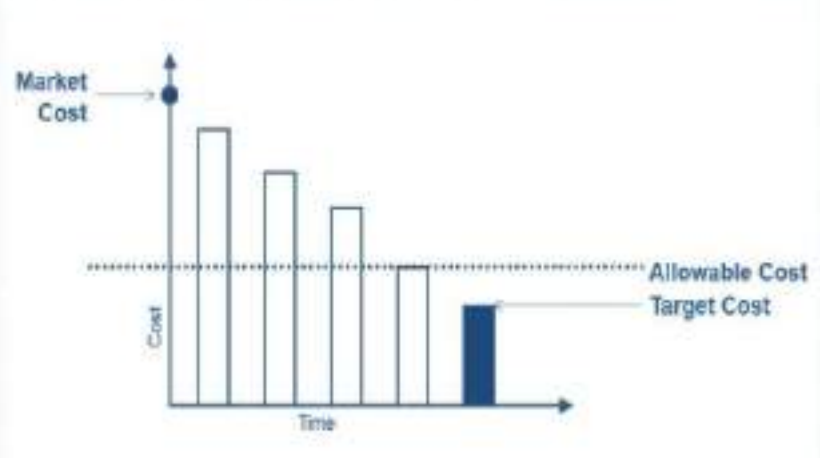
TVD Game: Game set-up and Instructions (cont'd)

Calculate and find various costs:

- Market Cost is set at the average cost of all the towers built during Round 1.
- Allowable Cost is calculated by deducting 15% - 20% from Market Cost (facilitator decides amount).
- Target Cost is set by team members. Target cost is less than allowable cost. All participants collaborate to try to meet the Target Cost.

TVD Game

TVD Game: Game set-up and Instructions (cont'd)



TVD Game

Example of cost sheet

ROUND I: Establish Market Cost, Allowable Cost, and Target Cost

		TEAM A		TEAM B		TEAM C		TEAM D		TEAM E	
	Unit cost	No. of units	Subtotal	No. of units		No. of units		No. of units		No. of units	
Spaghetti sticks	$1.00	3	$3.00	6	$6.00	9	$9.00	0	$0.00	4	$4.00
Coffee Stirrers	$5.00	21	$105.00	1	$5.00	11	$55.00	8	$40.00	8	$40.00
Drinking straws	$2.00	30	$60.00	12	$24.00	8	$16.00	24	$48.00	16	$32.00
Bamboo skewers	$3.00	16	$48.00	15	$45.00	2	$6.00	8	$24.00	4	$12.00
Masking tape (per join)	$0.50	17	$8.50	9	$4.50	3	$1.50	8	$4.00	8	$4.00
Subtotal			$224.50		$84.50		[illegible]		$116.00		$92.00
Profit (10%)			$22.45		$8.45		$8.75		$11.60		$9.20
TOTAL			$246.95		$92.95		[illegible]		$127.60		$101.20

Establish Target Cost

Market Cost Cost (= average of all towers): $131.67
Allowable Cost (=20% lower than Market co: $105.34

	TEAM A	TEAM B	TEAM C	TEAM D	TEAM E
Teams Declare **Target Cost** preferences	98.21	80	95	70	85

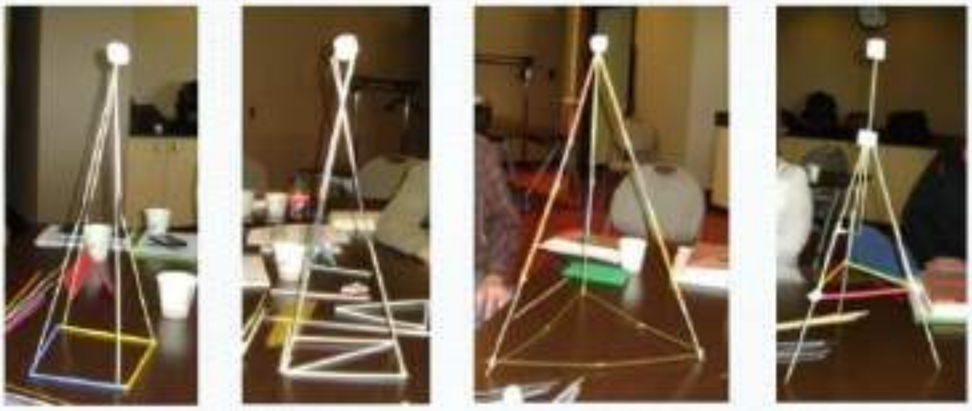
TARGET COST 82.06 (=average of all declared TCs)

ROUND 2: Design to Target Cost

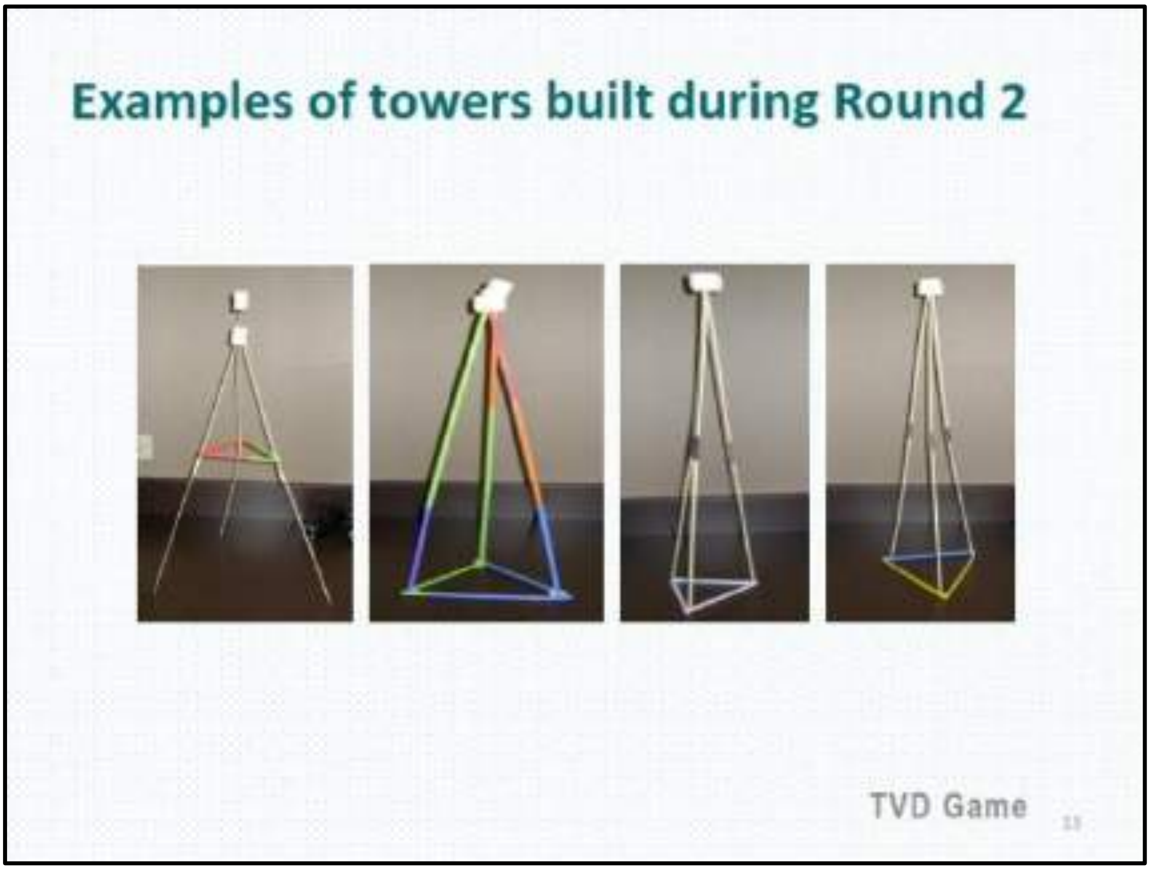
		TEAM A		TEAM B		TEAM C		TEAM D		TEAM E	
	Unit cost	No. of units	Subtotal	No. of units		No. of units		No. of units		No. of units	
Spaghetti sticks	$1.00	1	$1.00	4	$4.00	1	$1.00	0	$0.00	4	$4.00
Coffee Stirrers	$5.00	0	$0.00	0	$0.00	6	$30.00	0	$0.00	4	$20.00
Drinking straws	$2.00	3	$6.00	12	$24.00	3	$6.00	6	$12.00	2	$4.00
Bamboo skewers	$3.00	9	$27.00	9	$27.00	6	$18.00	8	$24.00	4	$12.00
Masking tape (per join)	$0.50	13	$6.50	0	$0.00	1	$0.50	4	$2.00	4	$2.00
Subtotal			$40.50		$55.00		$55.50		$38.00		$42.00
Profit (10%)			$4.05		$5.50		$5.55		$3.80		$4.20
TOTAL			$44.55		$60.50		$61.05		$41.80		$46.20

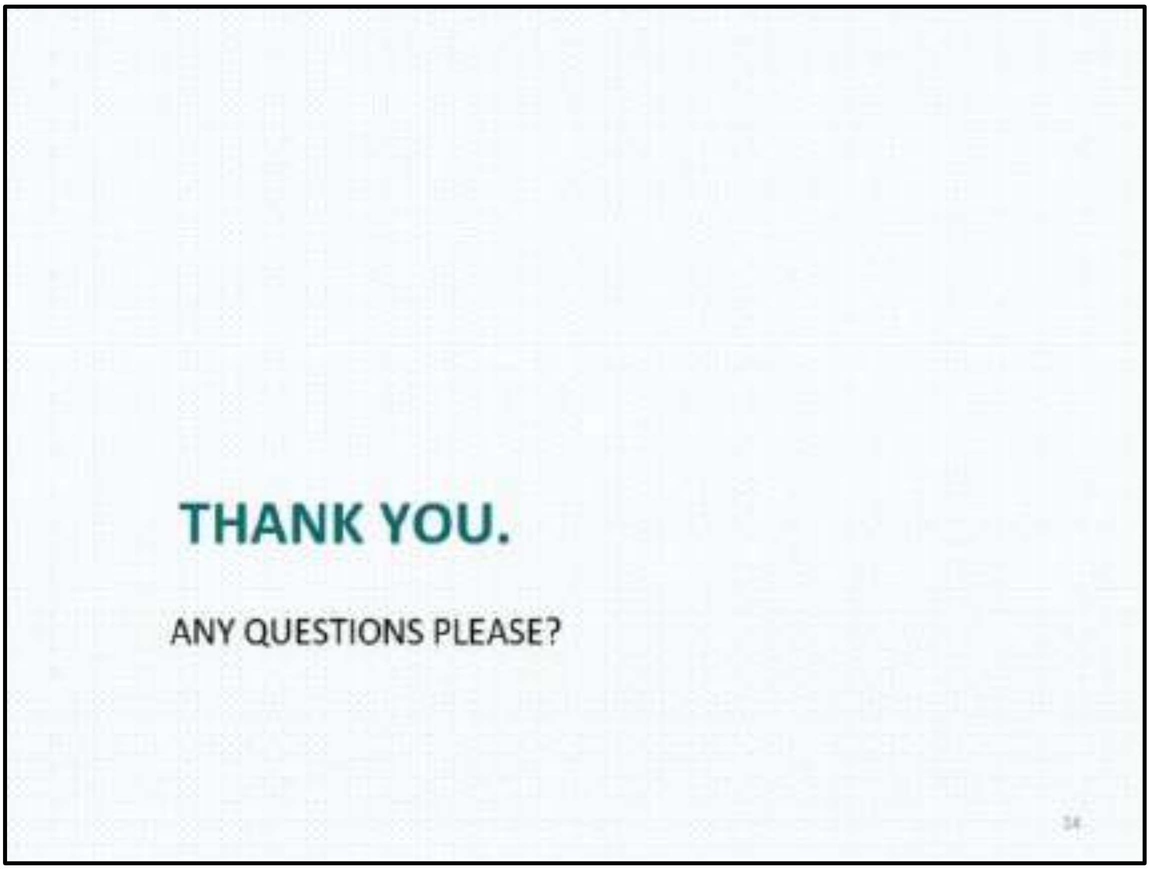
TVD Game 11

Examples of towers built during Round 1



TVD Game 12


Examples of towers built during Round 2
TVD Game


THANK YOU.
ANY QUESTIONS PLEASE?

Appendix 12: The card game instructions

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CARD GAME

Overview

The game is designed to investigate the desired values of clients on projects. The objective of this game is to identify the needs and expectations of house owners/ end users in relation to housing and, from this information, to define project recommendations and to improve customer value.

Card Game Instructions

The card game is divided into five suits of value attributes, these are: Financial, urban and internal spatial qualities, social and cultural perceptions. The suit consists of 26 different cards presented to represent design values. The game will be played in two cycles.

1st Cycle

This cycle consists of five rounds, one for each category (suit), so that the interviewed hierarchize their preferences of the items that make up each category. The cards are composed of user priorities within each category, the user will rank their priorities among all cards in each suit. The frequency of each card must first be obtained in all positions of choice within the category. It is necessary that in each round the end-user clearly reads the exposed cards.

Thus, in the categories Financial Perspective, Cultural Values and Environmental Quality Internal, and spatial qualities the letters could be chosen on the 1st, 2nd, 3rd, 4th or 5th position, however, in the category of Socio-cultural Perceptions, there are 6 possible positions for each card.

2nd Cycle Round 6

In this round, the user will select the most important card in each of the five suits. The user is advised to choose one of five value cards in each of the presented suits. The response of the card chosen should be recorded on the answer sheet.

This round is designed to establish the most important value in the five selected cards in the first cycle. That is round must be applied with the first cards of each suit selected by the user. The user is advised to select one card from the cards selected in round two.

Illustrative cards (Kowaltowski and Granja, 2011)

Appendix 13: Sample of TVD Workshop/Training slides


Why is the industry inefficient?
Designers, subcontractors and other specialist groups working in isolation in their respective disciplines resulting in rework, change orders, re-pricing.
Lacking predictability of cost, time & quality standards.
Collaborative practices are uncommon.
Projects are unaffordable and off-target for clients.
Poor and over designs which generate waste.
Inefficient work flow & Lack of Coordination Between Disciplines.
Lack of delivering value.


Waste in Construction
Accidents
Delay, waiting
Over-ordered materials, damaged materials
Poor payment systems
Settling disputes after project commences
Tendering
Sarhan, S., Pasquire, C., & King, A.
INSTITUTIONAL WASTE WITHIN THE CONSTRUCTION INDUSTRY: AN OUTLINE.
waste 55-65%
support 30-35%
value creation 5-10%
What we have to do to enable us create what the customer wants, e.g.

Target Value Design

- Stakeholders in the Nigerian Construction Industry have advocated for the need of new and effective techniques to improve performance of projects.
- Target value design have been identified as a strategy and practice proved to be successful in delivering client's needs in a set Target Cost below the Market Price
- It adopts a "design to target" method in order to increase the predictability of project performance by designing to cost while delivering customer value and eliminating waste. All these efforts indicate a potential for generating value beyond cost reduction.
- Term given to the adaptation of target costing to construction projects.
- A strategic pathway for achieving more collaboration by adopting value perceived by the client within project constraints (specific design criteria, cost, schedule).
- Includes value improvement tools from various disciplines and aids the project environment with favourable characteristics to generate value.

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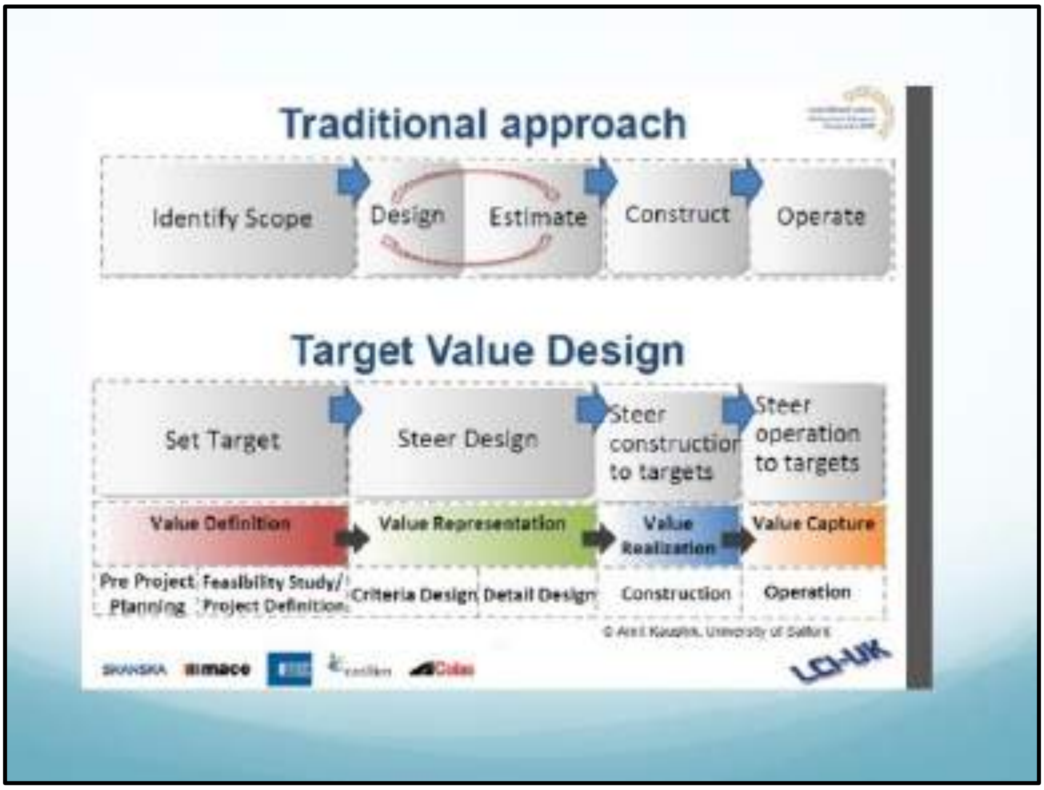
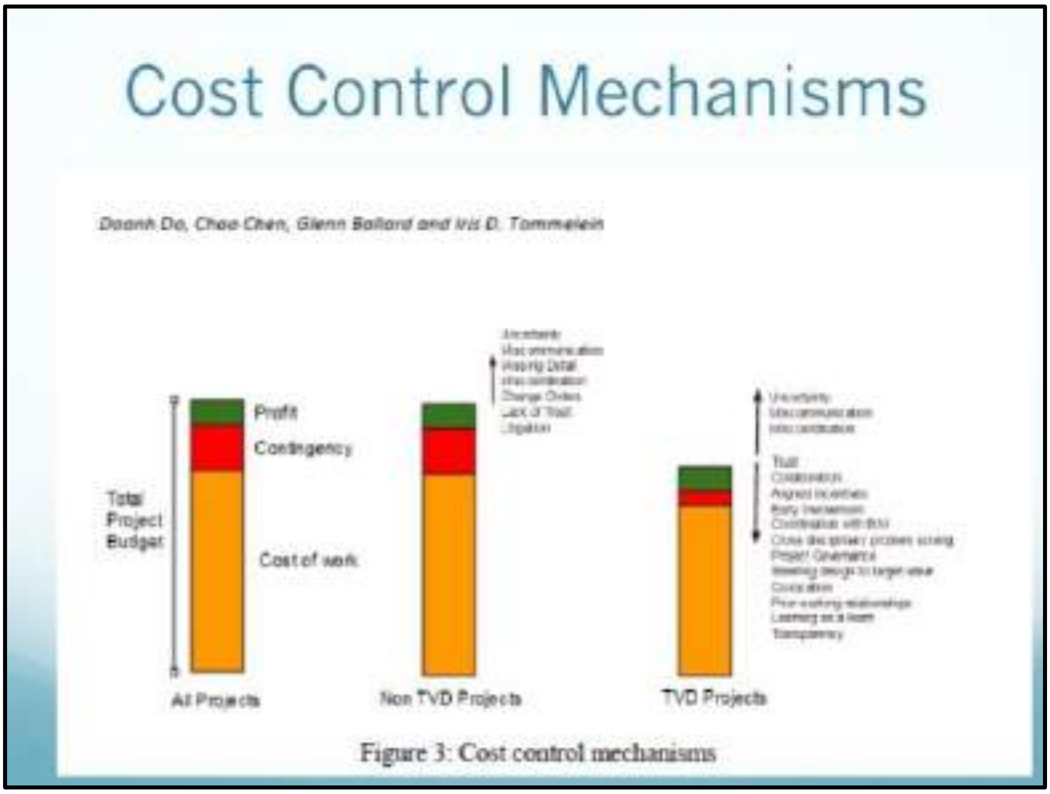
TVD Foundational Practices

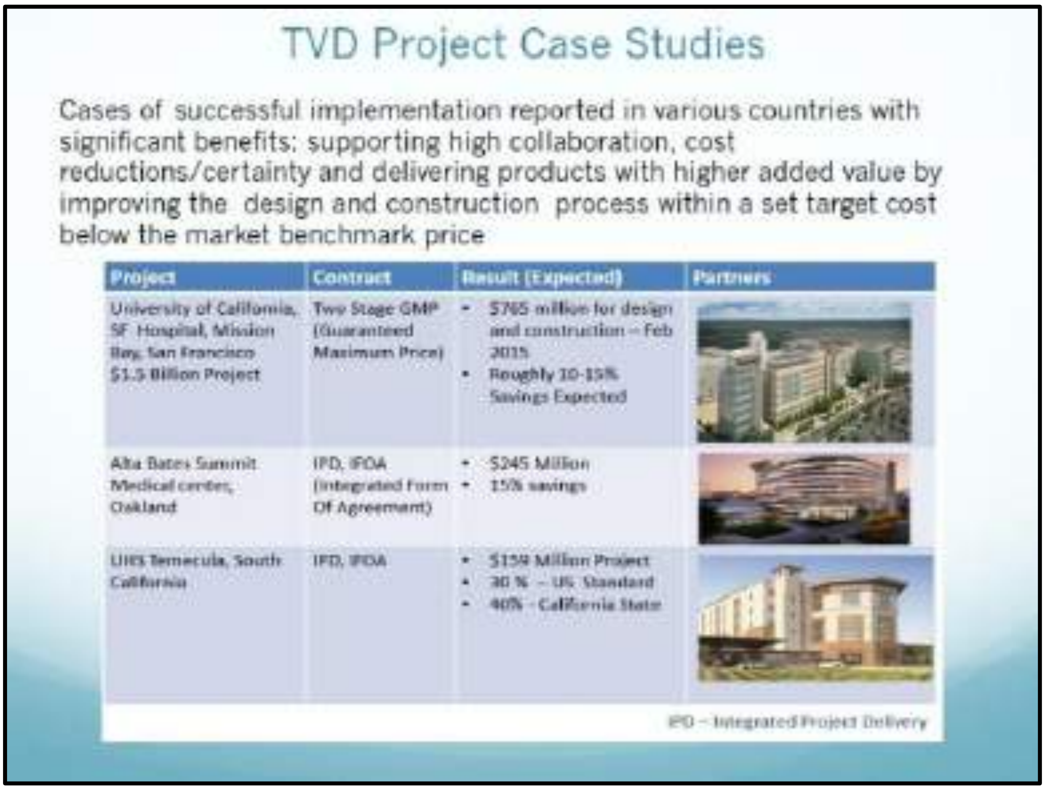
- **Engage deeply with the client to establish the target-value.**
- **Lead the design effort for learning and innovation.**
- **Design to a detailed estimate.**
- **Collaboratively plan and re-plan the project.**
- **Concurrently design the product and the process in design sets.**
- **Design and detail in the sequence of the customer who will use it.**
- **Work in small and diverse groups.**
- **Work in a Big Room.** Co-locating design team members is usually the best option.
- **Conduct Retrospectives throughout the process.**

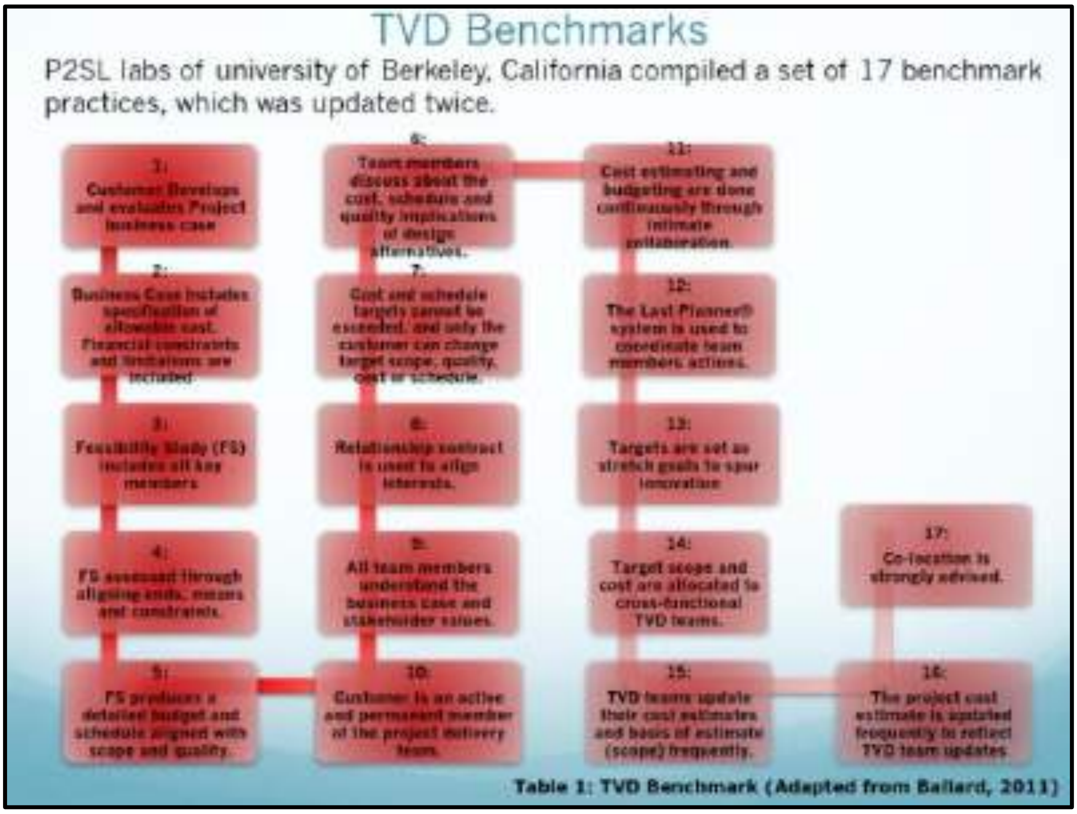


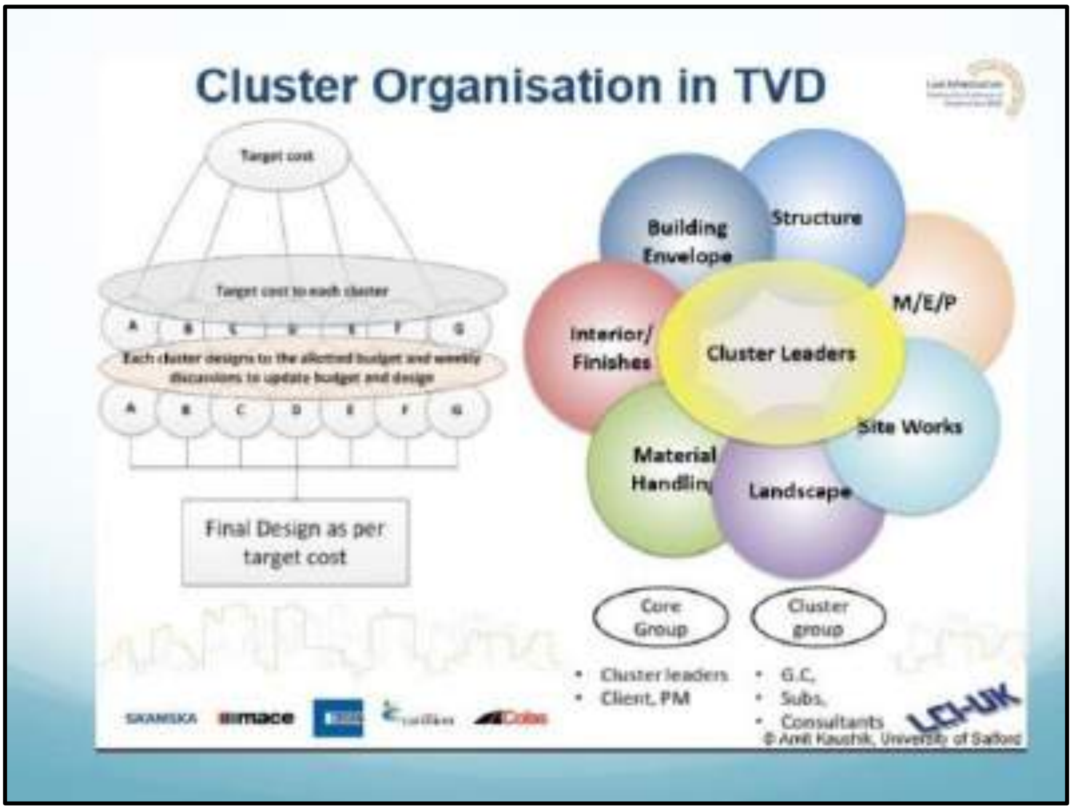
Design under TVD vs Traditional Practice

TVD	Traditional practice
Design-estimate-redesign	Design-estimate-rework
First a detailed estimate is built up then a design is made in line with the estimate	Architect/ civil/structural designs are drawn up then an estimate is built up
Design is based only on what is possible to construct	An evaluation of the design for constructability might be necessary
All designers are involved from the initial design (architect, engineers, landscape.... etc.)	Architect design then the other designers base their designs on the architect's design

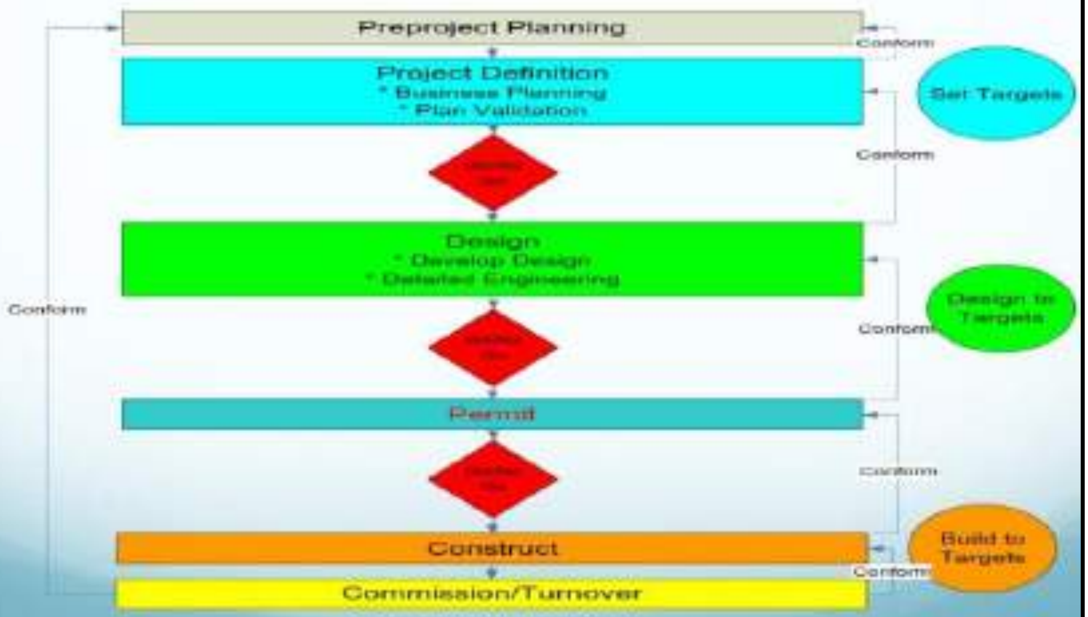

Cost Control Mechanisms
Doanh Do, Chao Chen, Glenn Ballard and Iris D. Tommelein
Profit
Contingency
Total Project Budget
Cost of work
All Projects
Non TVD Projects
TVD Projects
Figure 3: Cost control mechanisms


TVD Project Case Studies
Cases of successful implementation reported in various countries with significant benefits: supporting high collaboration, cost reductions/certainty and delivering products with higher added value by improving the design and construction process within a set target cost below the market benchmark price
Project
Contract
Result (Expected)
Partners
University of California, SF Hospital, Mission Bay, San Francisco $1.5 Billion Project
Two Stage GMP (Guaranteed Maximum Price)
$765 million for design and construction – Feb 2015
Roughly 10-15% Savings Expected
Alta Bates Summit Medical center, Oakland
IPD, IFOA (Integrated Form Of Agreement)
$245 Million
15% savings
UHS Temecula, South California
IPD, IFOA
$159 Million Project
30 % – US Standard
40% - California State
IPD – Integrated Project Delivery


TVD Benchmarks
P2SL labs of university of Berkeley, California compiled a set of 17 benchmark practices, which was updated twice.
1:
2:
3:
4:
5:
6:
7:
8:
9:
All team members understand the business case and stakeholder values.
10:
Customer is an active and permanent member of the project delivery team.
11:
Cost estimating and budgeting are done continuously through intimate collaboration.
12:
The Last Planner® system is used to coordinate team members actions.
13:
Targets are set as stretch goals to spur innovation
14:
Target scope and cost are allocated to cross-functional TVD teams.
15:
TVD teams update their cost estimates and basis of estimate (scope) frequently.
16:
The project cost estimate is updated frequently to reflect TVD team updates.
17:
Co-location is strongly advised.
Table 1: TVD Benchmark (Adapted from Ballard, 2011)


Cluster Organisation in TVD
Target cost
Target cost to each cluster
A
B
C
D
E
F
G
Each cluster designs to the allotted budget and weekly discussions to update budget and design
Final Design as per target cost
Building Envelope
Structure
M/E/P
Interior/ Finishes
Cluster Leaders
Site Works
Material Handling
Landscape
Core Group
Cluster group
• Cluster leaders
• Client, PM
• G.C,
• Subs,
• Consultants
SKANSKA
mace
LCI-UK
© Amit Kaushik, University of Salford

TVD Process



TARGET VALUE DESIGN PROCESS

- Assess the business case (demand, revenues) considering cost to own & use and use facility against cost to acquire it.
- Determine minimum acceptable ROI or maximum available funds: **Set allowable cost for the facility.**
- **Question: if we had a way to achieve our specific purposes and if we could get it within our cost, location and time, would we do it?**
- **If YES**, and if project delivery is not risky, fund the project. If the answer is positive and project delivery is risky, fund feasibility study to answer the question: **Can we have the facility we want, will it enable us achieve our purposes & can we acquire it within our constraints?**


Steps During Design
Set Target Cost: typically lower than the budget of current best practice.
Form a Target Value design teams then allocate target cost to each team.
Use set based approach, evaluate sets against target values.
Provide cost and constructability guidelines for design.
Promote Collaboration: designers provide cost inputs before developing design options.
Do rapid estimating: hold frequent budget alignment sessions.
Use value engineering proactively.
Hold design reviews with permitting agencies.
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Steps During Design
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Form a Target Value design teams then allocate target cost to each team.
Use set based approach, evaluate sets against target values.
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Promote Collaboration: designers provide cost inputs before developing design options.
Do rapid estimating: hold frequent budget alignment sessions.
Use value engineering proactively.
Hold design reviews with permitting agencies.
NTU
Centre for Lean Projects
NOTTINGHAM
TRENT UNIVERSITY


The Cardinal Rule
The Target Cost Must Never be Exceeded
:target
Applying the Cardinal Rule:
• Whenever improvements in design lead to increased costs, Alternative offsetting savings have to be found elsewhere without compromising value.
• It is not allowed to launch products with costs that exceed their targets
• It is not allowed to add scope to projects that will exceed target cost. Transition from design to construction should be carefully maintained to make sure target cost is indeed achieved.


"Thank you for your Attention"
NTU
Centre for Lean Projects
NOTTINGHAM
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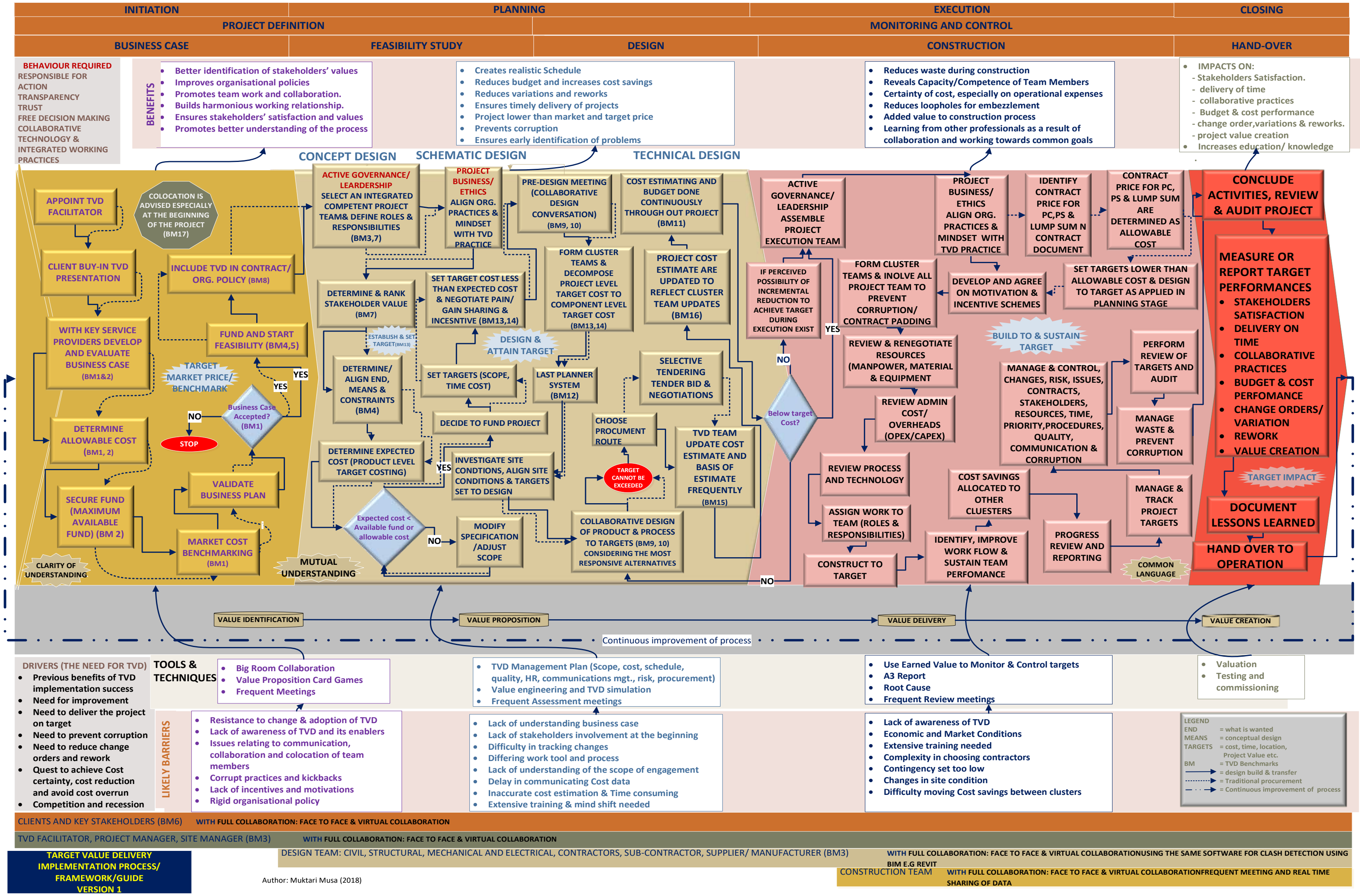
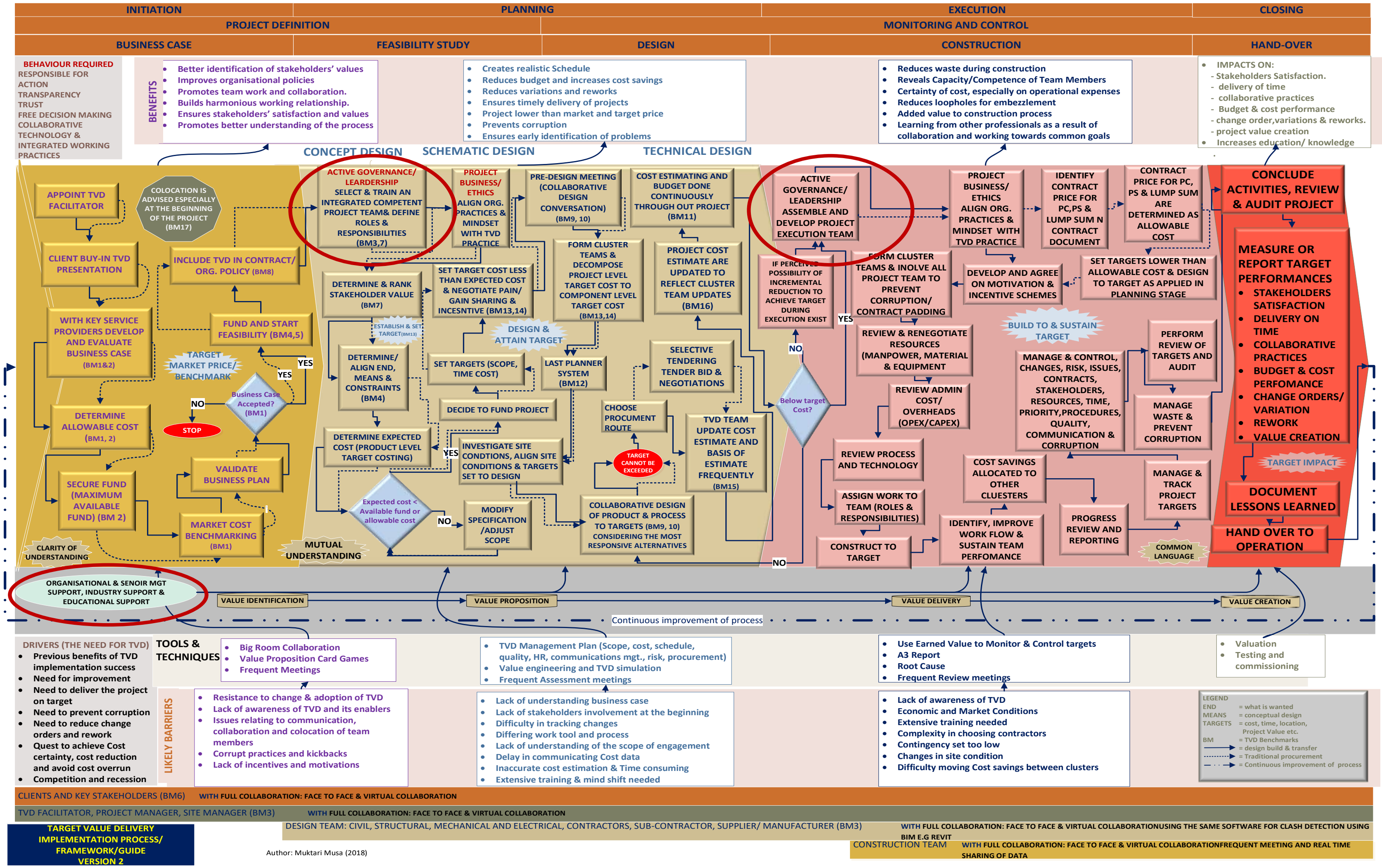
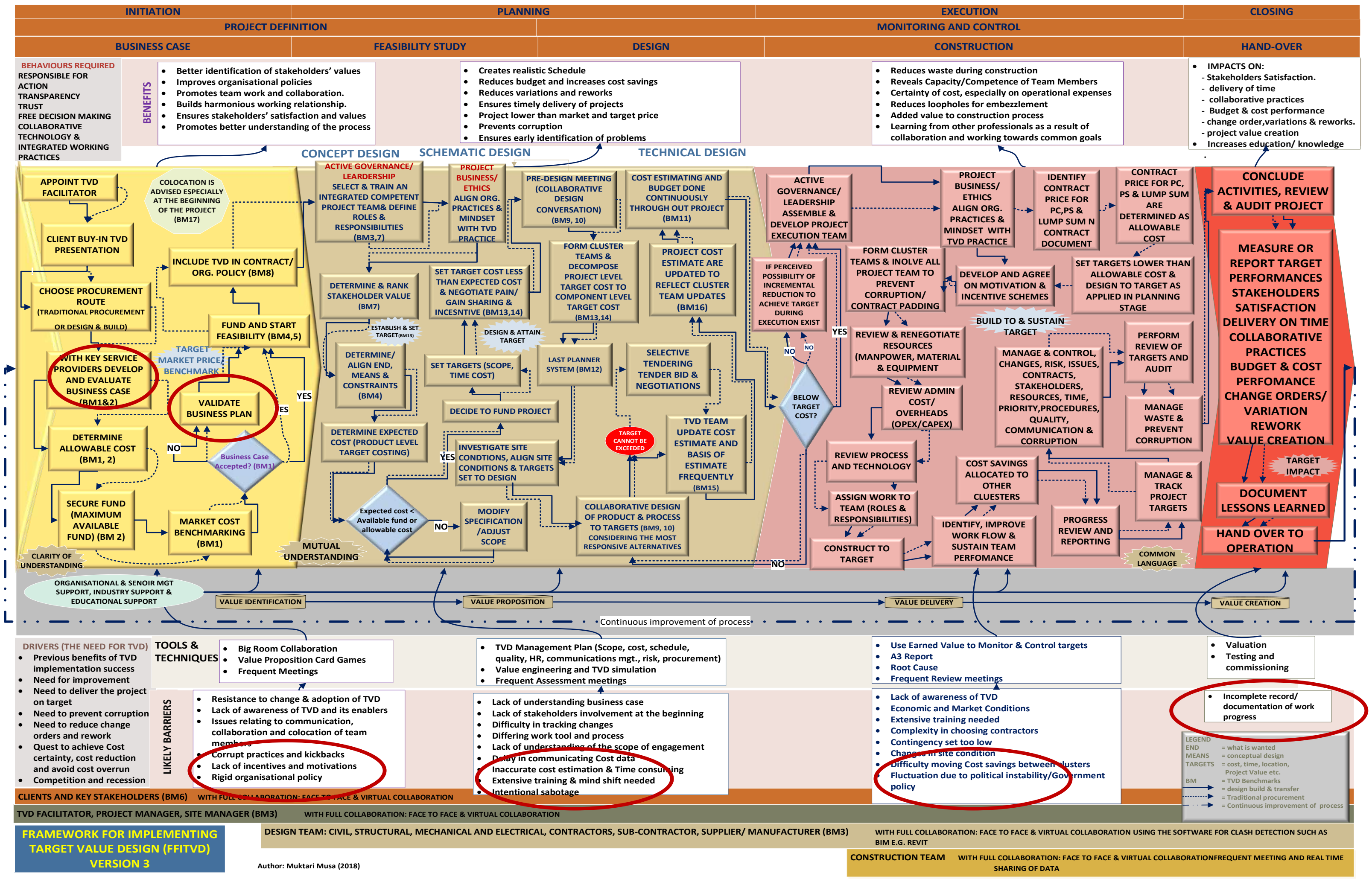
Appendix 14: Version 1 of the framework



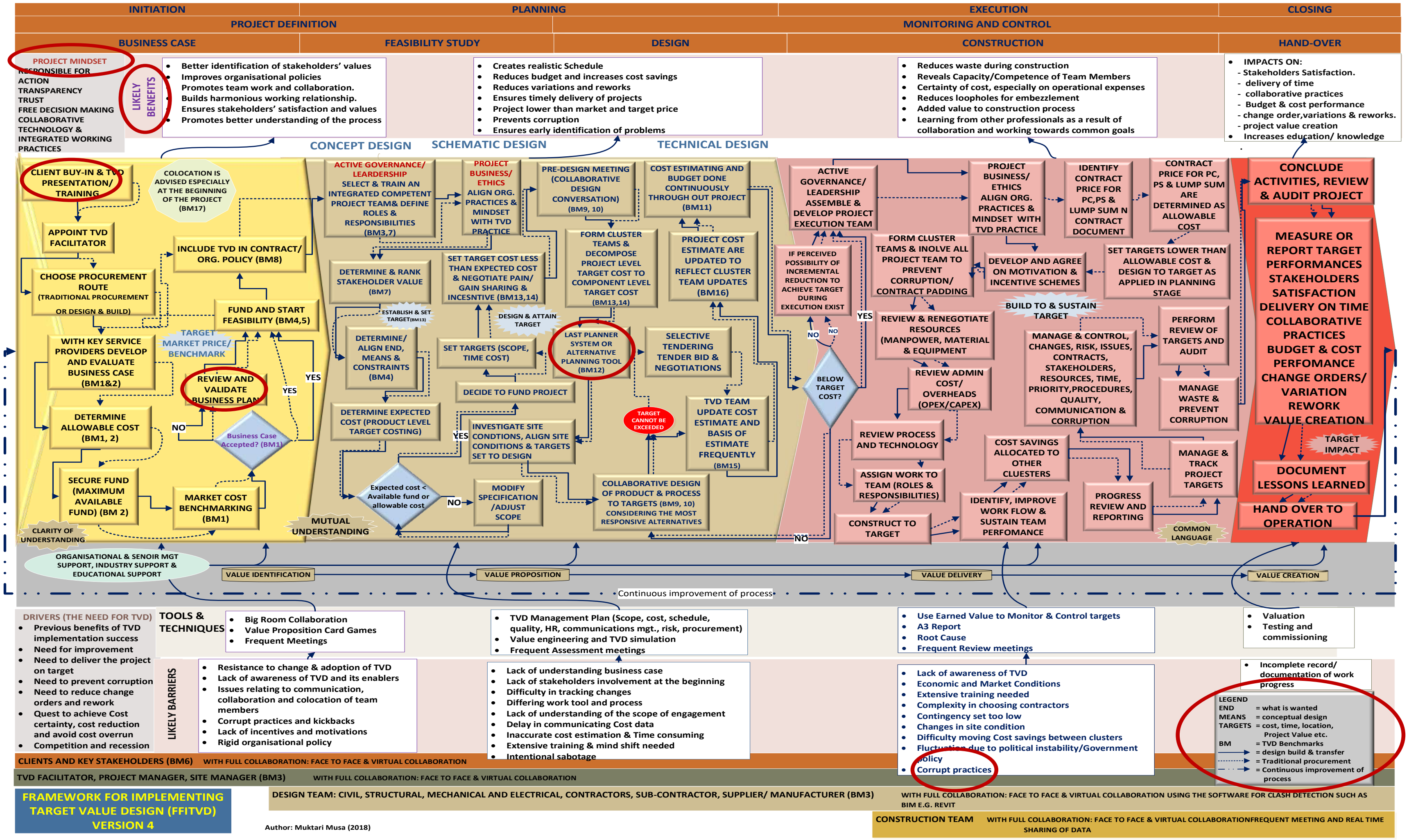
Appendix 15: Version 2 of the framework



Appendix 16: Version 3 of the framework



Appendix 17: Version 4 of the framework



Appendix 18: Sample of content analysis and coding

Table 1 Benefits of TVD at the project construction stage from interview transcripts Case study four

CLUSTERS OF BENEFIT	CATEGORIES	DESCRIPTION.
1. ENCOURAGES TEAMWORK/ COLLECTIVE DECISION MAKING/COLLABORATION/ TEAM SELECTION	**Teamwork and collaboration.**	• IBTANK: Also, we wanted to encourage teamwork, an approach which will create. • JAMES: There was cooperation and collaboration in the project teams, • BAKO: We had to collaborate as a team • JATTO: staying together on site with them engineer Ayo, collaborating on site, yes because I think through collaboration of the different contractors… and since everybody was on site, it was easier for communication right; give us more opportunities and options to participate freely and communicate • OJO: I am saying that this encourages teamwork approach and collaboration
	Harmonious working Relationship.	• IBTANK: Also, we also look at harmonious working relationship, which encourages efficiency. More opportunity for participants to express opinions and concerns openly and freely was an area as well. • IBTANK: Also, TVD helped in more collaborative and harmonious relationship with all the team members during the construction. Yes, it helped a lot to complete stakeholders and all the people involved both the National Defence College Authorities, IB Tank my company and yourself the consultant. It brought a very good relationship and brought everybody together which we were able to identify mistakes and put our heads together and able to fix things. • **JATTO:** Then the activity promotes a platform for work relationship between the consultant and the client.
2. Steering Design to Target Cost/ BETTER DESIGN & CONSTRUCTION PROCESS/ INNOVATION	**Designing to target cost.**	• **JAMES:** it allowed design to be aligned with target cost. TVD enabled us to know where we were going; it helped to be able to correct all the mistakes in relation to the site condition.
	Innovations and multiple Design options	• BAKO: TVD allowed us develop innovative ideas because we have a figure that the client is not ready to change and of course the contractor our client is there to make profit so we had to come up with innovative ideas of how to tackle that, redesign to suit that problem. TVD Added value in the construction, a typical example was we had the provision for a 600-diameter spiral staircase which was inadequate so we had to redesign to make it adequate for people to pass through conveniently. • **JATTO:** And added value to the design. During the construction, there are some changes we made to get the value of the design. so, it resulted in multiple design alternatives and options. We had many options.

	Added value to construction process	• IBTANK: then also adding value to the design of the project • JAME: It added value to the construction and made it faster
3. BETTER IDENTIFICATION OF STAKEHOLDERS' VALUES	**Stakeholders Values.**	• JATTO: Then better identification of shareholder values • JATTO: this job was a prototype. And as a prototype, it has 3 different contractors from the same client. But ours was the best out of the three because of this TVD method. … and the client was very happy. • JATO: Secondly, it helps save cost for the client and makes the contractor happy. • OJO: Part of the benefits for me is the contract being giving to me when I was involved from the beginning and when I finished diligently, it was commissioned and I was happy with the work I did.
	MEETING TARGETS: TIME, QUALITY AND COST	• JAMES: It added value to the construction and made it faster. • JAMES: It also help each stakeholder to deliver satisfactorily • **BAKO:** To reduce the contingency percentage. TVD project was good at maintaining a lower than contract project cost, thereby controlling a possible cost overrun. It helps avoid scope creep and there was minimum waste in the delivery process. As at that time we were acting more like a consultant to the contractor, we were able to bring in more participants that is both the contractor and us as his consultant was aware of some of the issues
EDUCATION/ KNOWLEGDE	**LEARNING FROM TRAINING AND WORKSHOP.**	JATO: TVD has made me learn so many new things
BETTER CONSTRUCTION PROCESS/ MINIMUM WASTE IN the CONSTRUCTION PROCESS	**COST REDUCTION**	
	MINIMUM WASTE	• IBTANK: And then minimum waste in the construction process was an area we wanted you to look at and help us solve if there are any issue there. • JAMES: There was less wastage of materials. • JAMES: There was minimum waste in the delivery process. It helped us in the relocation of the overhead tanks because where we had the borehole is not getting water that was what made us get the overhead and ground tank so that it could be closer to where the borehole is. • JATTO: Then its minimised waste in design.
		•
	PREVENTS CORRUPTION	IBTANK: This TVD helped us to prevent any kind of corruption n and misappropriation of funds in our project because every item in the provisional list was broken down into details and every detail was constructed as identified in the budget JAME: Another benefit is that it helps to prevent budget padding and embezzlement of project funds.

Appendix 19: FFITVD guide

“FRAMEWORK FOR IMPLEMENTING TARGET VALUE DELIVERY”

PROPOSED GUIDE

Muktari Musa
FEBRUARY 2019

Table of content

FFITVD Guide

1.1 Introduction

Extant literature clearly recognises the importance of supporting the application of new techniques and practices using either a set of guidelines, roadmaps, benchmarks, frameworks or critical success factors (Sacks et al., 2010; Nanda et al., 2016; Nesensohn et al., 2014; Ogunbiyi 2014). Industry-wide benchmarking is paramount in accurately assessing project value (Nanda et al., 2016).

This document is produced to serve as a guide for the Framework for Implementing Target Value Delivery (FFITVD). It is imperative that before the use of the framework, that a prospective user takes out time to study the framework in order to familiarize with it. The implementation process should only begin after thoroughly going through the framework and conversant with the steps and terminologies used in it.

1.2 Need for the FFITVD

Previous researchers worldwide have presented TVD approaches and processes which focus more on the pre-design and design stage of projects, which is not all-inclusive (Ballard 2012; Lee 2012).

To ensure the successful application of TVD, P2SL Labs of the University of Berkeley, California compiled a set of 17 benchmark practices. These have been updated twice, although the benchmarks are tailored more towards the US Construction Industry equipped with IPD (Integrated project delivery) and multiparty collaborative contracts IFOA (Integrated Form of Agreement) (Kaushik et al., 2014).

In Nigeria, very limited studies have been conducted on the application of TVD. No study has explored and tested the application of TVD practice across major sectors of the NCI with the view to developing, evaluating, testing and re-evaluating a framework to support construction stakeholders in the implementation of TVD.

The fundamental reason for the development of the FFITVD was to create an outline that would:

c. serve as a guide to aid the implementation of TVD.
d. provide awareness and sensitize prospective users on the human behaviours required, the drivers of TVD, the tools and techniques required, the success factors that must be in place, the likely barriers that may be encountered, and the likely benefits inherent in its implementation.

1.3 What is FFITVD?

It is a roadmap to guide construction stakeholders to aid in the successful implementation of TVD and also in sustaining the implementation. This FFITVD attempts a detailed step by step approach to implementation of TVD. The FFITVD is not meant to be a rigid guide as it can be adopted/adapted to various sectors of the construction industry.

1.4 Why should I use it?

The FFITVD was developed to help the construction stakeholders that intends to implement TVD on their project. The framework will therefore help you to know and understand the various requirement for the successful implementation of TVD in both process and behavioural wise.

1.5 How should I use it?

The FFITVD should be used together with the guide for better and quicker understanding

2.0 FRAMEWORK FOR IMPLEMENTING TARGET VALUE DESIGN

2.1 Stages of Project

The topmost part of the framework shows the division into the five (5) project management process groups comprising of Project Initiation, Planning, Execution, Monitoring & Control and Closing. At the project initiation stage, the project business case is prepared and the feasibility study is funded and started. While the designs are done at the planning stage, the actual construction takes place during the execution and monitoring. Finally, the project is handed over to the client at the closing stage.

2.2 Project Mindset

The framework listed some project mindset expected from any user/company that intends to implement TVD. It is important to be cognizant of the expected ‘TVD project mindset’ (top right corner); these are the behaviours required from the team members as these behaviours are critical to the success of TVD implementation, the project mindsets include:

- Responsible for action
- Transparency
- Trust
- Free decision making (consensus is reached on all decisions)
- Collaborative & integrated working (with technology).

2.3 Likely Benefits of TVD implementation

The framework highlights the likely benefits that could be derived from the implementation of TVD at the various stages of the project. The likely benefits and the stages include:

2.3.1 Likely Benefits at the Project initiation stage

- Better identification of stakeholders’ values
- Improves organisational policies
- Promotes teamwork and collaboration.

- Builds harmonious working relationship.
- Ensures stakeholders' satisfaction and values
- Promotes better understanding of the process

2.3.2 Likely Benefits at the Project planning and design stage

- Creates realistic Schedule
- Reduces budget and increases cost savings
- Reduces variations and reworks
- Ensures timely delivery of projects
- Project lower than market and target price
- Prevents corruption
- Ensures early identification of problems

2.3.3 Likely Benefits at the Project execution stage

- Reduces waste during construction
- Reveals Capacity/Competence of Team Members
- Certainty of cost, especially on operational expenses
- Reduces loopholes for embezzlement
- Added value to construction process
- Learning from other professionals as a result of collaboration and working towards common goals

2.3.4 Likely Benefits at the Project closing stage

- IMPACTS ON:
  - Stakeholders Satisfaction.
  - delivery of time
  - collaborative practices
  - Budget & cost performance
  - change order, variations & reworks.
  - project value creation
- Increases education/ knowledge

2.4 FFITVD Steps

The arrows of the framework give a sequential direction of how the steps should follow and each step should be considered alongside the tools and techniques to determine which is best suited for the step, also more than one tool can be used in some steps. The steps of the framework are discussed in detail in the following paragraphs.

2.4.1 Steps at the project initiation stage

Project initiation stage is the stage where the stakeholders' values are identified (Value proposition), the following steps are expected to be followed at this stage:

Step 1: **CLIENT BUY-IN TVD PRESENTATION**

The implementation of the framework should commence with the client buy-in of the idea of TVD; without the support of the clients, it will be practically impossible to implement TVD on a project.

Step 2: **APPOINT TVD FACILITATOR**

After the clients accepts the idea of TVD, he then appoints and contract a TVD facilitator who will conduct seminars, workshops, trainings and presentations on TVD.

Step 3: **CHOOSE PROCUREMENT ROUTE (TRADITIONAL PROCUREMENT OR DESIGN & BUILD)**

The next important step is to choose the procurement route either Traditional Procurement (TP) or Design and Build (DB); in this framework, the path of the TD is shown with dotted lines while the DB is depicted with solid lines.

Step 4: **WITH KEY SERVICE PROVIDERS DEVELOP AND EVALUATE BUSINESS CASE**

The client then develops and evaluates a business case with the help of key service providers to explain why the client should undertake the project. Co-location is strongly advised especially at the beginning of the project (BM 17)

Step 5: **DETERMINE ALLOWABLE COST**

The allowable cost, which is the amount the client is willing and able to pay (P2SL 2016), is determined and secured, after which current market cost is benchmarked.

Step 6: **SECURE FUND (MAXIMUM AVAILABLE FUND) (BM 2)**

The source of the allowable cost is determined and secure, available is key to the success of any construction project.

Step 7: **MARKET COST BENCHMARKING**

The current market cost is benchmarked. Price benchmarking is characteristically used because of competition in the construction industry. By observing the quality and popularity of products of the competitors, a company can use price benchmarking to determine a price for their products in relation to their stand amongst the competition.

Step 8: **VALIDATE BUSINESS PLAN**

This is one of the most crucial part of the project initiation stage because the fate of the project depends on how well or badly the business is validated. After the validation, the business plan is tested either accepted or not accepted **<is Business Case Accepted>?**

Step 9: **NO: REVIEW AND VALIDATE BUSINESS PLAN**

If the business plan is not accepted, it is reviewed and validated again

Step 10: **YES: FUND AND START FEASIBILITY (BM 4, 5)**

If the business plan is accepted, the client decides to go ahead with the project

Step 11: **FUND AND START FEASIBILITY**

After accepting the business plan, the client decides to fund and start a feasibility study for the project.

Step 12: **INCLUDE TVD IN CONTRACT/ORG. POLICY (BM 8)**

Efforts are made to include TVD include in the contracts and organisation policy.

2.4.2 Steps at the project planning and design stage

The step during the planning and design stage are as follows:

Step 1: **ACTIVE GOVERNANCE/LEADERSHIP; SELECT AND TRAIN AN INTEGRATED COMPETENT PROJECT TEAM, DEFINE ROLES AND RESPONSIBILITIES (BM 3, 7)**

The planning stage commences with the active governance and leadership of the project, selecting and training of an integrated competent team, and defining the team’s roles and responsibilities of each team members.

Step 2: **PROJECT BUSINESS/ETHICS; ALIGN ORG. PRACTICES & MINDSET WITH TVD PRACTICE**

The project business ethics are then integrated by aligning the organisation’s practices and mindsets with TVD practices to ensure its smooth and effective implementation.

Step 3: **DETERMINE & RANK STAKEHOLDER VALUE (BM 7)**

The stakeholder’s values are determined and ranked using such tools as value proposition cards, amongst others.

Step 4: **DETERMINE/ ALIGN END, MEANS & CONSTRAINTS (BM 4)**

Also, in determining the stakeholders’ values, the ends (what is required), means (conceptual design) and constraints (cost, time, location, etc.) are assessed.

Step 5: **DETERMINE EXPECTED COST (PRODUCT LEVEL TARGET COSTING)**

The expected cost of the project is determined, the expected cost is assessed to determine if is less than the allowable cost determined at the initiation stage.

<Expected cost < Available fund or allowable cost?>

If NO: modify specification/adjust scope

If YES: decide to fund project

Step 6: **SET TARGETS (SCOPE, TIME COST)**

Scope, stakeholder value, quality, time and cost targets are established ensuring that the target cost is less than the expected cost.

Step 7: **SET TARGET COST LESS THAN EXPECTED COST & NEGOTIATE PAIN/GAIN SHARING & INCENTIVE (BM 13, 14)**

In addition, motivation and incentive schemes (such as pain and gain sharing) or alternative schemes are negotiated

Step 8: **PRE-DESIGN MEETING (COLLABORATIVE DESIGN CONVERSATION) (BM 9, 10)**

The design holds pre-design meetings where collaborative design conversation is encouraged

Step 9: **FORM CLUSTER TEAMS & DECOMPOSE PROJECT LEVEL TARGET COST TO COMPONENT LEVEL TARGET COST (BM 13, 14)**

During the pre-design meeting, the team is divided into smaller groups known as cluster teams; the cluster teams set their own targets from the targets of the project level. This is referred to as "decomposition of project level target cost to component level target cost".

Step 10: **LAST PLANNER SYSTEM OR ALTERNATIVE PLANNING TOOL (BM 12)**

Lean tools, such as Last Planner® System (or an alternative), are used to coordinate the actions of the team members.

Step 11: **INVESTIGATE SITE CONDITIONS, ALIGN SITE CONDITIONS & TARGETS SET TO DESIGN**

Site investigations are undertaken to align the site conditions with set targets. Such as confirmatory topography, soil test, geophysical test, hydrological tests etc.

Step 12: **COLLABORATIVE DESIGN OF PRODUCT & PROCESS TO TARGETS (BM 9, 10) CONSIDERING THE MOST RESPONSIVE ALTERNATIVES**

The next step is the collaborative design of product (drawings) and processes (how work is to be carried out) while ensuring that targets are not exceeded: this is a key principle of TVD.

Step 13: **SELECTIVE TENDERING TENDER BID & NEGOTIATIONS**

This choice of procurement route made at the outset determines the next step. The traditional procurement route goes on to selective tendering and bid negotiations, whereas the design and build procurement route skips the tendering stage.

Step 14: **TVD TEAM UPDATE COST ESTIMATE AND BASIS OF ESTIMATE FREQUENTLY (BM)**

TVD clusters frequently update cost estimates and the basis of estimate.

Step 15 and 16: **PROJECT COST ESTIMATE ARE UPDATED TO REFLECT CLUSTER TEAM UPDATES (BM 16) AND COST ESTIMATING AND BUDGET DONE CONTINUOUSLY THROUGH OUT PROJECT (BM 11)**

The cluster updates are reflected in the project cost estimate. This process is done continuously throughout the project.

2.4.3 Steps at the project execution/construction stage

At the end of the design stage the design estimates are assessed to determine if they are below the target cost; three options of action are available:

<is design estimate Below target cost?>

First, if NO: the team can proceed to construction if the project cost is higher than the target cost but there is a perceived possibility of incremental reduction to achieve the target cost during construction.

Second, if NO: the project cost is higher than the target cost, the team goes back to redesigning to target, considering the most responsive alternative. This is done using value engineering or other tools/techniques.

Third, if YES: the team can proceed to the construction stage if the project cost estimate is below the target cost.

Steps 1: **ACTIVE GOVERNANCE/LEADERSHIP, ASSEMBLE & DEVELOP PROJECT EXECUTION TEAM**

Although some of the design team members will form the nucleus of the construction team, it is imperative to assemble and develop an execution team.

Step 2: **PROJECT BUSINESS/ETHICS ALIGN ORG. PRACTICES & MINDSET WITH TVD PRACTICE**

The mindsets, organisational practices and business ethics of the team must be aligned with TVD practices.

Step 3: (TP) **IDENTIFY CONTRACT PRICE FOR PC, PS & LUMP SUM N CONTRACT DOCUMENT**

The tradition procurement route also deviates a little at this point to identify contract prices for provisional sums and prime cost sums,

Step 4: (TP) **CONTRACT PRICE FOR PC, PS & LUMP SUM ARE DETERMINED AS ALLOWABLE COST**

The identify contract prices for provisional sums and prime cost are set as allowable costs.

Step 5: (TP) **SET TARGETS LOWER THAN ALLOWABLE COST & DESIGN TO TARGET AS APPLIED IN PLANNING STAGE**

Then, design to a newly-set target, as applied in the planning stage.

Step 6: **DEVELOP AND AGREE ON MOTIVATION & INCENTIVE SCHEMES**

The incentive and motivation are developed and agreed upon.

Step 7: **FORM CLUSTER TEAMS & INVOLVED ALL PROJECT TEAM TO PREVENT CORRUPTION/CONTRACT PADDING**

Next, cluster teams are formed involving all the project team members (no working in isolation.) to ensure that corruption and project padding is prevented or minimised.

Step 8: **REVIEW & RENEGOTIATE RESOURCES (MANPOWER, MATERIAL & EQUIPMENT**

Resources such as manpower, materials and equipment are reviewed, renegotiated and allocated.

Step 9: **REVIEW ADMIN COST/ OVERHEADS (OPEX/CAPEX)**

The operational and capital expenditures (OPEX/ CAPEX) are reviewed to ensure further cost reductions at this stage.

Step 10: **REVIEW PROCESS AND TECHNOLOGY**

Processes and technology are also reviewed to ensure that they are working properly.

Step 11: **ASSIGN WORK TO TEAM (ROLES & RESPONSIBILITIES)**

Work is assigned to each team member for construction to commence. This is done to ensure that every team member knows their duties and can be held responsible for them.

Step 12: **CONSTRUCT TO TARGET**

The team ensure that they build to and sustain targets.

Step 13: **IDENTIFY, IMPROVE WORKFLOW & SUSTAIN TEAM PERFORMANCE**

The next step is to identify how to improve workflow and sustain team performance.

Step 14: **COST SAVINGS ALLOCATED TO OTHER CLUSTERS**

Cost savings from clusters can be allocated to other clusters with deficits.

Step 15 & 16: **PROGRESS REVIEW AND REPORTING/ MANAGE & TRACK PROJECT TARGETS**

Work progress is then reviewed and reported to ensure that the project targets can be tracked and managed. This can be done using earned value management, A3 etc reports during frequent review meetings.

Step 17: **MANAGE & CONTROL, CHANGES, RISK, ISSUES, CONTRACTS, STAKEHOLDERS, RESOURCES, TIME, PRIORITY, PROCEDURES, QUALITY, COMMUNICATION & CORRUPTION**

Issues that can derail the project, such as changes, risk, contract issues, communication issues and corruption, are properly monitored and controlled through the conduct of reviews of targets and audits. Efforts are made to manage and prevent waste and corruption.

Step 18: **PERFORM REVIEW OF TARGETS AND AUDIT**

Progress against targets is monitored and audit carried out

Step 19: **MANAGE WASTE & PREVENT CORRUPTION**

Efforts are made to eliminate and manage all kinds of wastes; also, efforts are made to prevent all kinds of corruption.

2.4.4 Steps at the project closing stage

Step 1: **CONCLUDE ACTIVITIES, REVIEW & AUDIT PROJECT**

To successfully close a project, the team needs to ensure that all the projects’ activities have been completed and reviewed by testing and commissioning. The accounts should be audited using valuation.

Step 2: **MEASURE OR REPORT TARGET PERFORMANCES**

Target performances (impacts) such as stakeholders’ satisfaction, delivery on time, cost/budget, reworks/change orders, collaborative practices etc. are measured and reported.

Step 3: **DOCUMENT LESSONS LEARNED**

The lessons learned during the project should also be properly documented

Step 4: **HAND OVER TO OPERATION**

And, then the project is formally handed over to the client.

2.5 Major support needed

Also familiarise yourself with the possible supports required and make adequate provisions for these supports to be available.

- Organisation and senior management support
- Industry support
- Educational support

2.6 Likely drivers (The need for TVD)

The users should also call to mind the common drivers (Need for TVD, located bottom left) of TVD; these are the reasons for implementing TVD. The likely drivers are:

- Previous benefits of TVD implementation success
- Need for improvement
- Need to deliver the project on target
- Need to prevent corruption
- Need to reduce change orders and rework
- Quest to achieve Cost certainty, cost reduction and avoid cost overrun
- Competition and recession

2.7 Tools & Techniques

Study all the tools and techniques to see the ones that are familiar with and the unfamiliar ones. The unfamiliar one should be learnt because all the tools are required for the successful implementation of TVD. Some of the tools and techniques required at the various stage of the project are listed below:

2.7.1 Tools and techniques at project initiation stage

- Big Room Collaboration
- Value Proposition Card Games
- Frequent Meetings

2.7.2 Tools and techniques at project planning and design stage

- TVD Management Plan (Scope, cost, schedule, quality, HR, communications mgt., risk, procurement)
- Value engineering and TVD simulation
- Frequent Assessment meetings

2.7.3 Tools and techniques at project execution stage

- Use Earned Value to Monitor & Control targets
- A3 Report
- Root Cause
- Frequent Review meetings

2.7.4 Tools and techniques at project closing stage

- **Valuation/Final account preparation**
- **Testing and commissioning**

2.8 Likely Barriers

Finally, be conscious of the possible challenges and barriers to be encountered in the course of the implementation of the framework. Having a prior knowledge of the barriers, puts one in vantage position to succeed with the implementation of the framework and possibly increases the likelihood project success. The likely barriers to be encountered at the various stages are listed below

2.8.1 Likely Barriers at the project initiation stage

- Resistance to change & adoption of TVD
- Lack of awareness of TVD and its enablers
- Issues relating to communication, collaboration and colocation of team members
- Corrupt practices and kickbacks
- Lack of incentives and motivations
- Rigid organisational policy

2.8.2 Likely Barriers at the project planning and design stage

- Lack of understanding business case
- Lack of stakeholders’ involvement at the beginning
- Difficulty in tracking changes
- Differing work tool and process
- Lack of understanding of the scope of engagement
- Delay in communicating Cost data
- Inaccurate cost estimation & Time consuming
- Extensive training & mind shift needed
- Intentional sabotage

2.8.3 Likely Barriers at the project execution stage

- Lack of awareness of TVD
- Economic and Market Conditions
- Extensive training needed
- Complexity in choosing contractors
- Contingency set too low
- Changes in site condition
- Difficulty moving Cost savings between clusters
- Fluctuation due to political instability/Government policy
- Bribery and Corrupt practices

2.8.4 Likely Barriers at the project closing stage

- **Incomplete record/ documentation of work progress**

2.9 Stakeholders involved and stages

The major stakeholders involved in the implementation of the Framework includes

- The Clients and key stakeholders (BM 6): who are expected to collaboratively develop and evaluate the business case at the project initiation and can also participate from design to the closing stage. The collaboration includes be face to face & virtual meetings.
- TVD facilitator, project manager, site manager (BM 3): this group of stakeholders are also important as they participate fully with face to face and/or virtual collaboration from project initiation to project closing.
- Design team: includes the civil, architectural, structural, mechanical and electrical, contractors, sub-contractor, supplier/ manufacturer (BM3) who all collaborate either face to face or through virtual collaboration during the planning/design stage of a project to produce the schematic and technical designs. Software such as BIM, REVIT etc can be used for clash detection in designs. Part of the design team members are co-opted the construction team.
- Construction team starts work after the final design are approved and ready, working with full collaboration during the construction stage to build to set targets, they use frequent meeting and real time sharing of data to track targets from construction to closing

2.10 Value Identification, Proposition, Delivery and Creation

- Value creation comprises of value identification, proposition, and delivery (Cell 2004) and is a fundamental concept in LC that contributes significantly to successful projects. Value identification is referred to as “what is needed”, value proposition as “planning what is needed” and value delivery is “achieving what is needed”, the process of doing the three is value creation

- While Value identification usually takes place during the project initiation stage, value proposition takes place during the planning/design stage, value delivery takes place during the construction/execution stage and value creation takes place at the closing. The success of many projects is linked to the initial agreement of value propositions, and that the achievement of creating value for stakeholders is the fundamental purpose of projects.

2.11 Clarity of Understanding

- At the project initiation stage, there is the need for clarity of understanding. The client must be able to understand the express his ideas and values to other stakeholders in a manner that it will be easy for them comprehend.

2.12 Mutual Understanding

- At the planning and design stage, there should be mutual understanding. This is very important as it is required for the various disciplines involved in the collaborative design to mutually understand each other to avoid the adversarial and opportunistic behaviour common in the traditional construction environment.

2.13 Common Language

- Common language is required in the construction industry for stakeholders to be able to establish and attain clear targets. Common language is also required for better and efficient communication, exchange of ideas and for collaborative working.

2.14 Continuous Improvement

- The FFITVD is design for continuous improvement of process and product. The framework provides for avenue for streamlining workflow and reducing waste in the form of cost, time and rework.

2.15 Legend

- A concise legend is provided in the framework to explain some important concepts and

END	**= what is wanted**
MEANS	**= conceptual design**
TARGETS	**= cost, time, location, project value etc.**
BM	**= TVD Benchmarks**
$\longrightarrow$	**= design build & transfer**
$\dashrightarrow$	**= Traditional procurement**
	= Continuous improvement of process

"FRAMEWORK FOR IMPLEMENTING TARGET VALUE DELIVERY"